SPECIAL SOUND AND AUDIO ISSUE

RADIO & TELEVISION NEWS

NOVEMBER 1949

RADIO-ELECTRONIC ENGINEERING EDITION

SUPERSONIC TONE SELECTS RECEIVERS

Page 61

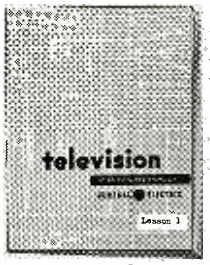
In Radio and Television Tube Sales

1949 IS A G-E YEAR!

The G-E Pocket Office turns your job-time into more dollars by making cards, forms, and records available in convenient form.

TECHNI-TALK—G. E.'s down-to-earth service magazine edited by practical men for practical men—assists you in building repair business.

G. E.'s new shop garments—smart, serviceable—are a big hit with tube dealers and repairmen everywhere.



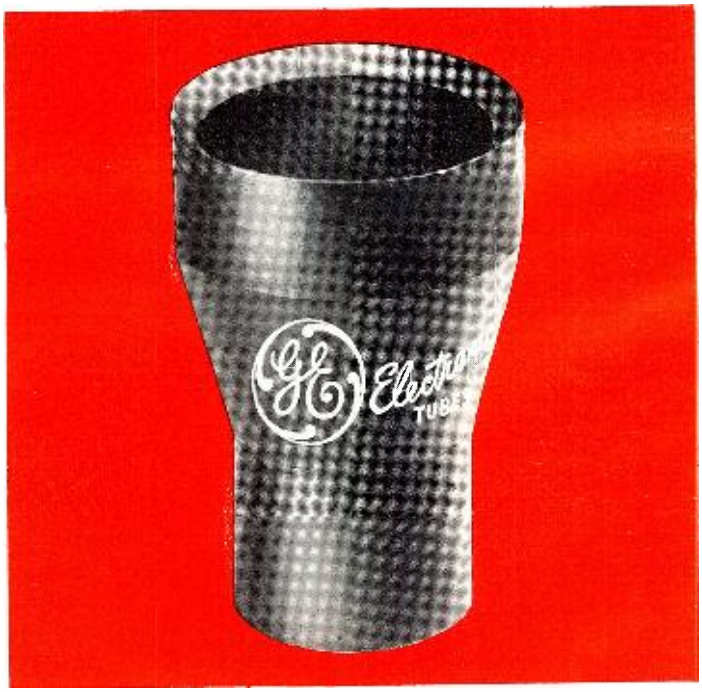
The General Electric TV-service course helps you profit from television's great new market for tubes, parts, and service.

and now... THE HANDY G-E TUBE PULLER!

Latest of a series of helps that speed your work, increase your sales, and upgrade your profits, the new G-E tube puller cuts time on the job materially. Now you'll find it quick and easy to remove tubes without the risk of burns, shock, or cuts from fractured glass.

Regular glass types, metal tubes, 7- and 9-pin miniatures—all yield to this universal device, which smoothly extracts tubes no matter how firmly wedged in their sockets. The puller is made of heavy rubber—your fingers are fully protected and insulated. It's simple to use; long-lived.

Ask your G-E tube distributor about this ingenious tube puller—how to obtain one . . . fast! Inquire, if you haven't before, about the other aids to sales mentioned on this page; also, about the folder describing the many G-E advertising helps that are ready to go to work for you. Stock the tubes that are easy to sell because you get more practical help in selling them . . . G-E tubes! *Electronics Department, General Electric Company, Schenectady 5, N. Y.*



You can put your confidence in—

GENERAL ELECTRIC

181-HA7

NEW

I'LL TRAIN YOU FOR YOUR FCC LICENSE

A Federal Communications Commission Commercial Operator's License puts you in line for a good job in Radio or Television Broadcasting, Police, Marine, Aviation, Two-way, Mobile or Micro-wave Relay Radio. Mail coupon below for book and catalog (both FREE) about my NEW Communications course.

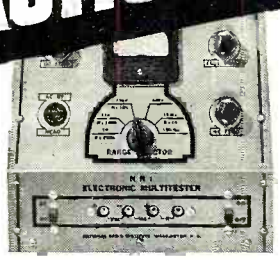
YOU BUILD THIS TRANSMITTER

with parts I send. This low-power broadcasting transmitter shows you how to put a station "on the air." You perform procedures demanded of Broadcast Station Operators, conduct many experiments, make many practical tests.

LEARN COMMUNICATIONS by PRACTICING at Home in Spare Time

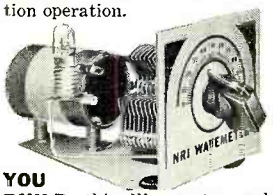
with MANY KITS of MODERN EQUIPMENT I SEND

YOU BUILD this Transmitter Power Supply used in the basic experiments in RF and AF amplifiers, frequency multipliers, buffers, etc.



YOU MEASURE current, voltage (AC, DC and RF), resistance and impedance in circuits with Electronic Multitester you build. Shows how basic transmitter circuits behave; needed to maintain station operation.

YOU SET UP code amplitude and frequency modulation circuits (put voice, music, etc., on "electrical signal" you produce). You introduce, correct defects, learn how to get best performance.



YOU BUILD this Wavemeter and use it to determine frequency of operation, make other tests on transmitter currents.

Ever think HOW FAST Radio-Television Communications is changing, developing, growing? Have you considered what this amazing progress can mean to you?

In 1945, there were 943 Broadcasting Stations. Today 2,694 are on the air! Result—THOUSANDS OF QUALIFIED MEN STEPPED INTO GOOD JOBS. Only 19 Television Stations were on the air in 1947. Today there are more than 50 and experts say there will be 150 in a few months, 1,000 within three years. That means thousands of well-paid jobs for trained Operators and Technicians. Then add development of FM, Two-way Radio, Police, Marine, Aviation and Micro-wave Relay Radio! Think what all this means!. New jobs, more jobs for beginners! Better jobs, better pay for experienced men!

Are you a beginner who wants steady work in this growing field? My NEW course can help you get an FCC License and prepare for the job you want. Are you a man with some training in Radio or Radar, or a Licensed operator? My NEW course modernizes, increases the value of your knowledge and experience!

MY COURSE INCLUDES TELEVISION

Course Is New! Different!

Mail coupon now for facts about my NEW, intensely practical course in Radio-Television Communications. Let me send you FREE books. Read outlines of 78 lesson texts written for you by leading Communications experts, edited by my practical staff. See the nine big Kits of Parts I send that "bring to life" theory you learn. Read about the transmitter you build and operate, about the Electronic Multitester you get. All equipment yours to keep. My BRAND NEW course includes BOTH Theory and Practical Experience, with result-getting kits, in Radio-Television Communications. It's backed by N. R. I.—the world's oldest and largest home study Radio school.

Servicing Training Also Offered by N. R. I.

If you prefer a good-pay job in Radio-Television Servicing . . . or your own money-making Radio-Television Sales and Service Shop, I'll train you at home. My famous Servicing Course also includes many Kits of Parts. You conduct experiments and tests with modern Radio and other circuits you build. I also show you how to make $5, $10 a week or more EXTRA MONEY fixing neighbors' Radios while training. Full information in my 64-page catalog. Mail coupon.

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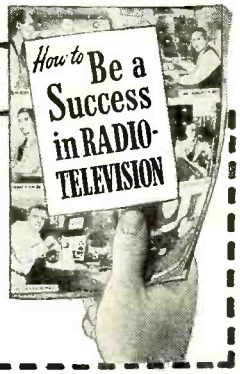
Send today! See what my NEW course is like. Find out how I get you ready for a brighter future, better earnings, more security in Radio-Televison. Send coupon now in envelope or paste on penny postal. NO OBLIGATION. NO SALESMAN WILL CALL! My books, sent to you FREE, tell the full story. J. E. SMITH, President, Dept. 9MR, National Radio Institute, Washington 9, D. C.



I TRAINED THESE MEN

"I am now Chief Engineer of Radio Station WORD, in charge of four engineers. Owe all I know about Radio to N. R. I."—C. J. BURDETTE, Spartanburg, S. C.

"I have been in several kinds of Radio work. I am now specializing in Marine Radio telephone installations and service." — MURRAY DICKSON, Paducah, Ky.

"Thanks for splendid Home Study Radio Course, a large factor in my getting present position as Senior Radio Operator of Station WRGP."—C. LISTER, Pensacola, Fla.

"When I enrolled, I had no idea of entering Commercial Radio. Now Operator, Police Radio Station WASP and Highway Station WKSJ."—G. DeRAMUS, Selma, Ala.

"Hold a Radio telegraph Second Class License. Now with Civil Service as P-4 Electrical Engineer."—OTIS L. WRIGHT, Albuquerque, N. M.

"Am now Chief Engineer at Radio Station WAGC. Still using my N. R. I. texts as swell references."—CHAS. W. STOKELEY, Chattanooga, Tenn.

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MR. J. E. SMITH, President, Dept. 9MR
National Radio Institute, Washington 9, D. C.

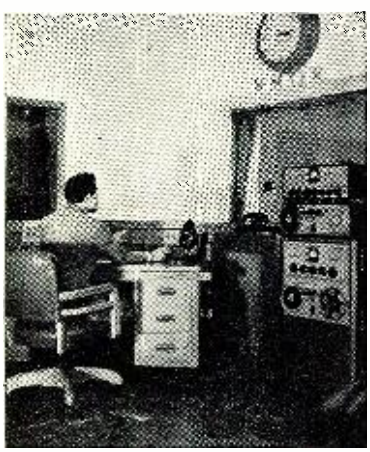
Mail me FREE Catalog and Book about Radio and Television Communications opportunities and training. (No salesman will call. Please write plainly.)

Name.....Age.....

Address.....

City.....Zone.....State.....

☐ Check if Veteran Approved Under G. I. Bill



COVER PHOTO. Jay Trompeter, announcer and engineer, in the control room at FM Station WMOR. On the right against the wall are two *Magnecord* tape recorders. (Kodachrome by Art Haug)

First in radio-television-electronics

Average Paid Circulation over 200,000

RADIO & TELEVISION NEWS

Radio News Trade Mark Reg. U.S. Pat. Office No. 378427

CONTENTS — NOVEMBER, 1949

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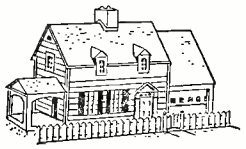
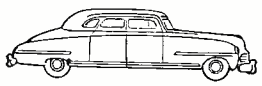
Which Do You Want?

Better Pay



A Nice Home



A New Car

Greater Security

Happy Vacations and Travel

Get Your FCC Ticket
Jobs leading to
$3,000 to $7,500
(Average Pay Reported by FCC Nationwide Survey)
are opening up right now for FCC Licensed Radiomen.

dd Technical Training to Your Practical Experience and

Get Your FCC COMMERCIAL RADIO OPERATOR LICENSE in a Few Short Weeks

It's EASY if you use CIRE Simplified Training and Coaching AT HOME in SPARE TIME

Get your license easily and quickly and be ready for the jobs open to ticket holders that lead to $3000 to $7500. CIRE training is the only planned course of coaching and training that leads directly to an FCC license.

YOUR FCC TICKET IS ALWAYS RECOGNIZED IN ALL RADIO FIELDS AS PROOF OF YOUR TECHNICAL ABILITY

CIRE Job-Finding Service Brings Amazing Offers of Jobs

"Have found and accepted a position at KWAD in Wadena, Minn. I am indebted to CIRE for I secured this position through the help of the CIRE Job-Finding Service. I had six other offers from stations receiving my employment application and CIRE reference. I am sincerely under obligation to you."
Student No. 2760 AT

"I am working at WRJM as transmitter engineer, and I received this position in response to one of the employment applications sent me upon completion of my course and the receiving of my Diploma. I received my 1st class Radiotelephone License on March 2, 1949. I want to express my sincere appreciation to the staff of CIRE."
Student No. 2608 AT

"I now hold ticket Number P-10-3787, and holding the license has helped me to obtain the type of job I've always dreamed of having. Yes, thanks to CIRE, I am now working for CAA as Radio Maintenance Technician, at a far better salary than I've ever had before. I am deeply grateful."
Student No. 3319N12

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2. Tells How We Guarantee to Train and Coach You Until You Get Your FCC License.
3. Tells How Our Amazing Job-FINDING Service Helps You Get the Better-Paying Radio Job Our Training Prepares You to Hold.

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I want to know how I can get my FCC ticket in a few short weeks by training at home in spare time. Send me your FREE booklet "Money Making FCC License Information," as well as a sample FCC-type exam and FREE booklet, "How to Pass FCC License Examinations," (does not cover exams for Amateur License).

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☐ Veterans check for enrollment information under G. I. Bill.
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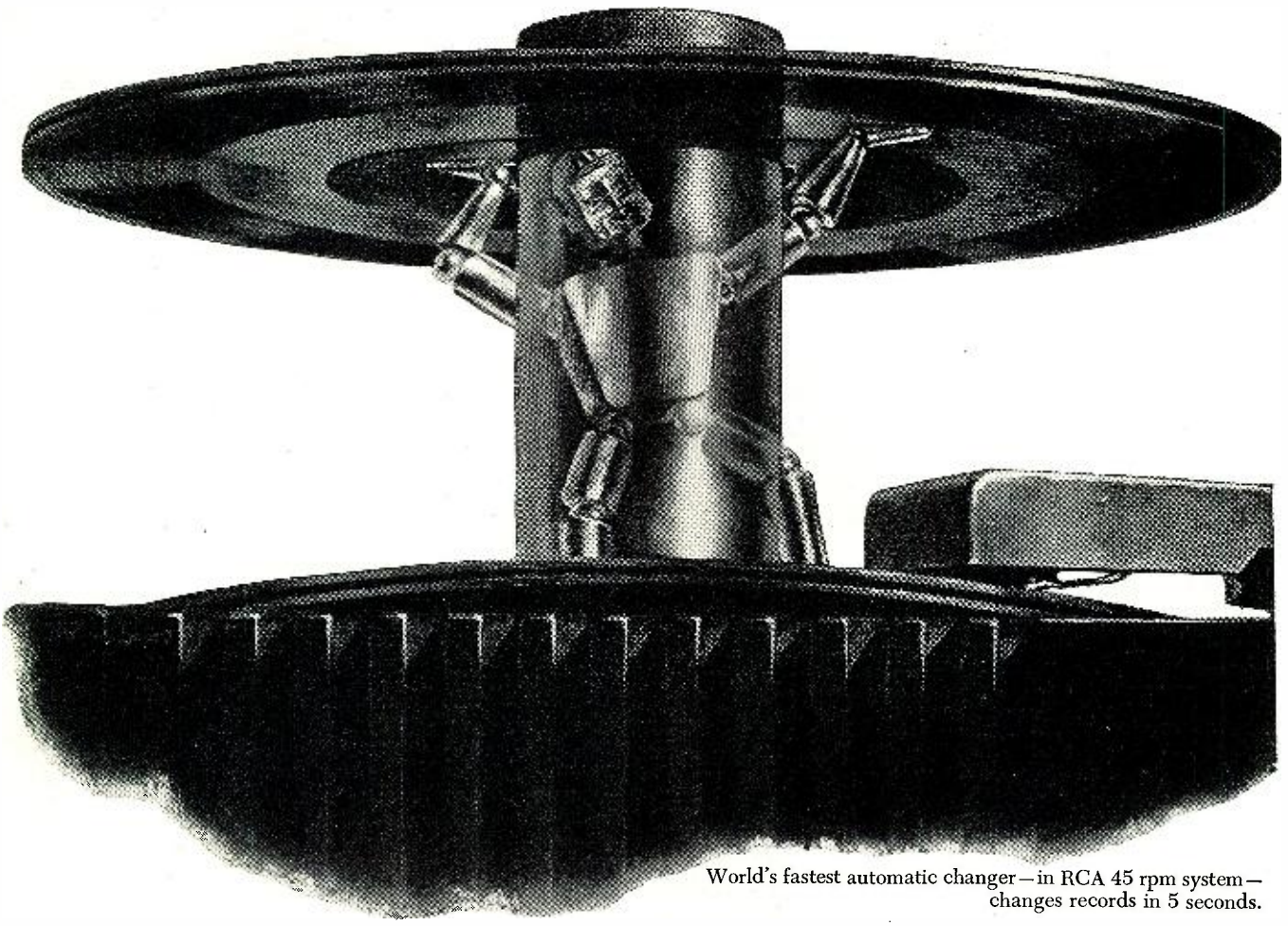


World's fastest automatic changer—in RCA 45 rpm system—changes records in 5 seconds.

Quick change artist

Hundreds of thousands are now enjoying RCA's thrilling new way of playing records . . . they marvel at its wonderful tone . . . and the speed with which it changes records.

Prolonged research is behind this achievement, research which sought—for the first time in 70 years of phonograph history—a record and automatic player designed for each other.

Revolutionary is its record-changing principle, with mechanism *inside* the central spindle post on which records are so easily stacked. Result: *a simplified* machine, that changes records in 5 seconds.

Remarkable, too, are the new records—only 6⅞ inches in diameter—yet giving as much playing time as conventional 12-inch records. Unbreakable, these compact vinyl plastic discs use only the distortion-free "quality zone"... for unbelievable beauty of tone.

Value of the *research* behind RCA's 45 rpm system—which was started 11 years ago at RCA Laboratories—is seen in the instant acceptance, by the public, of this better way of playing records. Music lovers may now have *both* the 45 rpm system, and the conventional "78."

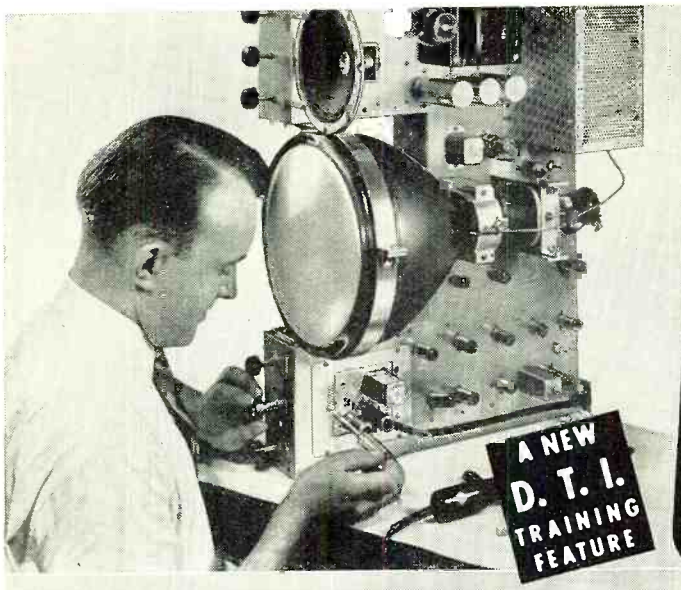
* * *

Development of an entirely new record-playing principle is just one of hundreds of ways in which RCA research works for you. Leadership in science and engineering adds value beyond price *to any product of RCA, or RCA Victor.*

RCA

RADIO CORPORATION of AMERICA

World Leader in Radio—First in Television



NOW! Build and Keep Big Screen Top Quality Television Receiver at Home as You Prepare for a Profitable job in TELEVISION RADIO-ELECTRONICS

Choice of 10, 12½ or 16 inch picture tube

Now you can get this amazingly practical aid for learning Television at home, to help you get started toward FASCINATING WORK . . . GOOD MONEY . . . a THRILLING FUTURE—in a real job, or your own sales and service business. • When you complete our regular home training—described below—you can build and keep a top quality commercial-type Television Receiver. Standardized chassis is adaptable for a 10, 12½ or 16 inch direct view tube that gives big, bright, sharp, steady pictures. This is an optional training advantage—designed to provide the utmost in practical "learn-by-doing" home training in Television. Mail coupon for complete details. See why you owe it to your "Television Future" to enroll for DeForest's Training, Inc.

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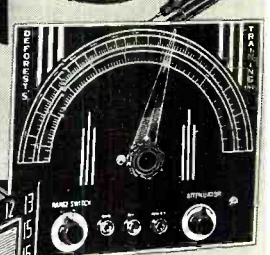
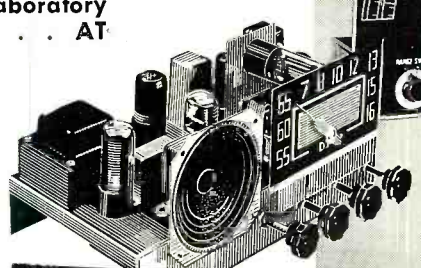
See how D. T. I.'s amazingly effective methods help start you toward a GOOD JOB or your OWN BUSINESS in one of America's most promising fields—including Television, F.M. Radio, Aviation, Train, and Taxi Radio, Broadcast Radio, Industrial Electronics. Get modern lessons . . . plus 16 shipments of Radio-Electronic parts. Work over 300 experiments and projects—including building of (1) commercial-type OSCILLOSCOPE for practical T-V circuit training, (2) double-range R-F SIGNAL GENERATOR, (3) jewel-bearing MULTIMETER, (4) quality 6-tube SUPERHET RADIO. Then build and keep that big new Television Receiver. Here's EVERYTHING YOU NEED for real laboratory type training . . AT HOME!

You also build and keep this Professional Type Equipment





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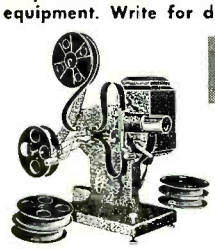

You also use HOME MOVIES! a D. T. I. Exclusive!

D. T. I. alone includes the modern, visual training aid . . . MOVIES . . . to help you learn faster, easier at home. See electrons on the march and other fascinating "hidden action"—a remarkable home training advantage that speeds your progress.

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Street.....Apt.....

City.....Zone.....State.....

For the RECORD

BY THE EDITOR

MANY years of experience in analyzing RADIO & TELEVISION NEWS' "reader interest" shows an almost universal preference for more and more articles on audio and sound. Many requests are received from radio technicians wanting to know how they can increase their earnings by renting and selling p.a. equipment. Others want to know how to take measurements and make frequency runs and over-all performance checks on amplifiers. Then there is the engineer who is always seeking fresh information on new circuits and techniques. Even the amateur has an interest in sound and is continuously searching for means of getting the best possible intelligence from his modulator or from the audio system in his receiver.

The student in sound may be one trying for only a limited amount of knowledge so he may go ahead and do experimental work with the construction of amplifiers and recording systems, or he may be aiming for a degree in audio engineering. We find, therefore, that there is no segment of radio, television, or electronics that has greater widespread interest than has audio and sound. Accordingly, and in reply to the many requests for up-to-the-minute material on all phases of this specialized subject, we are devoting the editorial contents of this month's issue to a discussion of the many facets of sound.

Special articles were assigned to our top writers, including John Goodell of *Minnesota Electronics,* who is considered one of the foremost authors on speaker systems in the country. Mr. Goodell gives an analysis of speaker enclosures, based on actual work done in conjunction with custom installations. Mr. Glen Southworth, who has been writing for RADIO & TELEVISION NEWS for many years, tells how to evaluate distortion in audio amplifiers. Hams will be especially interested in the c.w. filter described by Commander Countryman, W3HH, which is designed to reject interfering signals.

We have received many requests for a simple test analyzer that would be capable of checking distortion in amplifiers when used in conjunction with an audio oscillator and an oscilloscope. Michael Wolfe, in his article on Page 44, tells how this is done.

If you are looking for a good-quality amplifier with a full-range tone control and simplified dynamic noise suppressor, don't miss reading Charles Mayeda's "Wide-Range Phono Amplifier" on Page 46. Intercoms seem to be high on the list of requested articles. R. G. Finkbeiner, W8AQK, gives answer to these requests in his article describing the construction of an intercom for the home or office. No matter what a reader's interest may be in audio and sound, the chances are that he will find something of definite interest in these or in many of the other articles appearing in this special November issue.

We commissioned Dave Fidelman, one of our top writers, to examine the audio field and to prepare a complete analysis of test instruments. Here for the first time is a complete, concise presentation of equipment suitable for various tests, including frequency response, noise level, voltage current or power, harmonic distortion, intermodulation distortion, transient response, phase response, and wow and flutter. Mr. Fidelman breaks his charts into specific categories, such as signal generating instruments, instruments for measurement and observation of electrical signals, instruments for measurement of sound, instruments for characteristics of audio signals, multiple instruments, and accessory units. The preparation of so extensive an assignment as this is was not an easy task. Mr. Fidelman certainly came through with flying colors, and we are sure you will agree.

In this issue, we had planned to bring you a similar breakdown of disc, wire, and tape recorders, together with complete specifications; however, the inclusion of this material would have necessitated the elimination of the analysis on audio test instruments. Accordingly, it will be prepared for a future issue devoted largely to recording and playback systems.

Even our front cover this month was chosen especially to illustrate the subject of sound. You will enjoy reading the article on Page 61, which describes a unique application of sound employed by Station WMOR in the Chicago area. Conceived and operated by some ex-GIs, the story of WMOR is indeed a story of success. This station has a reputation for maintaining a high degree of audio fidelity.

We sincerely hope all our readers will enjoy this special content issue, and would appreciate receiving reactions and comments. If you would like in the future to have more issues similarly devoted to specialized subjects, it will be our pleasure to serve you. ....O. R.

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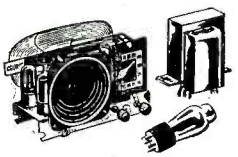

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Address.....

City.....*Zone*.....*State*.....

STAY AHEAD IN CHOOSE

CHARACTERISTICS
TYPE 16GP4

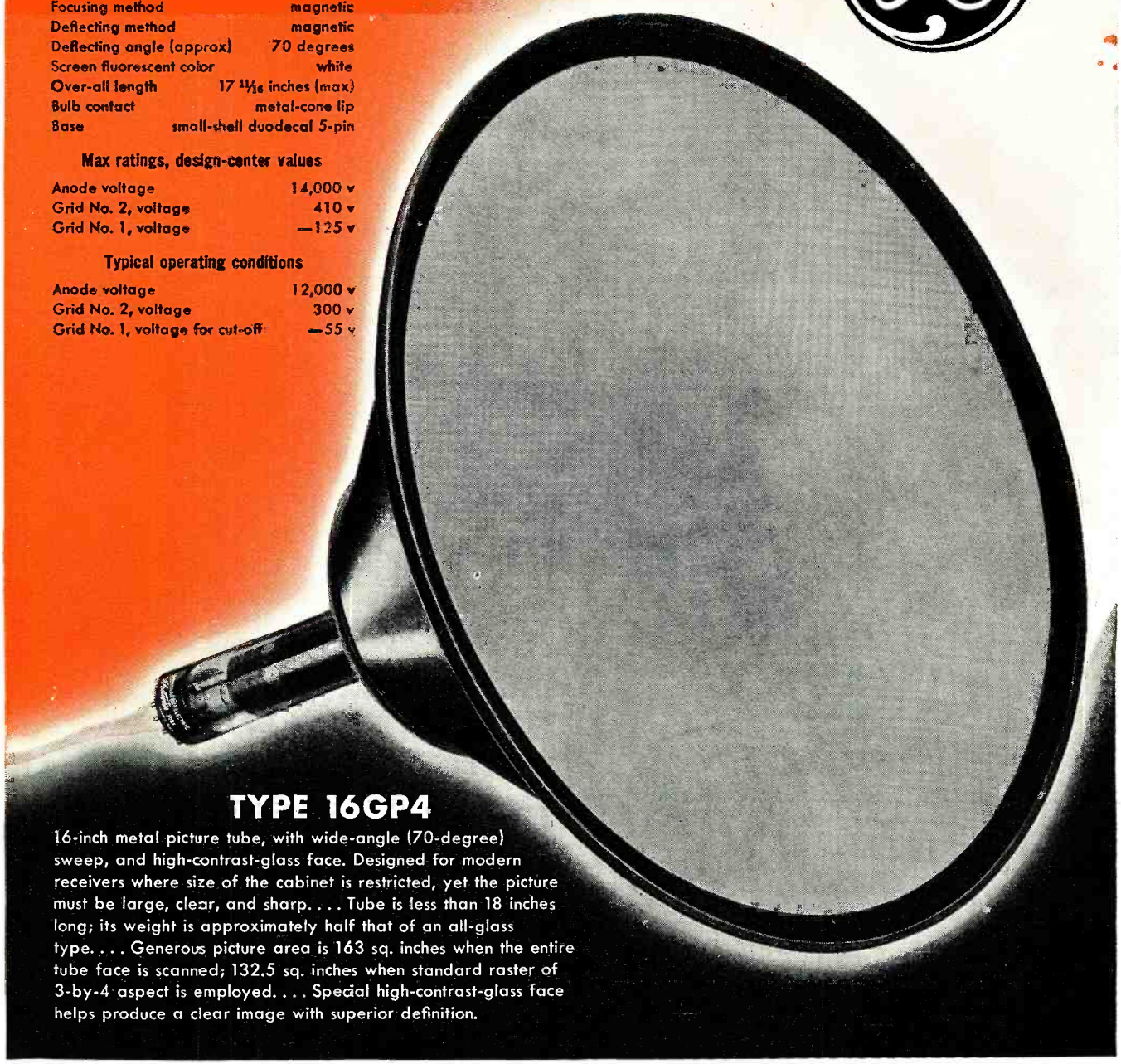
Max bulb diameter	16 inches
Min useful screen diameter	14 ⅜ inches
Heater voltage	6.3 v
Heater current	0.6 amp
Focusing method	magnetic
Deflecting method	magnetic
Deflecting angle (approx)	70 degrees
Screen fluorescent color	white
Over-all length	17 11/16 inches (max)
Bulb contact	metal-cone lip
Base	small-shell duodecal 5-pin

Max ratings, design-center values

Anode voltage	14,000 v
Grid No. 2, voltage	410 v
Grid No. 1, voltage	—125 v

Typical operating conditions

Anode voltage	12,000 v
Grid No. 2, voltage	300 v
Grid No. 1, voltage for cut-off	—55 v



TYPE 16GP4

16-inch metal picture tube, with wide-angle (70-degree) sweep, and high-contrast-glass face. Designed for modern receivers where size of the cabinet is restricted, yet the picture must be large, clear, and sharp. . . . Tube is less than 18 inches long; its weight is approximately half that of an all-glass type. . . . Generous picture area is 163 sq. inches when the entire tube face is scanned; 132.5 sq. inches when standard raster of 3-by-4 aspect is employed. . . . Special high-contrast-glass face helps produce a clear image with superior definition.

TELEVISION! GENERAL ELECTRIC TUBES!

LEAD, or be left behind! Designers and builders of TV receivers face that challenge. By specifying General Electric tubes, you (1) help assure the over-all advanced design of your product, and (2) make a popular move to meet the demand of buyers for what's newest and best in television home equipment.

Progress shows, for example, in every characteristic of G.E.'s new 16-inch wide-angle picture tube. Because of its comparatively short length, you can design a receiver about Type 16GP4 that will fit conveniently into the average small living-room. At the same time, the picture area is large, giving excellent visibility for a good-sized group of guests. The face of the tube is a special new dark-tone glass providing high contrast . . . images show more clearly, with sharper definition.

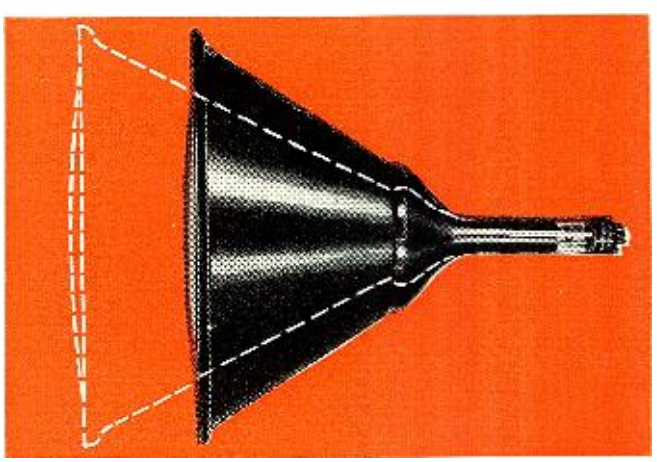
G-E receiving tubes of advanced design spell progress and economy. The new 6BN6, a miniature gated-beam tube, functions as a limiter, discriminator, and audio-amplifier in TV and FM receivers, thereby replacing 3 tubes and associated components.

Other G-E picture tubes—Types 8AP4, 10BP4, 10FP4, 12KP4 and 12LP4—share in the advancements being recorded by General Electric's continuous research in television. And a full line of G-E receiving-type tubes is available, including such outstanding new designs for television use as the 6AB4, 6BN6, 12AT7, 12AU7, and 12AY7.

Choose General Electric tubes to make sure the product you design, build, and sell is in the forefront competitively! Experienced G-E tube engineers will be glad to work with you in selecting the right types for your circuit. Wire or write today to *General Electric Company, Electronics Department, Schenectady 5, New York.*

SHORTER—MAKES POSSIBLE A MORE COMPACT TV RECEIVER

Why Type 16GP4 picture tube is nearly 5 inches shorter than the standard 16AP4 16-inch type, is shown here. A sweep angle of 70 degrees for the 16GP4 against 53 degrees for the 16AP4 (portrayed in dotted lines) results in a flatter conical shell. This reduces the over-all length of the tube to 17 11/16 inches, compared with 22 5/8 inches for the 16AP4. Receivers using the new tube can be shorter and less bulky, consequently are more acceptable in the home.



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GENERAL ELECTRIC

181-H2

If your Pictures look like this →

YOUR TELEVISION WILL BE IMPROVED WITH A WARD OUTDOOR AERIA

to give you Pictures like this →

The modern miracle of pictures by air can be a most satisfying means of entertainment. But be satisfied only with a picture comparable to a class "A" motion picture—on every station in your area. *It is unnecessary to compromise!*

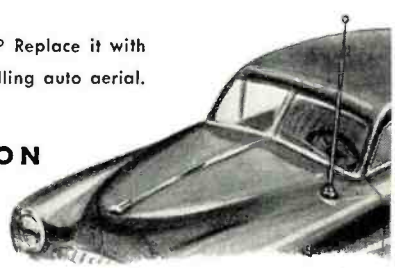
HERE'S WHY: Television waves are like light beams – solid objects reflect and refract them, making it impractical to pick up all stations from an indoor aerial. That is why you get double images on some stations.
In addition, indoor aerials have poor signal pickup making it difficult to get good pictures on all stations.

FURTHERMORE: Your indoor antenna may have a high noise level which increases the amount of interference as you advance the contrast control to bring up a weak picture. All of these technical difficulties are eliminated by a WARD outdoor aerial installed by a competent radio serviceman. In *every case*, a Ward outdoor antenna will improve reception over an indoor aerial. Also, Ward aerials are so well designed, they are attractive on a house. *It is unnecessary to compromise!*

WARD is the largest and oldest exclusive maker of television and auto radio aerials.

WARD
World's Finest
Aerials

Does the antenna on your automobile need repair? Replace it with WARDS'S 8-BALL—world's largest selling auto aerial.



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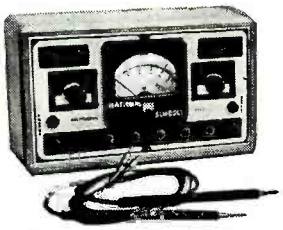
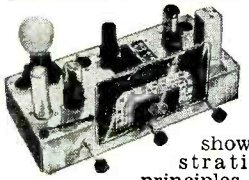


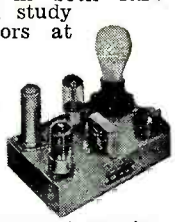
YOU RECEIVE THIS PROFESSIONAL MULTITESTER!

You will use this professional instrument to locate trouble or make delicate adjustments—at home—on service calls. You will be proud to own this valuable equipment. Complete with test leads.



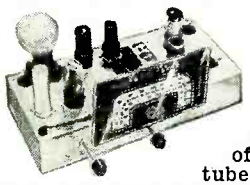
SIGNAL GENERATOR

You construct the Transitron Signal Generator shown here, demonstrating Transitron principles in both R.F. and A.F. stages. You study negative type oscillators at firsthand.



AUDIO OSCILLATOR:

An electronic device, which produces audio-frequency signals for modulating R.F. (radio frequency) carrier waves, testing A.F. (audio frequency) amplifiers, speakers, etc.



T.R.F. RECEIVER

You build several T.R.F. Receivers, one of which, a 4-tube set, is shown here. You learn construction, alignment, make receiver tests, and do trouble shooting.

GOOD PAY and Unlimited Opportunities in JOBS LIKE THESE:

Business of Your Own. Radio Manufacturing, Sales, Service. Broadcasting. Telecasting. Television Manufacturing, Sales, Service. Laboratories: Installation, Maintenance of Electronic Equipment, Electrolysis, Call Systems. Garages: Auto Radio Sales, Service. Sound Systems and Telephone Companies; Oil Well and Drilling Companies; Engineering Firms. Theatre Sound Systems. Police Radio.

And scores of other good jobs in many related fields

YOU CONDUCT MANY EXPERIMENTS LIKE THESE!

Checking action of condensers
Experiments with AF and RF amplifiers
Experiments with resonance
Producing beat frequencies
Calibrating oscillators
Experiments with diode, grid-bias, grid-leak and infinite impedance detectors
Practical experience in receiver trouble shooting
Application of visual tester in checking parts and circuits
Experiments with audio oscillators
Advanced trouble-shooting
. . . and many, many others.

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The same highly trained faculty, instruction materials and methods used here in our large, modern residence school, are adapted to your training *in your own home*. Shop Method Home Training has been proved by hundreds of successful graduates.

Both Resident and Home Study Courses Offered

YOU LEARN BY DOING

You receive special laboratory experiment lessons to show you how to build with your own hands various experimental units such as those shown at left, and how to conduct many tests.

You will find all lessons easy to understand because they are illustrated throughout with clear diagrams and step-by-step examples that you work out yourself. Every piece of the equipment and complete lesson material we send you is yours to keep and enjoy, including the multitester, experimental equipment, all parts of the Superheterodyne, tube manual, radio dictionary, and complete, modern Television texts. All parts are standard equipment.

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HAND OR DESK MICROPHONE (BA-116)

Rugged dependability and uniform frequency response. Unbeaten in its price range for PA, home, institutional and industrial use. Use in hand or on desk without need of stand. But also equipped for use with standard 5/8" 27 thread stand. Brown metallic finish, 8' cable. List, $14.75.

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Miniature contact-type microphone with unusually wide frequency response. 7/8" x 3/4" x 5/8". Output volume from .05 to .1 volt or higher. Complete with mounting clamp and 25' cable. List, $19.50.

NEW MICROPHONE (BA-109) FOR PA, HOME AND AMATEUR

A beautiful new microphone for applications that require natural reproduction of both music and voices. Uses an advanced development of the "Acousticel" cartridge pioneered by Brush. Pickup pattern non-directional in the horizontal plane. Essentially flat frequency response from 40 to 10,000 cps. Designed for use with 5/8" 27 thread stand. Finished in maroon plastic and brushed chromium . . . . . List, $22.50.

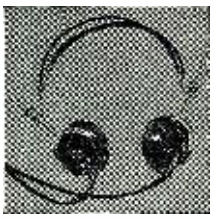
GENERAL PURPOSE MICROPHONE (BA-106)

Using the exclusive "Acousticel" cartridge. Vibration, shock, low frequency wind noise or humidity do not affect the high fidelity. Excellent for general use. Output level Minus 50 db. below 1 volt/bar . . . . List, $19.75.

LAPEL MIKE (BL-2)

Virtually flat response. Small and rugged. Can be used as hand or instrument mike, as well as lapel. 1½" x 2¼". Complete with 25' cable. List . . . . . $25.00.

Monitor with a Brush Phone



High fidelity Model "A-1", $18.00

Model "A" general purpose, $12.00

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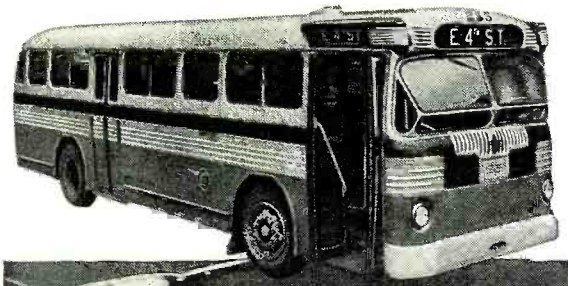
FM RADIO ON DULUTH-SUPERIOR BUSES MADE POSSIBLE THROUGH



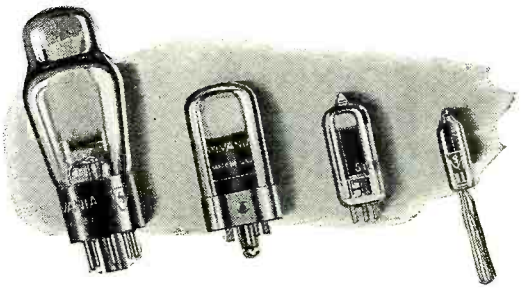
LINK EQUIPMENT... SYLVANIA TUBES!

In Duluth, Minnesota, passengers on Duluth-Superior Transit Co. buses listen to radio entertainment, weather forecasts and local where-to-buy-it information as they ride. Link Radio equipment with Sylvania Radio Tubes takes on the rugged broadcasting job.

Close-up of Link speaker. These units are attached to ceiling of bus at regular intervals for even distribution of sound.

The success of transitcasting was assured with the development by Link Radio of an ultra-sensitive, fixed-frequency, crystal-controlled mobile FM receiver with high-fidelity characteristics. 35 of these receivers—complete with Sylvania Radio Tubes—have been riding through ice-furrowed streets, extremes of noise and temperature, and up and down steep hills in Duluth for over a year . . . and maintenance has been so low that one man can easily service all of them!

Sylvania tubes have a long record of superlative performance under rugged conditions—having been in use in autos, trains, and aircraft from coast to coast. For full details about the entire line address Radio Tube Division, Advertising Dept. E-2912, Emporium, Pa.



The Sylvania line of high quality tubes includes every variety for a multitude of applications—from the standard glass tubes to the tiny subminiatures.

SYLVANIA ELECTRIC

RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES; FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES, SIGN TUBING; LIGHT BULBS; P[illegible]

Spot Radio News

★ *Presenting latest information on the Radio Industry.*

By RADIO & TELEVISION NEWS'
WASHINGTON EDITOR

AN HISTORIC PATTERN of TV's future began to unfold in Washington during the early fall days, when the much-heralded allocation hearings were finally called to order in the Commission's session hall in the Department of Commerce building. Striking testimony on the possibilities of video in monochrome and in color, on the present bands and in the ultra-highs, offered by rounds of specialists during the initial days of the meeting, which, incidentally, was expected to last for many weeks and possibly months, disclosed that significant strides had been made in the laboratories of the country.

The accent appeared to be on color, with RMA, JTAC (Joint Technical Advisory Committee), *CBS*, and *RCA* the featured performers.

Preceded by an intriguing bit of correspondence with Senator Edward C. Johnson, chairman of the Senate Committee on Interstate and Foreign Commerce, and FCC Commissioners Robert F. Jones and Paul A. Walker, the *CBS* story teemed with drama. The letter writing was sparked by Senator Johnson, who, after attending a demonstration of color television staged by *Smith, Kline, and French* at the Armory in Washington, notified *CBS* that the test was . . . "a magnificent and utterly convincing proof that color TV is here now, and that all that is necessary for it to sweep the nation is for the FCC to remove the roadblock and promulgate standards for its operation. . . . However, the reluctance to show the FCC the facts by those who know most about color and who can most effectively demonstrate its development disturbs me." Within a day, Frank Stanton, *CBS* prexy, replied to the Senator, stating that *CBS* is doing . . . "everything we reasonably can to make color television generally available at the earliest possible time."

Several days later, FCC Commissioner Jones fired a critical letter to *CBS* stating that . . . "Your zeal appears to have diminished in connection with the hearings merely because it has been instituted on the Commission's motion." The Commissioner went on to explain that *CBS* had failed to provide other than handmade equipment for tests. Said the FCC official: "Your action in the matter might well lead one to the conclusion that, while your company is anxious to transmit color TV, it is reluctant to permit others to operate color video receivers to appraise what you have transmitted. We must know whether laymen can operate the sets and can derive this only from experience of laymen operating the sets under as many diverse conditions as are common in black and white."

A seething reply from *CBS* Prexy Stanton in the form of an eight-page letter reported that . . . "No manufacturer would go into large-scale production of color converters and receivers unless a green light had first been given by the Commission. (By production was meant, of course, production in the accepted sense) . . . The production of quantities (25 to 100 or 100 to 1000) can be accomplished as a practical matter only through what amounts to hand fabrication with extremely high unit costs. . . . Thus, while the $75 figure per converter (*cited in earlier conversations with the Commissioner*) approximates the cost on a mass-production basis, the unit cost of handmade models would be many times that figure. . . . The complex process of translating a laboratory model into a production design, from which production in quantity is possible, is not something that can be done overnight."

Then, referring to the Senator Johnson letter which implied that *CBS* was not cooperative, Stanton offered a review of what the broadcasting system had done with color since the summer of last year when they developed a 6 mc. color system. In the fall of '48, the system was demonstrated before the Commission in New York, with converted receivers used to pick up both color and black and white transmissions. And, according to Stanton, between December and May of this year, *CBS* had designed and constructed color TV equipment for demonstration of surgical and medical procedures under a contract with *Smith, Kline, and French Laboratories*. Shortly after, a color installation was made at the University of Pennsylvania Medical School, Stanton revealed, and on August 2, daily 6 mc. color transmissions were begun over WCBS-TV.

Continuing with his recording of *CBS* color work, Stanton cited that engineers had constructed and oper-

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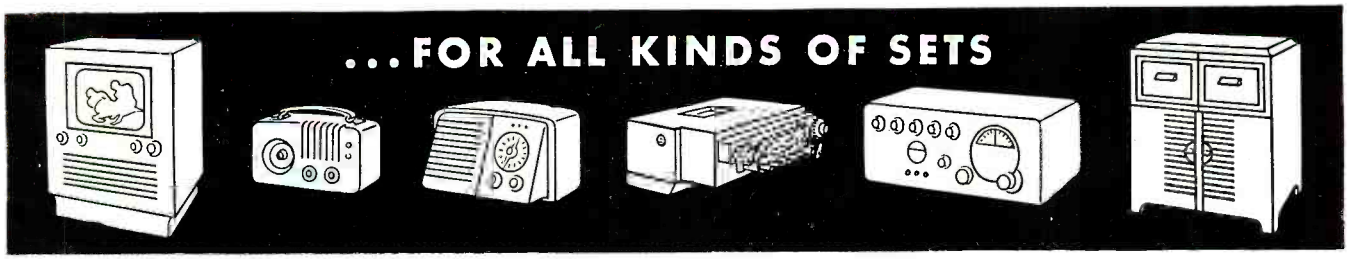

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ated an all-electronic receiver for the sequential system, employing one picture tube; developed new color primaries permitting use of standard picture tubes for reproduction; developed methods for converting standard receivers for black and white pickup of color signals or the sequential signals in color; used standard TV transmitters for sequential color sending; and cooperated with British engineers in the construction of a *CBS*-type color system for use in Great Britain.

In the letter to Commissioner Walker, Stanton declared that medical and surgical TV demonstrations are now being conducted and will continue until June of 1950. The reply also disclosed that arrangements had been completed with WOIC in Washington for the transmission of color signals as soon as the hearings began, for pickup over thirty receivers. Twenty-five were wired to pick up color signals in color, color signals in black and white, and black and white signals in monochrome, while the remaining five were used only for color pickup.

In a pre-hearing commentary on the factors to be judged in considering any color system, *CBS* said that electrical and economic compatibility with black and white methods were prime items.

Although no heated exchange of letters preceded the *RCA* appearance, their report for the record was quite exciting, too, disclosing a new all-electronic, wideband, simultaneous method of transmission of color, featuring the use of the present 6 mc. band, 525 lines, sixty fields-per-second, fifteen color pictures per second, and time-multiplex transmission. This system has been identified as a dot-sequential method with line and picture-dot interlace.

Describing the system, E. W. Engstrom, vice president in charge of research of the *RCA* lab division, said that the studio equipment provides three signals, one for each of the primary colors (green, red, and blue). Each color signal is sampled for a very short time, 3.8×10^6 times per second for each color. The three color signals from the camera are combined in an electronic *adder* and are then passed through a bandpass filter. The output of this filter contains frequencies between two and four megacycles, with contributions from each of the three color channels. The signal resulting from the addition of these three signals, identified as the sampler output, mixed high, and synchronizing pulses, are fed to a low-pass filter which cuts off at four megacycles. The signal from this filter is then applied to the modulator of a conventional transmitter.

Analyzing the electronic sampler, Engstrom said that the green is sampled every .263 microsecond (.263 = 1/3.8). At a time .0877 microsecond after a green sample, a sample is taken of the red signal. This time delay is one-third of the time between successive green samples. Red samples continue to be taken .263 microsecond apart. Blue samples are taken at the same rate and follow the red samples by a time of .0877 microsecond. The composite output of the sampler consists of a superposition of the green, red, and blue trains of pulses or samples.

Commenting on the scanning sequence used by *RCA*, Engstrom declared that the odd lines are scanned during the first field, but dots of the same primary color are separated by spaces. The even lines are scanned during the second field, again with spaces between like color dots. During the third field, the odd lines are again scanned, but with the color dots displaced so that the spaces are filled. The even lines are scanned during the fourth field, with the color dots displaced to fill in the spaces left during the second field scanning. Four scanning fields are required to completely cover the picture area, with all spaces filled with, say, green dots. Simultaneously, the area is being covered with red and blue dots. Since there are sixty fields per second, it may be said that there are fifteen complete color pictures per second. The effective field rate for the large-area flicker is sixty per second, the same as for current black and white receivers. Engstrom said that at viewing distances such that the picture-line structure is not resolved, the effect of small-area flicker due to line interlace and picture-dot interlace is not visible.

A regular schedule of color transmissions over WNBW was also set up by *RCA*, with six receivers in operation. Explaining the tests in a letter to FCC Commissioner Walker, Dr. C. B. Jolliffe, executive vice-president in charge of the *RCA* labs, said that . . . "receivers will be placed in typical locations and used under home conditions."

Both *CBS* and *RCA* scheduled special color demonstrations of their systems for the FCC, inviting members of the industry, and will present standards and operational data based on these and subsequent tests for the record during the hearings.

Color systems using other types of scanning were also proposed at the Washington hearings. One method, developed by *Color Television* of San Francisco, called a line-sequential approach, featured successively-traced image lines that appear on the screen in different colors. According to George E. Sleeper, chief engineer of the coast company, a raster is traced in each of three colors (red, green, blue) on the picture tube in a selected sequence.

Leon Ruberstein of New York City offered still another type of color system, wherein a special type of screen was used to provide color. The screen was described as consisting of microscopic prisms which separate the reds, greens, and blues from the light.

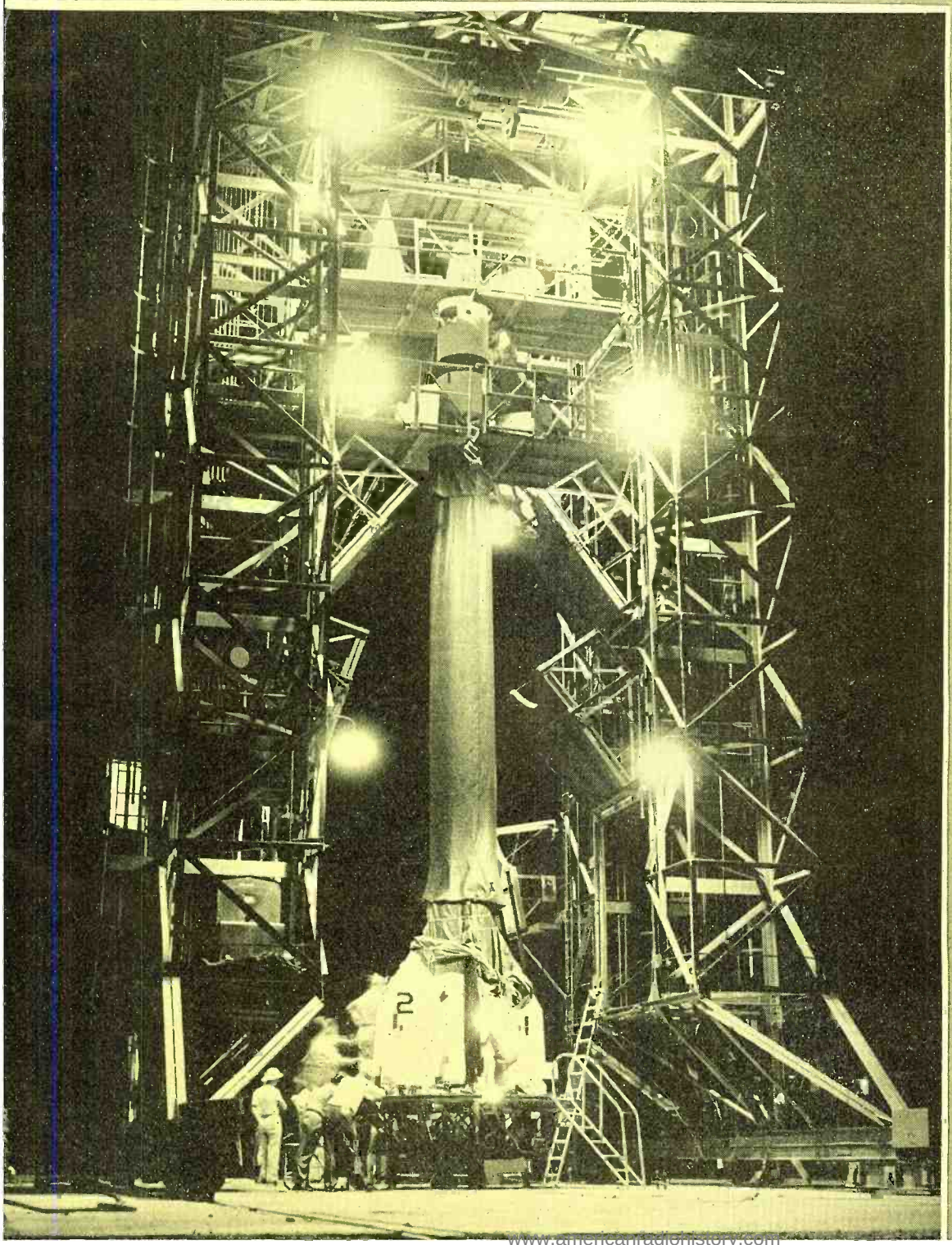
Although the period for official witness-stand comments on the proposals was, at this writing, weeks away, there were volumes of off-the-record opin-

(*Continued on page* 163)

NOVEMBER, 1949

RADIO & TELEVISION NEWS

RADIO-ELECTRONIC Engineering



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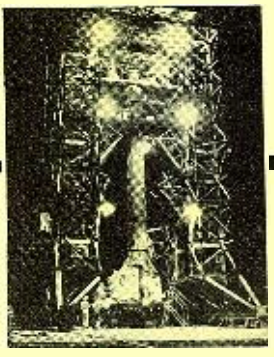


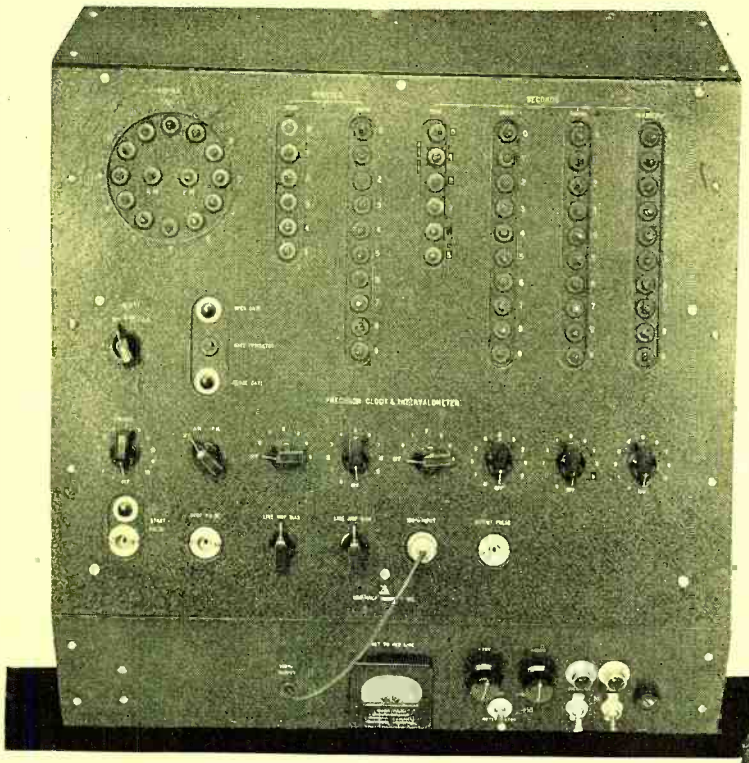
RADIO-ELECTRONIC ENGINEERING is published each month as a special edition in a limited number of copies of RADIO & TELEVISION NEWS, by the Ziff-Davis Publishing Company, 185 N. Wabash Avenue, Chicago 1, Illinois.

COVER PHOTO—By Acme

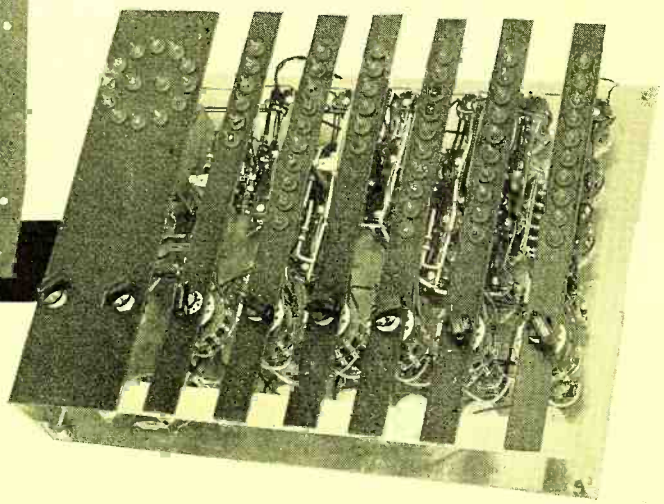
Preparations are under way to fire the Navy's giant Viking rocket at White Sands Proving Ground, N. M. A protective sleeve covers a portion of the target. The rocket contains a great deal of electronic telemetering equipment for reporting data back to the earth during flight.

By A. E. WOLFE, Jr.
and F. G. STEELE
Northrop Aircraft, Inc.

Design and construction of a highly accurate intervalometer for 1/100 sec. to 24 hr. timing.



Front panel view of the clock and intervalometer.



Interior view of the precision clock.

DIRECT READING TIMER and CLOCK

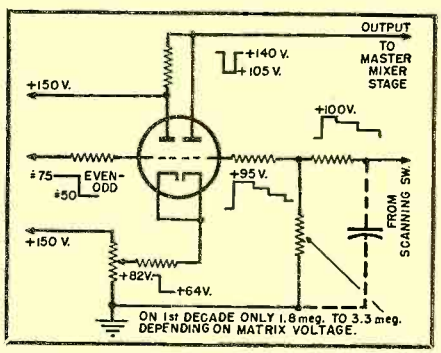
CONSIDERABLE interest has been shown lately in "Atomic" or electronic clocks. Engineers at *Northrop Aircraft* needed an extremely accurate clock, one which would start or stop at a previously determined time and which would record accurately to 1/100 second an interval between two operations. Their answer to the problem is the *Northrop* intervalometer.

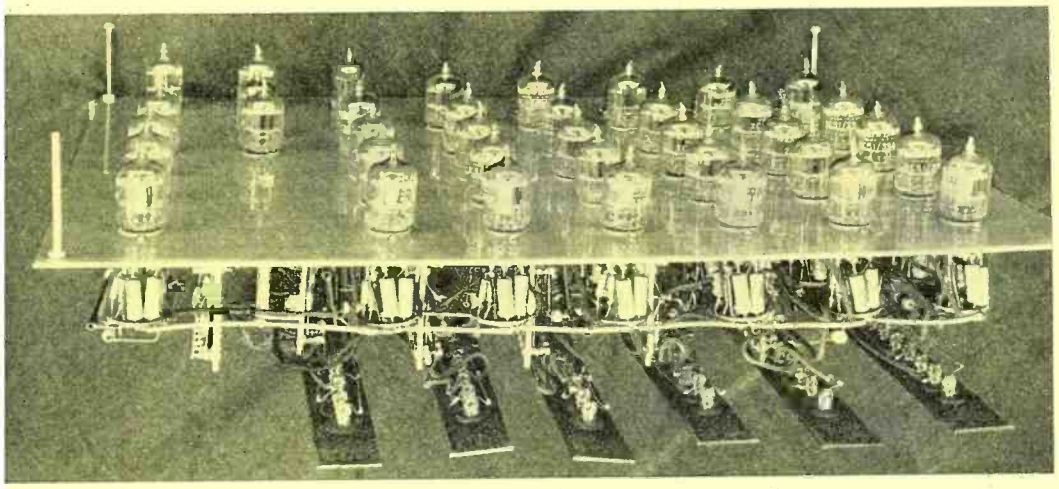
The intervalometer is used in conjunction with a frequency standard consisting of a temperature controlled 102.4 kc. quartz crystal oscillator and several frequency dividers. The reason 102.4 kc. was selected is that this is an even power of two and therefore simple scale of two dividing circuits could be used. It was believed that these scale of two dividing circuits would be more reliable than other types of circuits. The frequency divider consists of 10 double triode tubes and provides the input pulse rate to the clock of 100 pulses per second.

As shown in the picture, the "face" of the clock consists of six vertical rows of neon bulbs reading from right to left 1/100 sec., 1/10 sec., sec., 10 sec., min. and 10 min., and also a circular display of twelve neon bulbs corresponding to the hours. In the center of this circle are two neon tubes indicating AM and PM. Reading from the right, each of the first three rows of 10 bulbs is connected to a 10-position scaler unit. Each 10-position unit consists of four double triodes connected in a special feedback circuit (Fig. 3), the output of each scaler unit being fed to the succeeding unit. The output of the third scaler unit, which represents seconds, is fed to a six-position counter consisting of three double triodes. This scaler unit represents tens of seconds and feeds the minute unit. This is another scaler unit feeding a second six-position counter representing tens of minutes. This counter in turn feeds the hour counter which feeds the AM-PM indicator, a single flip-flop. Below each of the above mentioned scaler units is a multi-position switch which scans each unit and detects the number it contains. The outputs of all the switches are mixed, and the output of the mixer detects the total number contained in the clock. Depending on how the clock is used, this number could represent either a time interval or some absolute time. The unit below the face of the clock proper consists of a power supply and a built-in 100 cycle pulse source which can be substituted for the frequency standard if accuracy desired is not greater than variations in line frequency. All the preceding description refers to Fig. 2, sections (1) and (3). Section (2) consists of the reset circuits, the input gate and associated flip-flop controlling the gate, and the start-plus line amplifier.

Referring to Fig. 3, the typical binary "10" scaler unit consists of modified Eccles-Jordan circuits with a normal capacity of 16 pulses before recycling, which, however, is held to a capacity of

Fig. 1. Scanning or mixing tube.





Interior view of the precision clock and intervalometer.

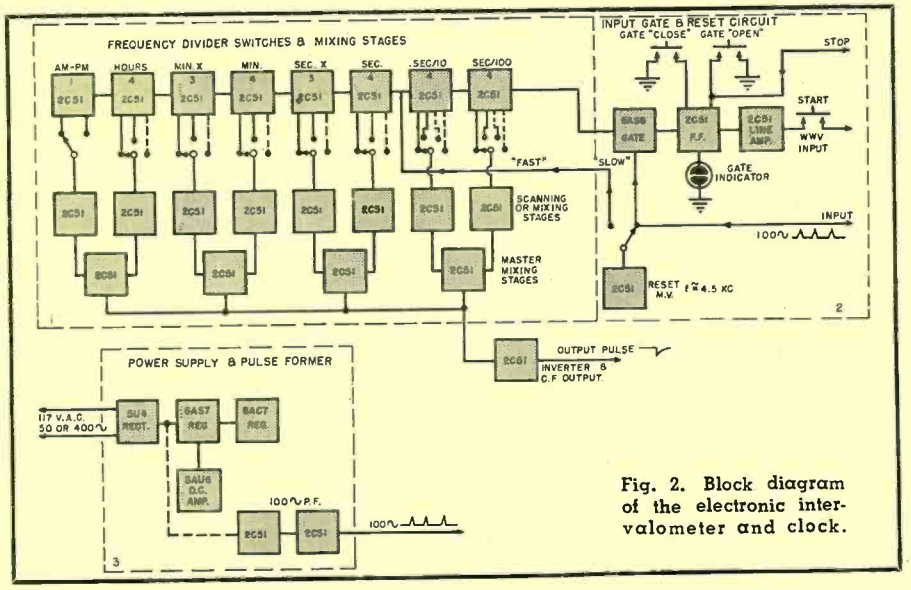


Fig. 2. Block diagram of the electronic intervalometer and clock.

10 by utilizing two feedback paths. The other types of scaler units utilize the same principle to reduce their normal capacity of eight pulses to a capacity of six pulses. Referring to the block diagram, it will be seen that four units with a capacity of 10 are used, i.e., sec./100, sec./10, sec. and min. Two scaler units with a capacity of six, i.e., sec. x 10 and min. x 10, are used, as well as one unit with a capacity for the hours. This latter unit is made up of a counter of six preceded by a flip-flop. The development of a matrix to scan the four tubes (Fig. 3) through their 10 positions is as follows: First, if a stage be in the 01 condition, let that = 0, and if a stage be in the 10 condition, let this = 1 in the following table (Fig. 4).

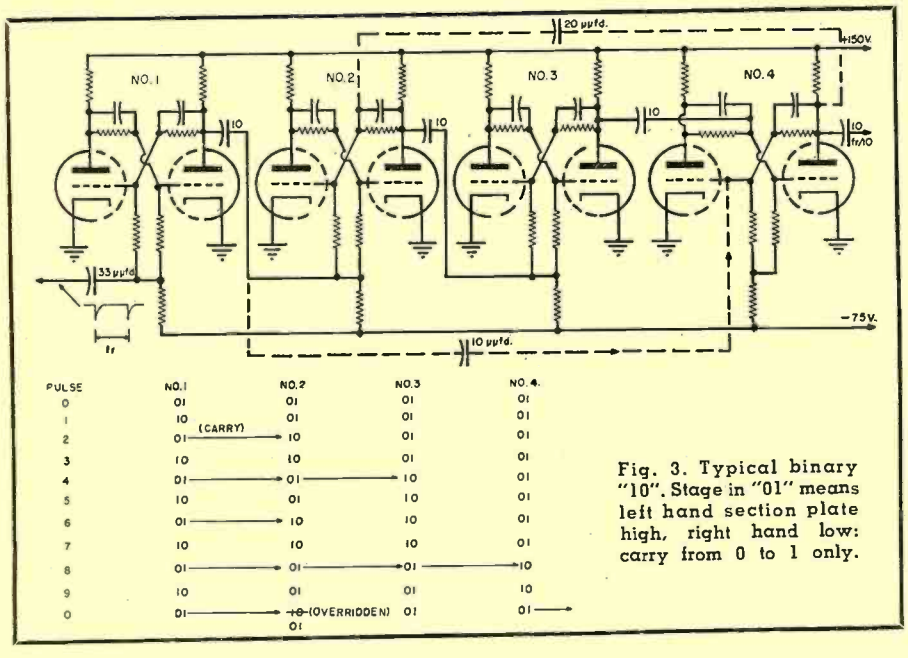


Fig. 3. Typical binary "10". Stage in "01" means left hand section plate high, right hand low: carry from 0 to 1 only.

The actual connections of the matrix appear at the right-hand side of the table. In the section immediately below the counting stages, junctions indicate 510,000 ohm resistors. Junctions below that indicate NE-2 bulbs. Referring to Fig. 4, the table shows five combinations of the last three stages which, when combined with the even-odd configuration of the first stage, gives us 10 possible outputs.

A short description of the operation of the matrix follows. Referring to Fig. 4B, the NE-2 bulb will only light when side *b* is high and side *a* is low. Side *b* is high only when all flip-flop plates connected to it are high.

Considering the counter with 0 pulses (10 configuration using the abbreviated sequence), each stage is therefore in the 0 condition, which means that all left-hand plates are high. As previously explained, an NE-2 bulb will only light when one side is high and the other side is low. Therefore, since the left-hand plates in all stages are high, we must use the right-hand plate in stage 1 and left-hand plates in stages 2, 3, and 4 to light the (0) bulb. If we feed one pulse into the counter, the first stage is the only one to be affected going from the 0 to the 1 condition, i.e., the left-hand plate is now low. Therefore, now to light the (1) bulb, we use the same "high" connection, but for the "low" side of (1) we use the left-hand plate of stage 1. Consider now the counter when we feed another pulse into it. From the table we see that both the first and second stages are affected, the first stage going back to the 0 condition and the second stage going to the 1 condition. The even branch from stage 1 now becomes low. In a similar manner, all subsequent positions up to 9 are carried out and the 10th pulse returns the system to zero.

It has been shown that the neon bulbs indicate the number of pulses fed into the counter. Associated with each scaler unit is a 2 deck wafer switch (see Fig. 8) connected as shown to the NE-2 bulbs. The rotors of these switches, therefore, will be able to detect when a given number appears in the counter. These rotors are con-

nected to the scanning or mixing stages.

Briefly, a mixing stage consists of a double triode d.c. amplifier connected as shown in Fig. 1. An input is applied to each grid of the double triode and coincidence is detected in the plate circuit. The wave shapes are as shown in Fig. 1, and the 100,000 ohm pot in the cathode circuit is used to detect only the most positive part of the wave on grid 2. Eight of these scanning or mixing stages are used, i.e., one to each scaler unit. Coincidence of all the outputs of all the scanning or mixing stages is detected in the master mixing stages. These consist of four double triode tubes with a common plate load resistance and separate inputs on each of the eight grids which are derived from the eight outputs of the eight scanning or mixing stages. There is an output from the master mixing stages when and only when inputs to all eight grids are present (Fig. 5).

The output from the master mixing stages is fed into the inverter and cathode follower output stage (Fig. 6). This consists of a 2C51 double triode. The input to the inverter stage is a rectangular wave of about 100 v. amplitude and .01 seconds (10,000 μs.) width. This wave is differentiated in the input circuit to the inverter, and only the leading edge is used. The output of the inverter is a negative going pulse approximately 50 μs. wide and approximately 100 v. in height. This is fed into the cathode follower and this negative going pulse appears on the output jack.

Input Gate and Reset Circuits

The input gate is a 6AS6 tube controlled by a flip-flop (Fig. 7). The 100 cycle timing pulses are applied to G_1 and the controlled voltage for the gate which is derived from the flip-flop is applied to G_3. The gated output appears in the plate circuit. The clock was designed to be started by WWV time pulses and therefore a pulse shaping amplifier was included. This pulse shaping amplifier merely develops a series of five sharp pulses from the five 1000 cycle sine waves which make up a WWV one-second pulse. In addition to the electronic means of controlling the gate, two push buttons are associated with the flip-flop allowing manual operation of the gate if desired. An NE-2 bulb connected to the proper plate of the flip-flop serves as a gate indicator showing either open or closed condition.

To set the clock at any given time, the reset circuits as shown in section (2) of the block diagram are used. These consist merely of a two-position switch and a free running multivibrator running at approximately 4.5 kc. In the "fast" position, the differentiated output of the multivibrator is fed directly

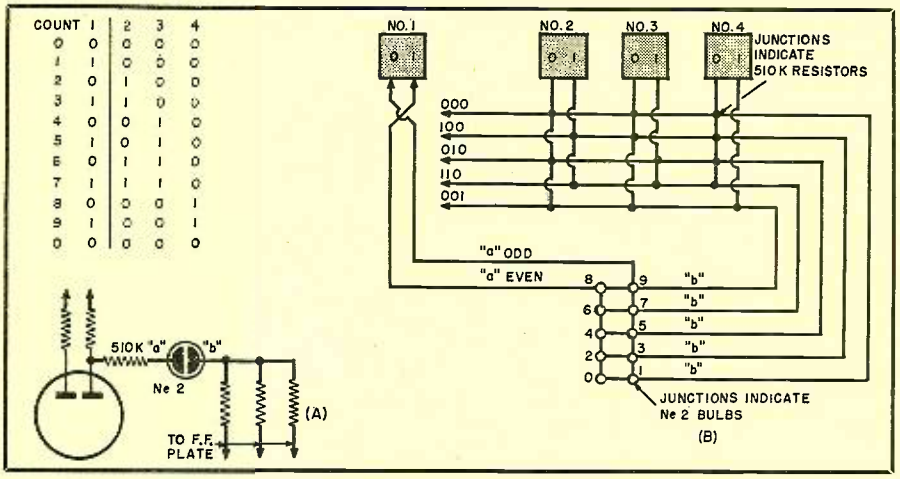


Fig. 4. (A) Matrix development for typical binary "10". A given bulb will light when even-odd bus is low on one side of bulb and high on other side. (B) Detail of (A). Bulb lights only when all F.F. plates on side "6" are high and "a" is low.

to the one-second scaler unit bypassing the input gate and the first two scaler units, i.e., the sec./100 and the sec./10 units. This is done to quickly cycle the last three scaler units to their approximate final position. When this has been accomplished, the reset multivibrator is set to slow, the output from the inverter and cathode follower unit is connected to the stop jack, and the 6AS6 gate is manually set open. As soon as the required number, as determined by the positions of the various switches, is present in the clock, a pulse appears at the output of the cathode follower which triggers the flip-flop controlling the input gate, thus closing the gate. The reset multivibrator is now turned off, the 100 cycle input is connected, and the clock is now set. The entire reset operation takes on the average 30 to 45 seconds.

In operation over an extended period, the only maintenance required has been the replacing of two type 2C51 tubes and the readjustment of one of the scanning or mixing tube cathode biases.

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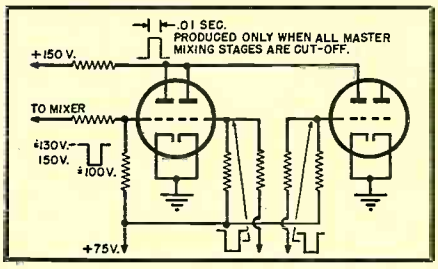


Fig. 5. Master mixing stages.

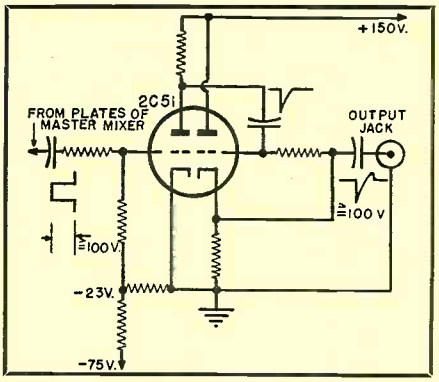
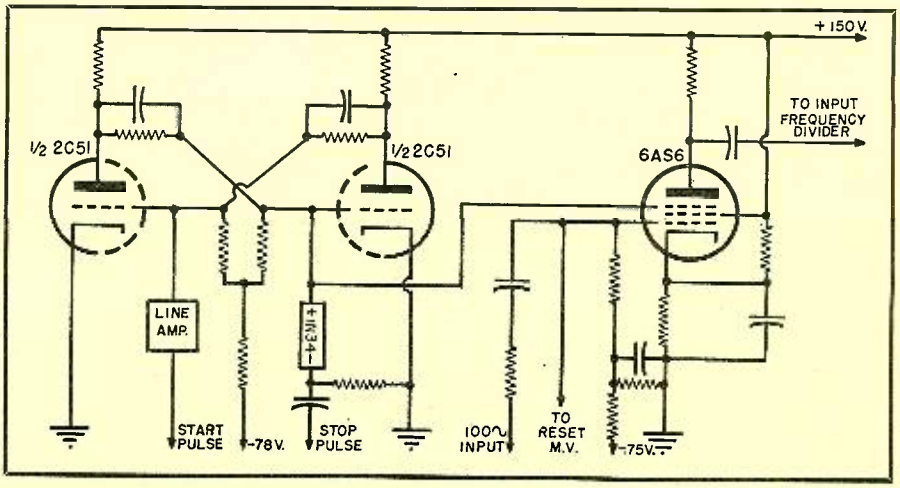


Fig. 6. Inverter and cathode follower for output pulse.

Fig. 7. Input gate driven from flip-flop.



A Stabilized VOLTAGE-DROPPING Element

By SYDNEY E. SMITH
Engineering and Industrial Experiment Station, University of Florida

A cathode follower may be used to provide an adjustable stabilized d.c. voltage with small bleeder current.

MANY electronic circuits require a variable current from a source of good voltage regulation. Often, the voltage required is lower than the power supply output voltage and is derived from a conventional voltage divider. It can easily be shown by means of Thevenin's Theorem that the voltage regulation of this type of circuit is inversely proportional to the bleeder current. When good regulation must be provided and the load current varies over a wide range, the necessary bleeder current may be an unduly large percentage of the total current load on the supply. Such a design is inefficient, both in first cost and in operation.

In cases of this kind, the cathode follower may often be used to advantage as a voltage dropping and stabilizing device requiring negligible bleeder current. In addition, the circuit may provide a considerable amount of filtering of a.c. ripple voltage which may be present on the output of the power supply, and a low impedance to signal components of load current.

Circuit Analysis

The circuit of the cathode follower employed as a voltage stabilizer is indicated in Fig. 2. The purpose of the capacitor C is twofold: to prevent any a.c. ripple present on the power supply voltage, E_{bb}, from appearing on the reference voltage E, and to maintain the grid at the a.c. potential of the low side of the load. The operation of the tube is then such as to provide considerable filtering of a.c. ripple and a low output impedance to a.c. components of load current. The d.c. output voltage E_b will be the difference between the drop across R_2 and the bias required by the tube at the value of load current and plate voltage $(E_{bb} - E_b)$ which obtains.

$$E_b = E - E_c \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Since it is generally desirable to operate the tube without grid current, the required grid bias, E_c, will be a negative quantity and the load voltage will be greater than E.

Assuming that the supply voltage E_{bb} does not vary, the regulation of the load voltage will be determined by the variation in grid voltage required by the stabilizer with varying load current.

$$\text{Regulation } (\%) = \frac{\Delta E_c}{E_b} \times 100. \quad . \quad (2)$$

ΔE_c is the variation in required grid voltage and E_b is the full load output voltage.

The degree of power supply ripple filtering provided by the stabilizer may be obtained by reference to the equivalent circuit of Fig. 3A. From this circuit, it follows that

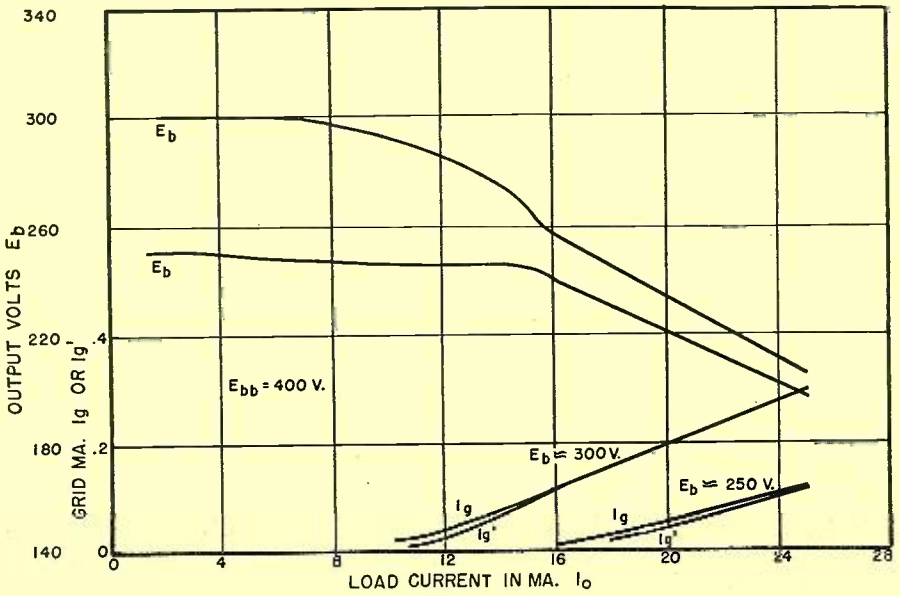
$$e_r = (e_{rr} - \mu e_r) \frac{R_L}{R_L + R_p} \quad . \quad . \quad . \quad (3)$$

Solving explicitly for e_r and dividing by e_{rr} to obtain the ripple attenuation ratio:

$$\frac{e_r}{e_{rr}} = \frac{1}{(\mu + 1) + \frac{R_p}{R_L}} \quad . \quad . \quad . \quad . \quad . \quad (4)$$

The stabilizer impedance to a.c. components of load current may be derived from the equivalent circuit of Fig. 3B in which the load has been replaced by a constant current generator driving i_L through the parallel resistors R_p and R_L. The tube has been replaced in the usual manner by a

Fig. 1. Voltage regulation characteristic of the circuit of Fig. 2, showing the abrupt increase in regulation as grid current begins.



constant current generator driving the current $-e_s g_m$ through the paralleled resistors. The signal frequency voltage appearing across the load is then:

$$e_s = (i_L - e_s g_m)\frac{R_L R_p}{R_L + R_p} \quad . \quad . \quad . \quad (5)$$

from which the output impedance of the stabilizer is:

$$R_0 = \frac{e_s}{i_L} = \frac{R_p R_L}{(1+\mu)\ (R_p + R_L)} \quad . \quad . \quad (6)$$

or, when $\mu >> 1$:

$$R_0 = \frac{1}{g_m} \times \frac{R_L}{R_p + R_L} \quad . \quad . \quad . \quad . \quad (6a)$$

Eqts. (6) and (6a) will be recognized as the usual ones for the output impedance of the cathode follower. In many applications, the fact that the output impedance is independent of frequency may be an added advantage of the circuit.

Since in the usual case the stabilizer will operate without grid current, the reference voltage divider may be of high resistance, requiring but one milliampere or less of bleeder current. The capacitor C should be chosen so that its reactance at the power supply ripple frequency, or at the lowest frequency of the signal load current, will be small compared with the magnitude of R_1 (or, more accurately, small compared with $(R_1 R_2)/(R_1 + R_2)$).

Practical Circuit Operation

The results of measurements performed upon a laboratory circuit employing a type 6J5 tube are indicated in Figs. 1, 4 and 5.

It will be observed that in both cases of Fig. 1 the output voltage drops slowly until grid current begins to flow, then falls sharply. In each case, the variation in the output voltage up to the point at which grid current begins agrees well with the value of grid voltage at plate current cutoff for the plate voltage $(E_{bb} - E_b)$ applied to the cathode follower. These curves indicate that for good voltage regulation the cathode follower should be operated between the limits of E_c = cutoff and E_c = zero as the load current varies from zero to its maximum value. Over this range, the output voltage will vary by the difference in grid voltage, and no grid current will flow.

The grid current curve I_g' was obtained with no ripple voltage applied to the circuit, while I_g was obtained with a ripple of 10 volts r.m.s. superimposed upon the 400 volt supply (3.54% ripple). As should be expected, the grid current curves indicate that the presence of ripple voltage upon the power supply output reduces the maximum d.c. load current which may be supplied without grid current.

Fig. 4 shows the variation in output ripple voltage with d.c. load current. At 300 volts output, the ripple attenuation ratio was of the order of 0.07, or about 22 db. to the grid current point, while for the 250 volts case, corresponding values were 0.06 and 24 db.

It must be observed that the a.c. output impedance curves of Fig. 5 are somewhat sketchy due to the limited capacity of the a.c. load current generator employed. They are included here, however, to indicate certain limitations in operation of the circuit. It will be observed that the output impedance is lowest at moderate values of direct current and small values of alternating current. The increase in impedance at low values of direct current is in agreement with Eqt. (6) since the transconductance of the tube falls off at low values of plate current. The increase in output impedance with a.c. load current is due to either of two factors:

(1) With increasing a.c. load current the path of operation of the tube extends over a greater portion of the characteristic curve. Since the plate current-transconductance characteristic of the tube is not linear, the transconductance averaged over the path of operation is less than that at the d.c. operating point.

(2) When the sum of the d.c. and the peak a.c. currents is greater than the value for which E_c of the stabilizer must be zero, the grid draws current, thus reducing the load voltage on the signal peaks. Again, the average value of the output impedance over the signal cycle is effectively increased.

The above discussion indicates that the maximum a.c. load current may be supplied when the d.c. load current is equal to one-half of the maximum d.c. current which the circuit can supply without grid current, in the absence of an a.c. load current. The maximum value of the peak load current is then equal to the d.c. load current, but the output impedance to the alternating

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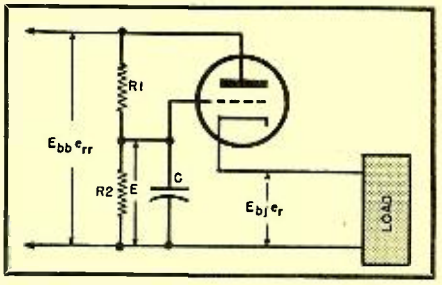


Fig. 2. Circuit diagram of the cathode follower voltage stabilizer.

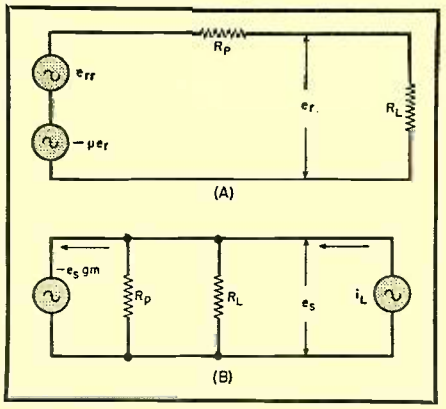
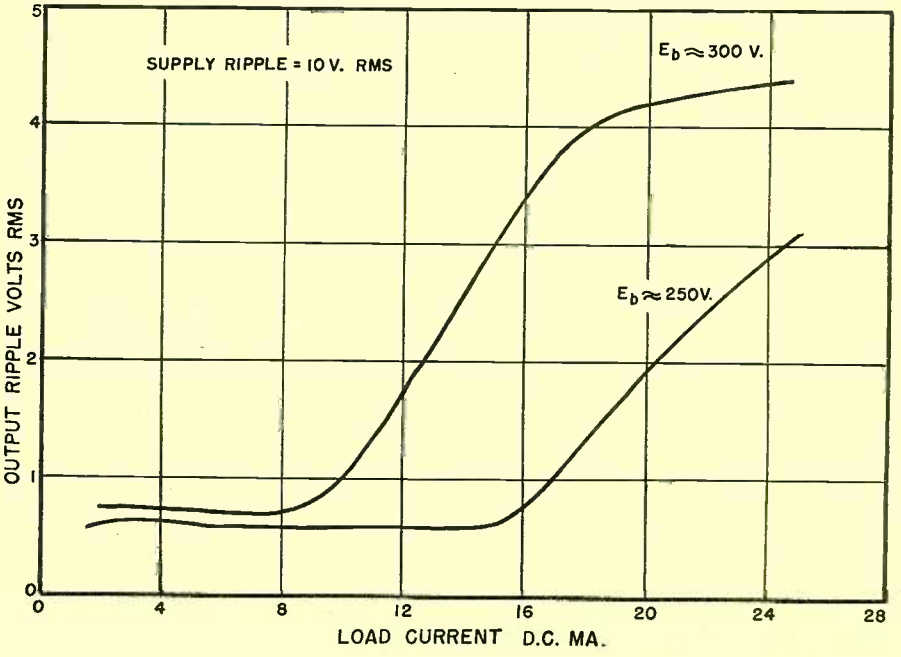
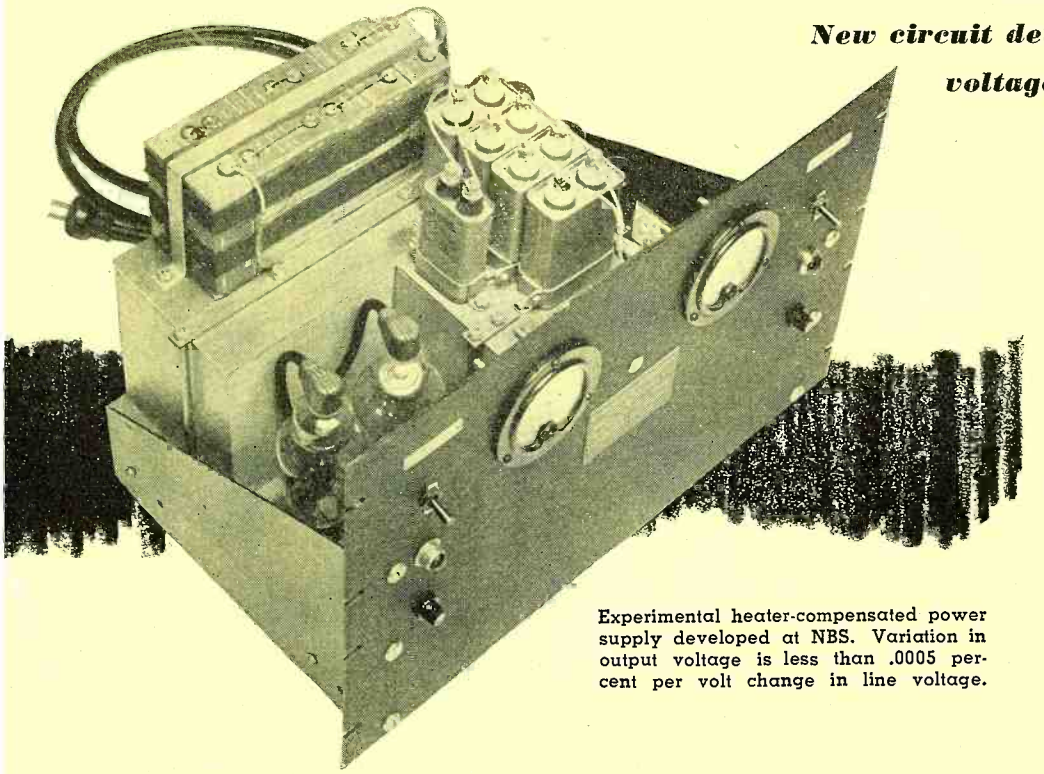


Fig. 3. (A) Circuit equivalent of Fig. 2 for ripple frequency components of power supply voltage, e_{rr}. (B) Circuit equivalent of Fig. 2 for a.c. components of load current.

Fig. 4. Power supply ripple filtering characteristic of the stabilizer.



New circuit developed at NBS uses heater-voltage fluctuations to compensate for line-voltage fluctuations.

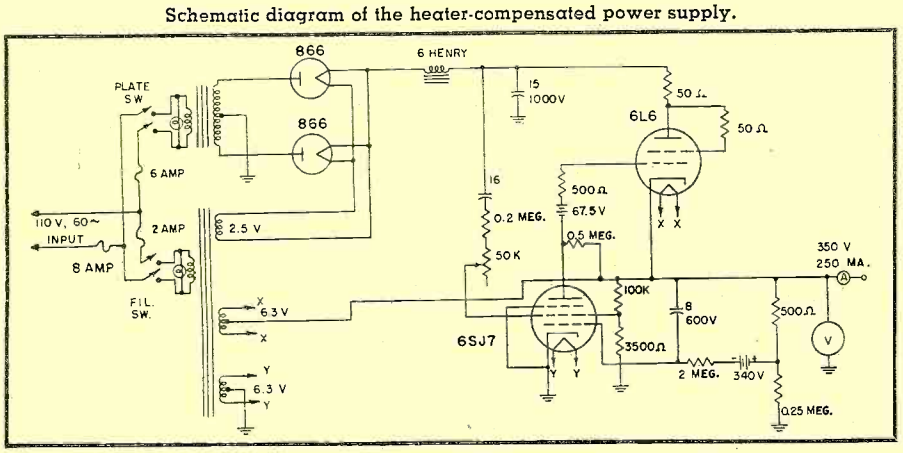


Experimental heater-compensated power supply developed at NBS. Variation in output voltage is less than .0005 percent per volt change in line voltage.

Heater-Compensated POWER SUPPLY

A NEW method of compensating for line-voltage changes in stabilized direct-current power supplies has been developed by Robert C. Ellenwood and Howard E. Sorrows at the National Bureau of Standards. In the new circuit arrangement, heater-voltage fluctuations are used to compensate for the line-voltage fluctuations. This compensation thereby increases the stability of the output voltage. This method can be applied to power supplies employing degenerative voltage stabilizers in which d.c. amplifiers compare the output voltage against a fixed reference voltage. When the output voltage changes, the resulting voltage difference between the output and the reference potential is amplified by the amplifier so that the resistance of a control tube is altered in such a way as to restore the output voltage to its original value. The stability of such power supplies without heater compensation is adequate for many purposes, but for very precise measurements where greater stability is required, the new heater-compensated power supply fills a definite need. Heater compensation can be used to good advantage in power supplies for such constant-current devices as direct-current amplifiers and microwave oscillators.

Schematic diagram of the heater-compensated power supply.



In order to analyze the effect of heater compensation, measurements were made on a typical stabilized power supply (350 volts, ¼ ampere). The experimental heater-compensated power supply constructed at the National Bureau of Standards employs a type 6SJ7 pentode as the amplifier. Other tubes of the same general type have also been used with satisfactory results. Small portable dry batteries are used as a reference voltage. The reference voltage was made nearly equal to the output voltage so that the full change in output voltage is applied to the control grid of the amplifier tube. The batteries are placed in series with the amplifier grid lead in such a way that no current is drawn. This results in a very stable reference voltage and lengthens the service life of the batteries. The control function is performed by several 6L6's connected in parallel. Six tubes can carry a load current of 250 milliamperes and present an internal impedance of only 2 ohms. The output voltage was found to be influenced by small changes in the heater voltage of the amplifier tube, but independent of the heater voltage of the control tube(s). A change in temperature of the amplifier cathode produces a corresponding change in the velocity of the emitted electrons and consequently in the magnitude of the amplifier plate current. The amount of compensation from heater voltage action is a function of the amplifier screen-grid voltage, and the degree of control by the cathode over the plate current is greatest at low screen potentials. The correct screen voltage for maximum stability must be determined experimentally.

When a change occurs in the heater voltage, the change in the amplifier plate current produces a proportional change in the voltage across the grid resistor of the control tube. This effect produces an additional compensation for line-voltage changes. For a constant heater voltage, an increase in line voltage of ten volts results in an increase in output voltage of about 0.1 volt. With the line voltage to the stabilizer held constant and the potential of the screen grid of the stabilizer set at 12.5 volts, an increase of ten volts in the primary voltage of the heater transformer results in a 0.1 volt decrease in output voltage. With the high-voltage and heater transformers connected

(*Continued on page* 30)

Adjustment of QUADRATURE NETWORKS

By SIDNEY WALD
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Design of a precision 90° phase shifting network which may be built from noncritical components.

MANY occasions arise in the electronics laboratory when it is necessary to set up a phase-splitter circuit to give a 90 degree phase shift of one of the input voltages.

Normally this is accomplished either by attempting to install precision circuit values in the apparatus or else by using non-precision parts and adjusting the components of the network until a circle is obtained on an oscilloscope. The first method is costly and not justified in low-cost equipment while the second method is too inaccurate since it is not possible to say with certainty that the achieved pattern is perfectly circular.

This article points out how an oscilloscope may become a useful device for precision checking of quadrature networks. The concept depends on the fact that a zero or 180 degree shift between vertical and horizontal plates may be recognized with good accuracy because the pattern closes to a straight line. With a good scope, phase deviations of the order of ½ degree may be detected in the deviation of the straight line display.

If we were to introduce a precise 90 degree phase shift between the circuit to be adjusted to quadrature conditions and the scope, the resulting pattern would be an inclined straight line when the adjustment is correct. Fig. 1A shows a typical application of this technique. The requirement which is difficult to fulfill is the accurate 90 degree fixed phase shifter particularly because of the common ground found in most circuits.

Many circuits have been proposed to give a 90 degree phase shift but unfortunately many are four terminal devices and require a transformer when a common ground is desired. Figs. 1B and C show well known 90 degree phase shifters.

The simplest and usually most desirable configuration for a phase shifter is the *RC* arrangement of Figs. 1D and 1E. The highest usable phase shift obtainable from either of these circuits depends upon the amplitude attenuation which may be tolerated, being .707 at 45 degrees and approaching zero output at 90 degrees.

Ordinarily it is undesirable to simply cascade such circuits to obtain greater phase shift than is possible with one because of the loading effect of successive circuits on the previous ones. For example, two 60 degree networks in cascade give an over-all shift which is considerably less than 120 degrees.

A special case arises when two 45 degree networks are cascaded, when the loading effect of the second circuit on the first vanishes. A simple analytical proof is given here to substantiate this statement.

Referring to Fig. 1F:

$$e_1 = I_1 (R - jX) - I_2R \quad . \quad . \quad . \quad (1)$$

$$o = -I_1R + I_2 (2R - jX) \quad . \quad . \quad (2)$$

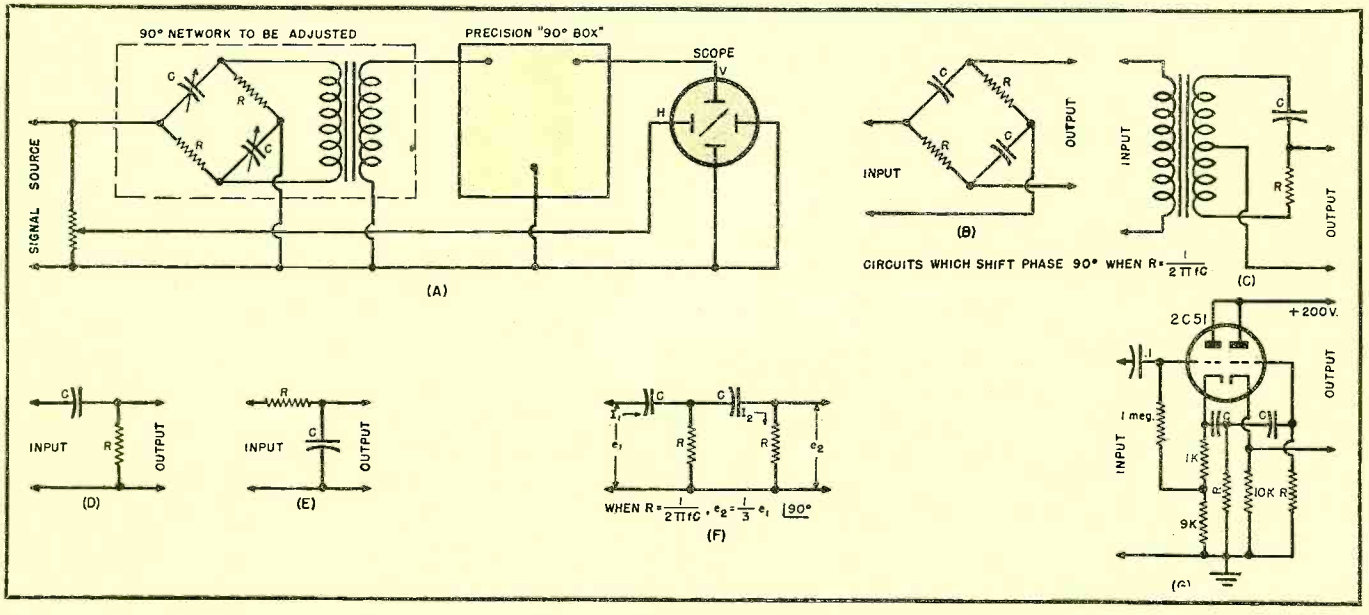
$$e_2 = I_2R \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Let $X = R$ and substitute (3) in (1):

$$e_1 = I_1R (1 - j) - e_2 \quad . \quad . \quad . \quad . \quad (4)$$

(*Continued on page* 31)

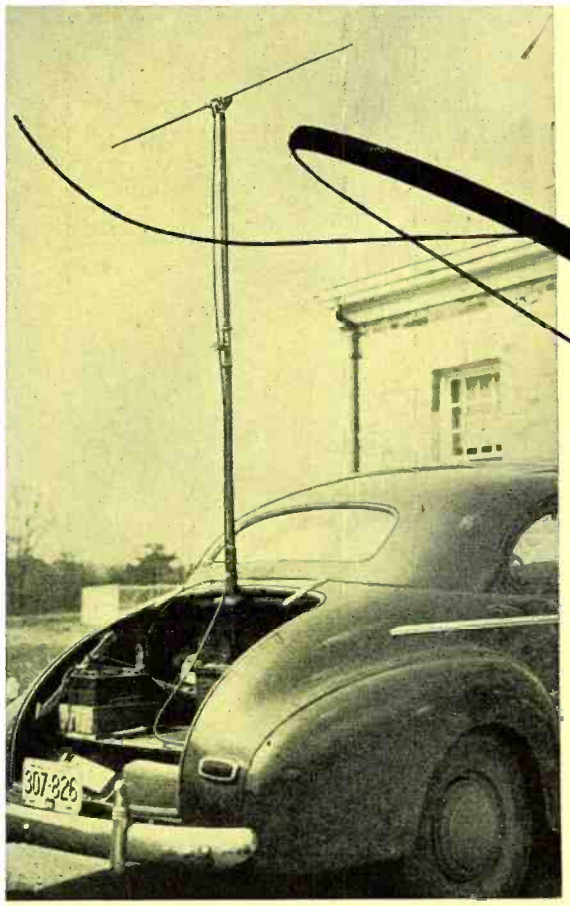
Fig. 1. (A) Typical quadrature network adjustment. C or R is varied until pattern is a straight line. (B) and (C) Circuits for shifting phase 90°. (D) and (E) Simplest R-C phase shifting arrangements. (F) 90° network. (G) A precision 90° box. $R = 1/2\pi fC$ for 90° between input and output.



FIELD INTENSITY SURVEY of an FM Station

By HAROLD REED
Chief Engineer, Station WOL

One method of making a field intensity survey of an FM station to meet the FCC requirements.



Rear view of car with trunk cover removed, showing how the antenna is mounted.

FIELD intensity contours of an FM broadcast station are to be determined in accordance with the methods prescribed in the "Standards Of Good Engineering Practice Concerning FM Broadcast Stations" of the Federal Communications Commission. These Standards state that FM broadcast stations shall determine the extent of their 1 millivolt per meter and 50 microvolt per meter contours. It is further stated that although some service is provided by tropospheric wave, the service area is considered to be only that served by the ground wave. The extent of the service is determined by the point at which the ground wave is no longer of sufficient intensity to provide satisfactory broadcast service.

The field intensity considered necessary for service in city business or factory areas is 1 millivolt per meter median field intensity and in rural areas 50 microvolt per meter median field intensity. A median field intensity of 3 to 5 millivolts per meter should be placed over the principal city to be served and for class B stations, a median field intensity of 1 millivolt per meter should be placed over the business district of cities of 10,000 or greater within the metropolitan district served. A field intensity of 5 millivolts per meter should be provided over the main service area of a class B station.

This paper presents a discussion of the procedure employed in conducting a field intensity survey, in accordance with the FCC Standards, of a class B FM station with effective radiated power of 20 kilowatts. The transmitter power output was 8.4 kilowatts. Transmission line efficiency was 79%. The antenna had a power gain of 3 with a height of 410 feet above average terrain.

Measurements to determine the service area of an FM broadcast station must be made with mobile equipment of a field intensity meter of proper frequency range and calibrated against recognized standards, a source of power for this instrument, an antenna designed for the frequency of the signal to be measured, a graphic instrument more popularly known as a recorder, a mobile recording assembly for driving the recorder from the speedometer shaft of the field survey car, and miscellaneous accessories for both the measuring apparatus and the recorder. This collection of equipment when properly installed and operated provides for the required continuous mobile recording of the field intensity of the FM transmitter in accordance with the FCC regulations.

Several installation problems were encountered in the process of setting up this equipment, foremost of which was in the mounting of the antenna on the car. The most convenient vehicle would be a light truck, or preferably a station wagon because of its all wooden body construction. These means of transportation were unavailable to the writer at the time this field survey was undertaken. It was therefore necessary to employ a passenger vehicle which in this case was a 1941 Chevrolet business coupe.

The FCC Standards specify that the receiving antenna be of a non-directional type and of the same polarization as the transmitting antenna. It was found that a completely satisfactory non-directional type of antenna for this work was unavailable. Experimental antennas have been constructed for this purpose and several were found to be fairly successful but none to the writer's knowledge proved to be entirely satisfactory. The greatest handicap of the non-directional antenna in the conducting of these tests is the weak signal pickup it provides as the end of any given transmitter radial is approached. Permission to employ a dipole antenna was obtained from the Federal Communications Commission. This, of course, had to be continuously properly oriented with respect to the transmitter as the field car moved outward from the transmitter site in order to insure maximum signal pickup at all times in the receiving antenna. This rotational provision further complicated matters, considering that it was necessary to make the installation on a privately owned car with as little mutilation as possible.

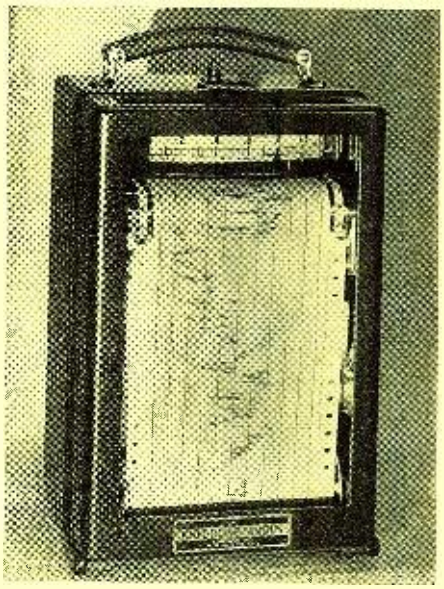
At first the logical support appeared to be the front or rear bumper of the car. However, it was decided the single support at the bottom of the antenna mast was not sufficient for the 10 foot pole and further the coupling drive for orientation could not be easily effected. Either side of the vehicle where the car radio whip antenna is usually mounted did not seem to offer any greater possibilities and presented a further disadvantage by allowing one half of the dipole to protrude outward from the car body with the hazard of striking high trucks, busses, trees, and other obstacles encountered in travel.

Cutting a hole through the roof of the car was out of the question.

The trunk in the rear proved to be the answer. The lid of the trunk was easily and quickly removed, being held by 4 screws in the hinges and 4 screws in the arms that hold the lid open. This particular car contained a substantial shelf in the trunk compartment upon which a gear box with a 20 to 1 ratio, purchased for a few dollars from a war surplus distributor, was mounted. A short length of 1¼ inch pipe was screwed into a coupling which was welded to the gear box, and a further support for this pipe was attached to the under side of the top of the trunk compartment.

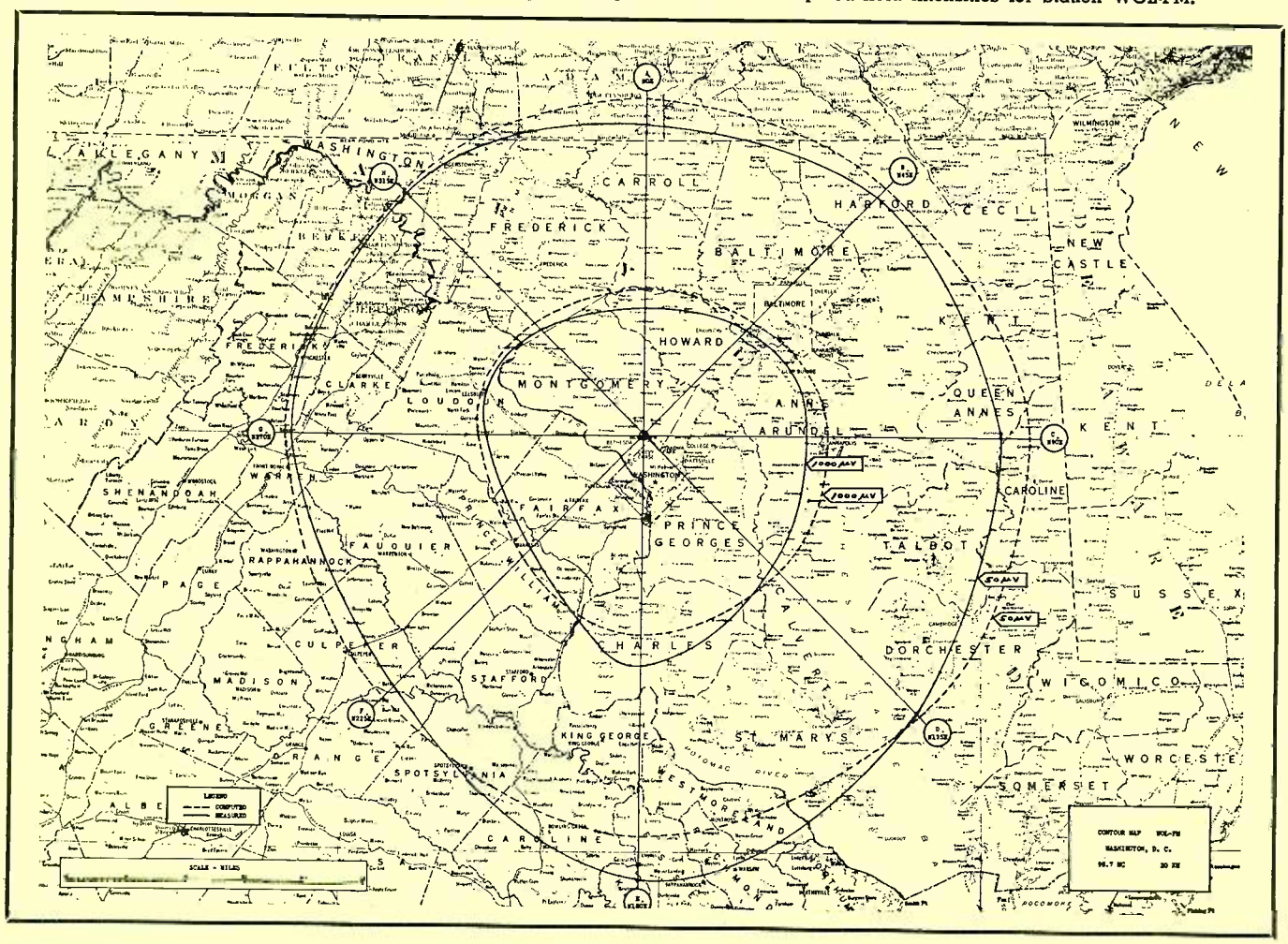
The dipole antenna which is supplied with the field strength meter includes 2 poles with a tee coupling to obtain either horizontal or vertical polarization. Using these 2 poles and coupling resulted in a height above ground of slightly less than the 10 feet the writer wished to achieve, so a longer pole was purchased from a local hardware store and substituted for the lower section. This 2 section mast could then be slipped into the short section of 1¼ inch pipe on the gear box. A 1½ inch long machine screw was inserted through the pipe and pole and a nut attached. This screw protruded far enough through the pipe to attach thereto a direction indicator which was made from a piece of copper tubing with a nut soldered to one end and the other end flattened to form a pointer which was painted white so it could be clearly seen through the rear window. The antenna must necessarily be easily and quickly removed because of low hanging tree branches and wires which may be encountered. In this case it was only necessary to loosen the thumb screw on the tee coupling and drop the upper half of the mast. The antenna arrangement may be seen in the photographs. The gear box is in the wooden housing on the trunk shelf.

A flexible shaft such as used for sanding discs, grinding wheels, etc. was connected to the gear box by means of the chuck on this shaft. The motor end of the shaft was fastened inside the car and a pulley was attached to which was bolted a handle for turning the antenna. The coaxial cable for the antenna goes through a hole, along with the flexible shaft, at the front part of the trunk compartment to the field meter inside the car. This arrangement resulted in a smoothly operating setup and the gear box held the antenna steady in any direction. It is necessary, of course, to adjust the length of the dipole for the frequency of the station. This may be calculated, or it may be ascertained from a curve supplied with the equipment. Also one of the poles



Esterline-Angus recorder of the type used to record field intensity along the various radials.

Contour map of Washington, D. C. and vicinity showing measured and computed field intensities for Station WOL-FM.



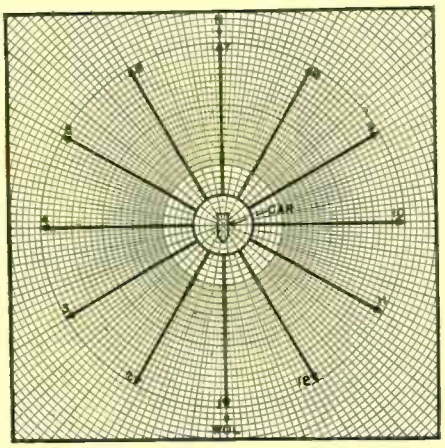


Fig. 1. Radials which were followed in making field intensity measurements.

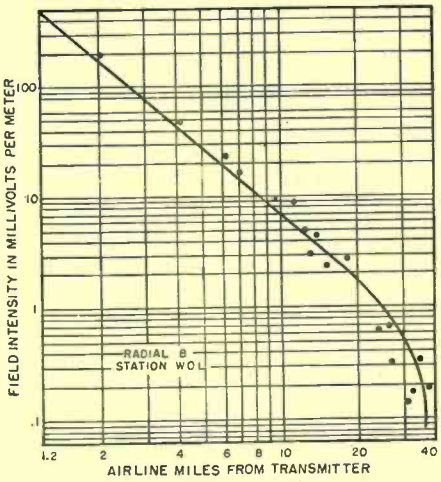


Fig. 2. Field intensity along radial B (Fig. 1) from Station WOL.

furnished has a scale engraved on it which is directly calibrated in megacycles.

Complete installation or removal of all equipment could be effected by the two engineers making the survey in just 15 minutes, including the removal or replacement of the trunk lid and license plate which was attached by two bolts with winged nuts to two small angle brackets placed on the car gravel plate.

The field intensity meter employed for these measurements was an *RCA* type WX-1A model made by the *Clarke Instrument Corp.* This equipment is furnished complete with two adjustable dipole antennas, a two section antenna mast with tee coupling for horizontal or vertical polarization, an adjustable tripod, coaxial antenna cable, and battery cable. Each half of the dipole may be folded parallel with the mast for easy adjustment and for transportation when not in use. The instrument contains a built-in vibrator power supply, permitting the use of a 6-volt storage battery as the power source. Output jacks are provided for direct connection to a standard 5 milliampere or 1 milliampere type graphic recorder. It also contains a built-in loudspeaker and audio amplifier for monitoring either AM or FM signals while measurements are being made. The frequency range of the meter is from 50 to 220 megacycles.

An *Esterline-Angus* graphic recording instrument was employed to continuously record the intensity of the transmitter output signal as the field car traveled away from the station. This instrument was a model A.W. d.c. milliammeter which is a 0-1 milliampere recorder. It contains a spring powered chart drive; however, for this work it is more satisfactory to operate the recorder from the speedometer drive shaft of the car. A photograph of the recorder with a section of the chart of Radial A of this survey on the instrument is presented through the courtesy of the *Esterline-Angus Co.* A model 110 mobile recording assembly, manufactured by the *Clarke Instrument Corp.* and distributed by *RCA* was used to drive the recorder. This assembly consists of a recorder drive, tee coupling box, and the required drive shafts.

To install this assembly the drive shaft is removed from the speedometer of the car and attached to the tee coupling box which was mounted on the fire wall of the car under the dash board. One of the drive shafts supplied connects from the tee box to the speedometer and the other one goes from the tee to the recorder drive which is mounted on the case of the graphic instrument. When this apparatus is properly installed it provides the necessary drive for the recorder chart and the chart speed with this assembly is 4 inches per mile. The recorder drive can be disengaged from the recorder by turning a knob on the side of the case. This is convenient when it is found necessary to back track on a radial run or when backing the car.

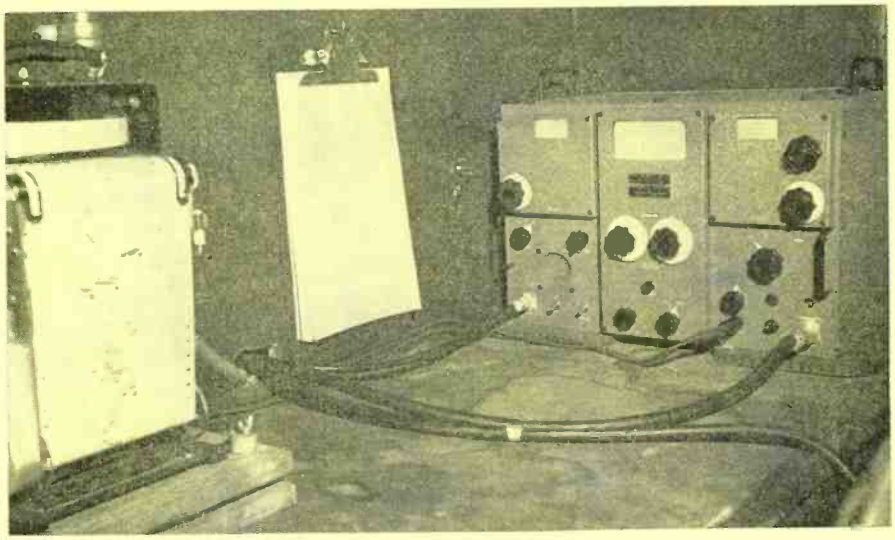
Sponge rubber pads were used in mounting the field meter and recorder between the car seats and wall of the trunk compartment. The flexible shaft for orienting the antenna was fastened to this wall. Winged nuts were used to secure all equipment for rapid installation and removal. There was enough room for an engineer to sit on an automobile cushion and operate the equipment and keep the log. This installation in the car interior is shown in the photographs, which together with the pictures of the antenna installation were taken by the author.

After all equipment was satisfactorily assembled in the car and several test runs made, it was necessary to correct the calibration of the field intensity meter due to the presence of the car body. The simplest procedure in determining the correction factor is to modify the antenna constant (K) given in the data sheets supplied by the manufacturer and which must be applied to the field intensity as read directly from the meter.

This instrument is supplied with frequency factor curves for each attenuator setting of the field meter. The result is based on the antenna being in free space as far as the dipole radiation resistance is concerned, and this K factor corrects for transmission line loss, r.f. attenuator setting, and frequency characteristic of the calibrating oscillator voltmeter.

To find the modified K constant required the field car was driven to a farm about 10 miles from the transmitter site. There on a level open field, over 500 feet from the nearest overhead wires, trees, buildings, and other obstructions, a compass rose was laid out by driving twelve wooden stakes into the ground in a circle, the stakes being 30 degrees apart. The car was then

Installations in the rear of the car include receiver and recorder.

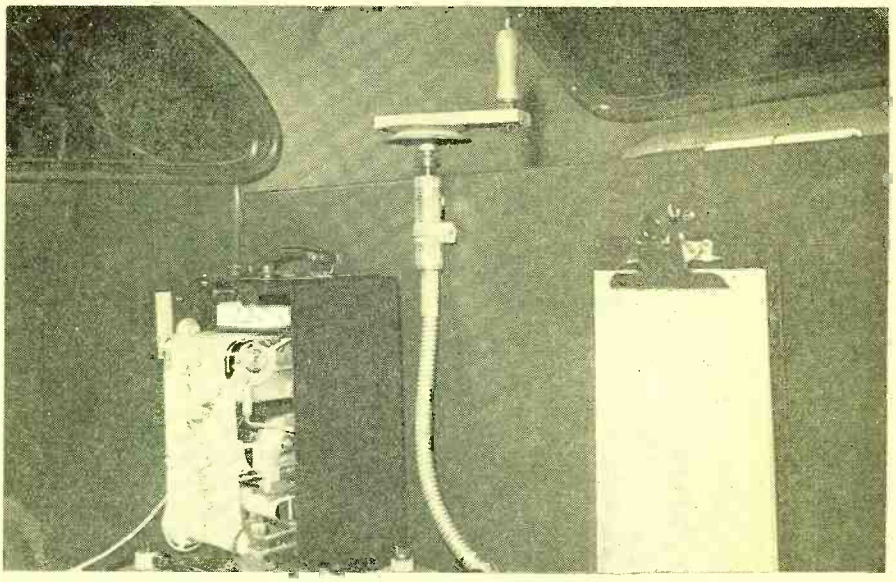


placed in the center of this circle and successively faced toward each stake and the field intensity reading for each of these positions carefully recorded. The dipole was in each instance properly oriented with respect to the transmitter while the car was rotated through the 360 degrees of the rose. It was carefully observed that each reading was taken under the same conditions except for the position of the vehicle. The car doors were closed and the engineers making the tests were inside the car when each reading was taken.

All apparatus was then removed from the car and set up on the ground with the antenna mounted on its tripod, 10 feet above ground and positioned in the center of the compass rose. The car was moved over 500 feet distant from the measuring location to prevent inaccurate measurement due to the car body. With the dipole oriented toward the transmitter the true field intensity reading was recorded.

The true field reading was found from the expression, $F = S \times K$, where F is the field intensity, S the scale reading of the meter, and K is the calibration constant for any given attenuator setting. This true field intensity was indicated as Ft. The field intensity reading for each position of the car in the compass rose was recorded as the apparent reading or Sa. Then K', the modified antenna constant, was obtained from the equation: $K' = Ft/Sa$. This ratio must be solved for each position of the car in the compass rose. The average of the K' values thus obtained is the correction factor to be applied. However, during this survey all measurements were made while following a radial in an outward direction from the transmitter site; therefore, the modified antenna constant used was the average of the K' values of positions 4, 5, 6, 7, 8, 9, and 10. See Fig. 1.

Two men were required to make the survey. One was assigned to drive the car, follow the plotted course, watch for low hanging tree branches and wires and assist with checking speedometer mileage readings. The other man operated the equipment and kept a detailed log.



Installation in rear of car showing hand crank for rotating antenna.

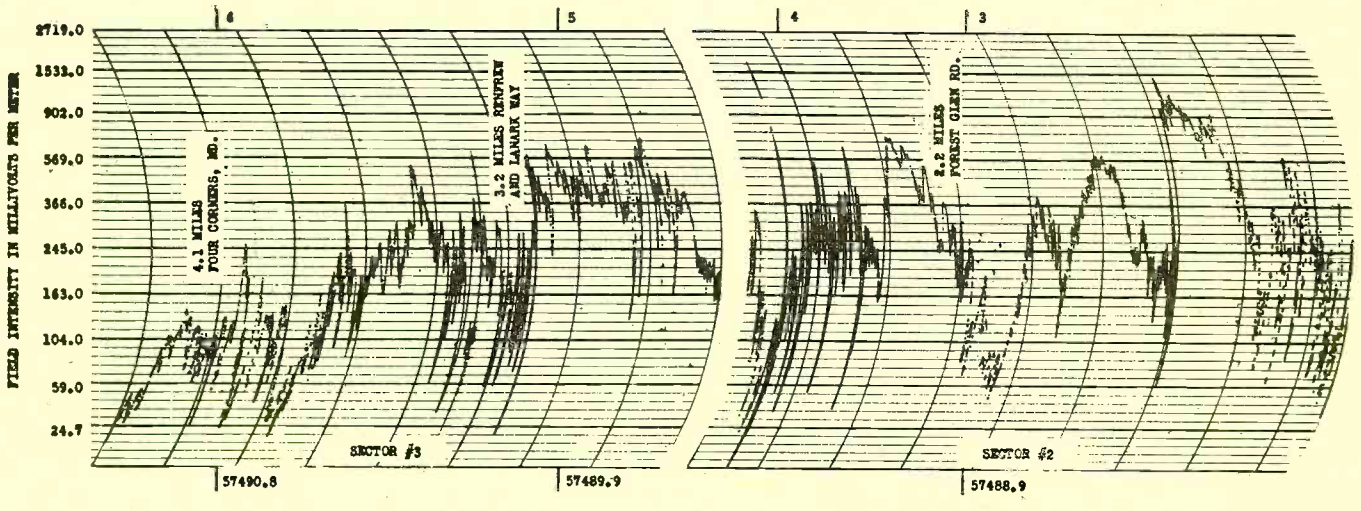
Before starting each radial run the route to be traveled was carefully planned. The FCC Standards state that measurements are to be made along roads which are as close and similar as possible to the radials which were submitted with the application for construction permit. These radials which were spaced 45 degrees apart around the transmitter site were drawn on road maps. Maps obtained from the American Automobile Association for the local area were found helpful in choosing streets and roads for the first half of the trip. Onion skin paper was placed over these maps and the radials and nearest roads thereto were traced on this paper. Street names, route numbers, and towns were shown. One copy was made for the driver and one for the operator of the antenna and field equipment. In accordance with FCC Standards measurements were made to a point on each radial well beyond the contour under investigation.

Accuracy of calibration of the field meter is maintained by a self-contained calibrating system. Calibration was checked at the start and several times during each radial run. The storage battery was in a fully charged condition at the beginning of each trip and the transmitter power output was held as constant as possible. The contents of the log included field intensities at frequent locations, identifying landmarks, car mileage, time of day, and comments.

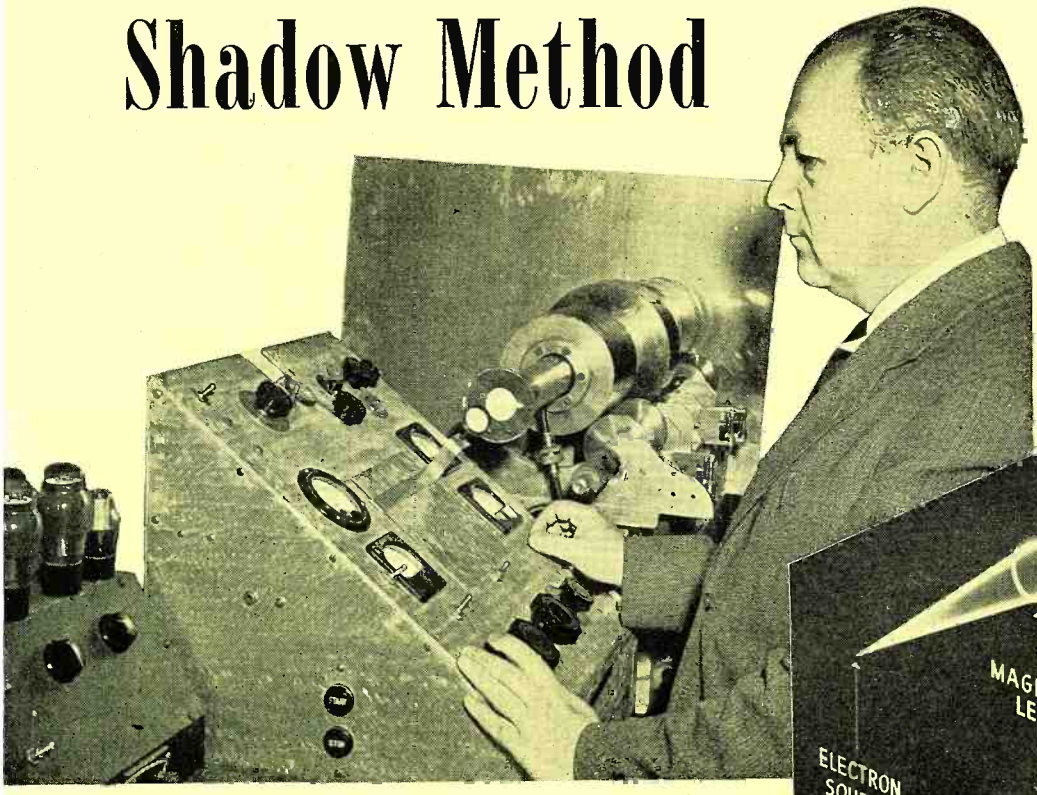
After all runs were completed the recording charts for each radial were divided into 15 or more sections as specified in the FCC Standards. Each section was numbered and analyzed to ascertain the median field intensity of the individual sectors. A section of the

(*Continued on page* 26)

Fig. 3. Sample portion of recording of field strength along radial B (Fig. 1).

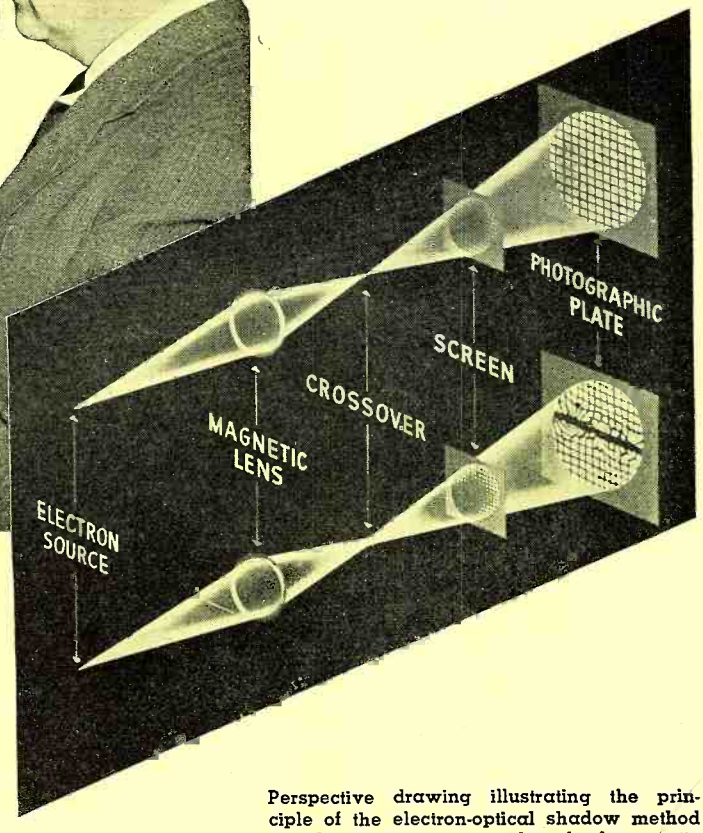


ELECTRON-OPTICAL Shadow Method



The magnetic lens system of this horizontal experimental electron microscope at the National Bureau of Standards was used to produce a visual representation of magnetic fields by means of the electron-optical shadow method. From the patterns thus obtained, field intensities may be computed. Dr. L. L. Marton of the Bureau staff, who designed the instrument, is shown at the control panel. Above and to the right of the panel the lens system ends in a circular fluorescent screen on which the electron beam converges to form an image.

A novel method developed at NBS for detecting and measuring very small electrostatic and magnetic fields.



Perspective drawing illustrating the principle of the electron-optical shadow method for the quantitative study of electrostatic and magnetic fields of extremely small dimensions. In this example, the new technique is used to explore the field of a ferromagnetic recording wire magnetized in evenly spaced short pulses. Above: conventional magnetic lens system. Below: the magnetic recording wire has been introduced between the electron source and the magnetic lens. From measurements of the distortion of the image, accurate values of the magnetic field intensity can be computed.

AS THE RESULT of a series of electron-microscope experiments at the National Bureau of Standards, Dr. L. L. Marton of the Bureau's electron physics laboratory has developed an electron-optical shadow technique[1] which provides a valuable tool for the quantitative study of electrostatic and magnetic fields of extremely small dimensions. The new method makes use of an electron lens system to produce a shadow image of a fine wire mesh placed in the path of the electron beam. From the distortion in the shadow network caused by deflection of the electrons as they pass through the field under study, accurate values of field strength are computed. Thus it is possible to investigate quantitatively fields that have not been susceptible to other methods of investigation, for example, the fringe fields from the small domains of spontaneous magnetization in ferromagnetic materials.

The new development, which is based on extensive theoretical analysis, should provide a powerful means for broadening present knowledge concerning space-charge fields, fields produced by contact potentials, patch fields in thermionic emission, charge distribution in a gaseous plasma, waveguide problems, and the basic magnetic properties of metals. Though similar in some respects to the electron-optical Schlieren method[2] previously developed at the Bureau, the shadow method is much better adapted to precise determinations of field intensity.

The principle of the shadow method was discovered in the course of a study of a recording wire magnetized in evenly spaced short pulses by means of a conventional magnetic recording head. In practice, the recording wire—or other object to be studied—is placed between an electron source and a system of electron lenses. The lens system focuses the electron beam to form an image of the wire on a fluorescent screen. By placing a wire mesh of known gage just beyond the back focus of the

1. *For more complete details see, "Electron Optical Observation of Magnetic Fields," by L. Marton and S. H. Lachenbruch, scheduled for publication in J. Research NBS 43, Oct. (1949) RP2033. See also, "Electron Optical Mapping of Electromagnetic Fields," by L. Marton and S. H. Lachenbruch, scheduled for publication in J. Ap. Phys. 20, Nov. 1949.*
2. *In the Schlieren method, a magnetic lens forms an image of a source of electrons on a small copper stop which intercepts all direct rays. If in the space between the electron source and the lens there is a variation of the index of refraction for electrons—in other words, a variation in electric or magnetic field intensity—an image of that inhomogeneity will then be produced by means of the same lens in a conjugate plane beyond the stop. Thus a dark-field image of the magnetic or electric field is obtained on a fluorescent screen or on a photographic plate. See "Electron-optical Schlieren effect," NBS Technical News Bulletin 32, 82 (1948).*

lens system, a shadow image of the mesh is superposed on the image of the wire. This shadow image is formed by projection from the virtual source provided by the reduced image of the source of electrons. The portions of the shadow network adjacent on the screen to magnetized regions of the recording wire are then found to show considerable distortion.

A complete theoretical analysis of this effect has shown that the distortion of the shadow image is due to the deflection of the electron beam by the field of the recording wire at each magnetized region. The result is a corresponding displacement of the reduced image of the electron source. This displaced image, acting as a virtual source, forms a shadow image, likewise displaced, of the network. Deflection of the beam may also change the distance of the virtual source from the wire, in which case the magnification of the displaced image is affected. Obviously, the displacement and change in size of the shadow image at any point depend on the strength of the field of the magnetized wire at a corresponding point.

Formulas have been derived by S. H. Lachenbruch of the Bureau staff which permit the calculation of consistent absolute values of field strength in magnetic or electric fields of various geometrics from experimental measurements of the position of the wire mesh, the displacement and magnification of its shadow image, and the known constants of the apparatus. The patterns obtained also provide a qualitative visual representation of minute electrostatic and magnetic fields. Although it is possible to compute field intensity from the intensity distribution of the pattern obtained by the Schlieren method, the shadow method is of far greater utility for quantitative work since the image displacement and magnification can be measured much more accurately than can the intensity distribution across the Schlieren pattern on a photographic plate.

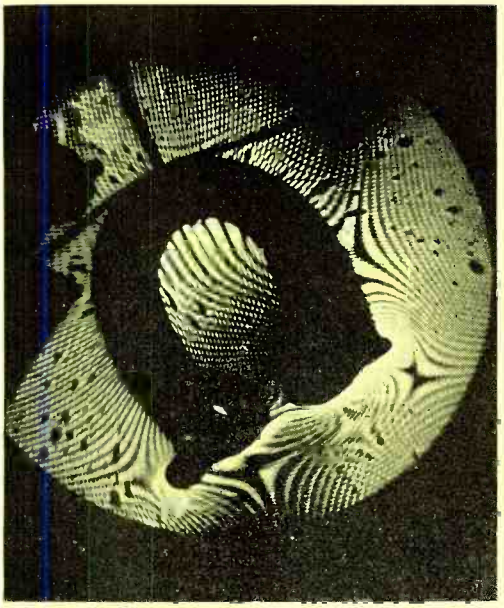
Perhaps the greatest value of the electron-optical shadow method lies in its utility for exploring complex electric and magnetic fields of extremely small dimensions or in which a probe of size greater than the electron would disturb the field under study. In the past, calculations of the field intensity at a point have been limited to those special cases in which the geometry of the field exhibits a high degree of symmetry. The shadow technique now provides data for accurate calculation of the absolute value of the intensity in the neighborhood of a specimen of any size or shape without altering or disturbing the field.

The method is thus well adapted to investigation of the fundamental nature of ferromagnetism. Experiments now under way at the National Bureau of Standards include a study of the behavior of the fringe fields of the ferromagnetic domains; in this work a single crystal of cobalt having very large magnetic domains is being used. An extension to ferroelectric materials is also contemplated for the purpose of checking the domain theory of these substances; of particular interest will be a study of the polarization of barium titanate and other high-dielectric materials which are now being widely used in the production of small-sized capacitors for radio, radar, and television.

In another application of the shadow method at the Bureau, space-charge fields in several types of apparatus employing electron beams are being investigated. In this connection, use of the method with a pulsed electron source for the stroboscopic study of fields that vary with time is under study.

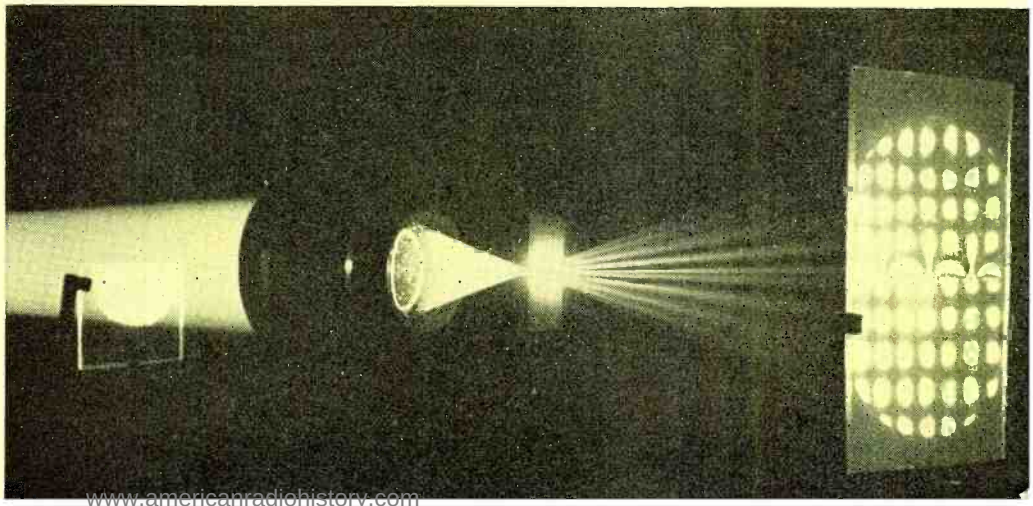
It has been suggested that the electron-optical shadow method may also be of value for the calculation of field intensities within a waveguide. Use of waveguides as conductors and circuit elements in ultra-high-frequency radar and communication often leads to arrangements whose geometry is too complicated for expression in any system of mathematical coordinates. Thus the electronics engineer, having in many cases only an intuitive picture of the field distribution at junctions and elbows of the guide, must rely on empirical methods in designing waveguide techniques and equipment. By the use of suitable auxiliary techniques, it is hoped that the shadow method may be adapted to the calculation of field intensities in regions of a guide that are not at present susceptible to analytical treatment.

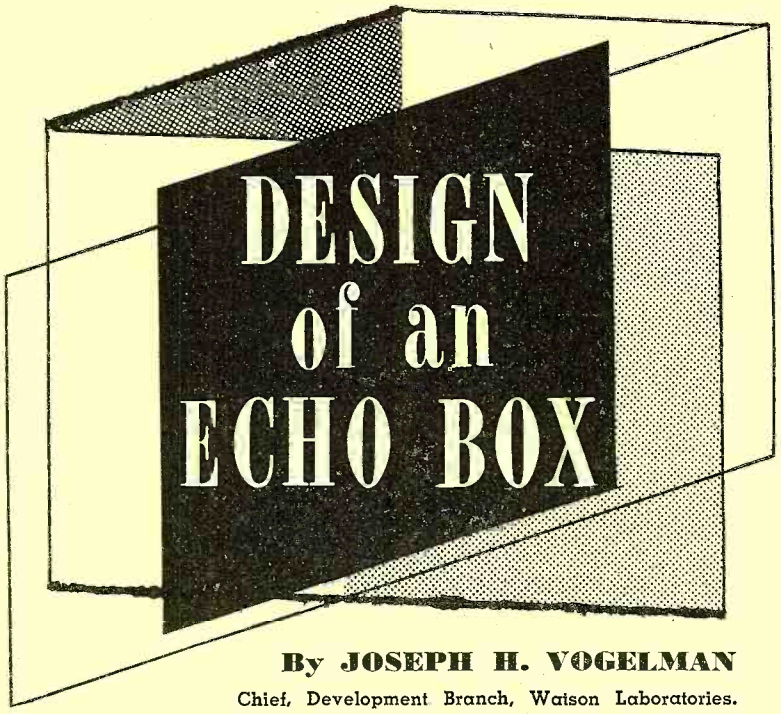
The Bureau is also applying the principle of the shadow technique to the study of spherical aberration in electron lenses. When a fine wire mesh is placed in the focal region of a lens having spherical aberration, the shadow image of the network is enlarged either centrally or at the periphery, depending on the position of the mesh and the nature of the lens error. The resultant pattern may thus be interpreted to give information of value in correcting the lens.



The magnetic field about a small horseshoe magnet, photographed by means of the new electron-optical shadow technique. Here the screen of an electron microscope shows the electron shadow of a fine wire mesh distorted by the deflection of the electrons as they pass through the field of the magnet. Total width of the magnet is about one-fourth inch.

The electron-optical shadow method is illustrated by means of an analogous experiment in light optics. Mounted lens system converges light from a distant source to form a reduced image of the source at a point just to the left of a wire screen. A magnified shadow image of the wire screen is formed on the ground-glass screen by projection from the reduced image. Here the lower half of the light beam is intercepted by a piece of plastic deformed along its edge in such a way as to deflect some of the light rays before they pass through the lens. The result is a distortion of the corresponding part of the shadow network. In the NBS method, the glass lens system is replaced by a magnetic lens, and the plastic is replaced by the magnetic or electrostatic field to be studied.





DESIGN of an ECHO BOX

By JOSEPH H. VOGELMAN
Chief, Development Branch, Watson Laboratories.

A highly accurate and adjustable echo box is essential in testing radar units. This box is tunable over the range 130-154 mc.

An echo box was required which would be tunable over the frequency band 130 to 154 megacycles per second, and capable of providing the operator of the radar system with a simple means of daily checking of performance of the system, without any interruption of its tactical operation. The quarter-wavelength coaxial echo box described herein was designed as the most feasible solution to the problem. The operation of the echo box and its application to the measurement of radar performance have been adequately covered in the literature[1] and will not be repeated.

The basic requirements for the echo box as set by the radar system for which it is intended are as follows:

Tuning Range—130 to 154 mc.

Decay Rate—Less than 1 db. per microsecond

Bandwidth of cavity—10 kc.

Level Difference between peak pulse power and receiver sensitivity at the echo box input—100 db.

To meet the decay rate requirement, the order of magnitude of the Q required is determined from the relation:

$$Q = \frac{27.3\,f}{d} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where f is in mc. and d is in db./μs. For 130 mc. this gives a Q of 3549, and for 154 mc., a Q of 4204.

To meet the bandpass requirement of 10 kc. the loaded Q required is determined from the relationship:

$$Q_L = \frac{f}{\Delta f} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

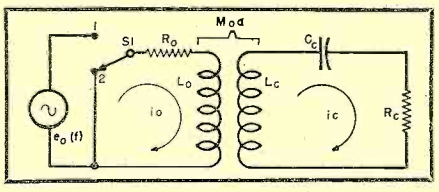
where f and Δf are in the same units. For 130 mc., Q_L is 13,000 and for 154 mc., Q_L is 15,400.

Since the Q requirement to meet the bandpass requirement is the greater, this value governs the design of echo box. Previous experience has shown that the loaded Q due to input and output coupling will have a ratio to unloaded Q of the order of 0.9. Further decreases in Q will result from the suppression of undesired modes and other compensation networks. To account for these losses, the unloaded Q for which the echo box will be designed is taken as 20,000.

For the purpose of this section the following symbols and dimensional units will be used:

a = inner conductor radius in cm.
b = outer conductor radius in cm.
f = frequency in mc.

Fig. 1. Equivalent circuit of echo box.



L = length of inner conductor in cm.
λ = free space wavelength in cm.
A = attenuation in db. per cm.
d = length of waveguide beyond cut-off attenuator in cm.

For a coaxial echo box, maximum Q is obtained when $b/a = 3.6$. Adding 25 per-cent to the Q to take care of short losses, the dimensions can be determined from the following relationship:

$$Q = \frac{302\,bf^{1/2}\ln b/a}{1 + b/a} \quad . \quad . \quad . \quad . \quad . \quad (3)$$

$$b = \frac{.0093\,Q}{f^{1/2}} = 25.4 \text{ cm.} \quad . \quad . \quad . \quad . \quad (4)$$

Then $a = 7.055$ cm.

For a satisfactory echo box it is necessary that modes other than the TEM be sufficiently below cut-off to prevent extraneous resonances or holes due to partial cancellations between TEM and a higher mode. To an accuracy of 7 per-cent the cut-off frequency for higher modes than TEM is found from the relationship:

$$\lambda = 2\pi\,\frac{b+a}{2} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (5)$$

which corresponds to a frequency of 293 mc. The frequency range 130 to 154 mc. is far enough below this value to insure that no higher modes will exist.

Where $a = 7.055$ cm. and $b = 25.4$ cm., the Q is 24,400 at 130 mc. and 26,500 for 154 mc.

These values of Q are calculated to include only the conductor loss but do not consider the short losses. For this preliminary calculation, the length of the center conductor for resonance will be taken as a quarter wavelength. The Q can be corrected for short loss by the relationship:[2]

$$Q' = \frac{\left(\frac{1}{2a} + \frac{1}{2b}\right)LQ}{\left(\frac{1}{2a} + \frac{1}{2b}\right)L + \ln\frac{b}{a}} \quad . \quad . \quad . \quad (6)$$

In making corrections for short loss, the shortening of the center conductor of the resonant line, due to the discontinuity capacity caused by termination of the inner conductor while the outer conductor is allowed to continue, is neglected for the present, to simplify the preliminary calculations. Under the above limitations the corrected Q's become 19,500 and 20,500 respectively for 130 mc. and 154 mc.

To determine the over-all length of the quarter-wavelength echo box, it is necessary to investigate the length of outer conductor required to give negligible reflection from the far end. The outer conductor beyond the termination of the center conductor acts as a waveguide beyond cut-off attenuator. If the length is such that a one-way attenua-

tion of at least 30 db. is obtained, the reflection from a short at the far end of the attenuator will be -60 db. or 0.1 per-cent in voltage. This value is sufficiently small to be neglected.

For the lowest mode TE $_{11}$ the attenuation of a cut-off attenuator is obtained from the relationship:[1]

$$A = \frac{16.0}{b}\sqrt{1-\left(\frac{3.42b}{\lambda}\right)^2} \quad . \quad . \quad (7)$$

For 130 mc. $A = .586$ db. per cm., and for 154 mc. $A = .565$ db. per cm.

The length required for 30 db. attenuation is obtained from the relationship $d = 30/A$. For 130 mc. this gives $d = 51.2$ cm. $= 20.2$ inches, and for 154 mc. $d = 53.0$ cm. $= 20.9$ inches. The total length required for the cavity $= \lambda/4 + d = 22.7 + 20.2 = 42.9$ inches.

The quarter-wavelength echo box would have an over-all length of 42.9 inches, a diameter of 20 inches and require a plunger movement of approximately 3.5 inches.

Tuning Mechanism

Whinnery, Jamieson and Robbins[2] have shown that for a coaxial line, where the outer conductor is below cut-off for all cylindrical waveguide modes and is of infinite length, the termination of the inner conductor results in a discontinuity capacity whose magnitude is a function of the inner and outer conductor diameters. For a coaxial line of $b/a = 3.6$ and $b = 25.4$ cm., the discontinuity capacity, $C_d = 3.57$ $\mu\mu$fd. is determined from the plot by Whinnery, Jamieson and Robbins of $C_d/2\pi b$ against b/a.

For a capacity loaded quarter-wavelength resonant line, the line length required for resonance is determined from the relationship:

$$\frac{L}{\lambda} = \frac{\tan^{-1}\left(\frac{1.59\times 10^5}{f\,c\,Z_0}\right)}{2\pi} \quad . \quad . \quad . \quad . \quad (8)$$

where f = frequency in mc.
c = capacity in $\mu\mu$fd. $= 3.57$
$Z_0 = 138 \log_{10} b/a = 76.77$ ohms
L = length of inner conductor in cm.
λ = free space wavelength $= 29979/f$

For $b/a = 3.6$:

$$\frac{L}{\lambda} = \frac{\tan^{-1}\left(\frac{580.08}{f}\right)}{360} \quad . \quad . \quad (9)$$

From (9) the length required for every megacycle has been calculated and will be found in Table III. The total center conductor displacement for the frequency band is 3.516 inches. If linear motion is assumed, displacement per megacycle is 0.146 inches. This may be closely approximated by a screw of seven threads per inch. If the plunger is adjusted to be correct at 136 mc. and the frequency indicating dial designed to read 1 megacycle per revolution with 100 division vernier, then the dial reading can be found from the relationship: Dial Reading =

$$136 + 7(18.516 - I) \quad . \quad . \quad . \quad (10)$$

The dial readings have been calculated and tabulated in Table III together with the error resulting from the use of a linear tuning dial. The actual frequency and the dial readings are plotted against plunger length in Fig. 2, and the frequency error against dial reading is plotted in Fig. 3. The tuning correction is engraved on the tuning dial every 0.1 mc. of correction to permit frequency accuracies of better than 0.1 megacycle per second. The tuning corrections are tabulated in Table II together with the frequency to which they correspond.

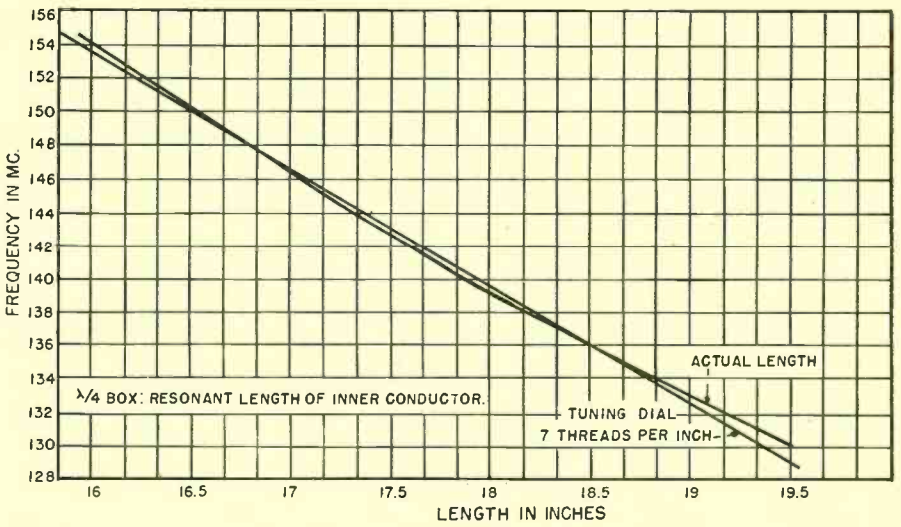


Fig. 2. Resonant length of inner conductor for quarter-wavelength box.

Compensation of Q

The resistance of a coaxial cavity having constant inner and outer conductor radii varies as the square root of the wavelength, and since the product ωL remains constant, the Q varies inversely as the square root of the wavelength or directly with the square root of the frequency as can be seen from Eqt. (3).

To achieve constant ringtime the Q must vary directly with frequency as can be seen from the ringtime equation.[2]

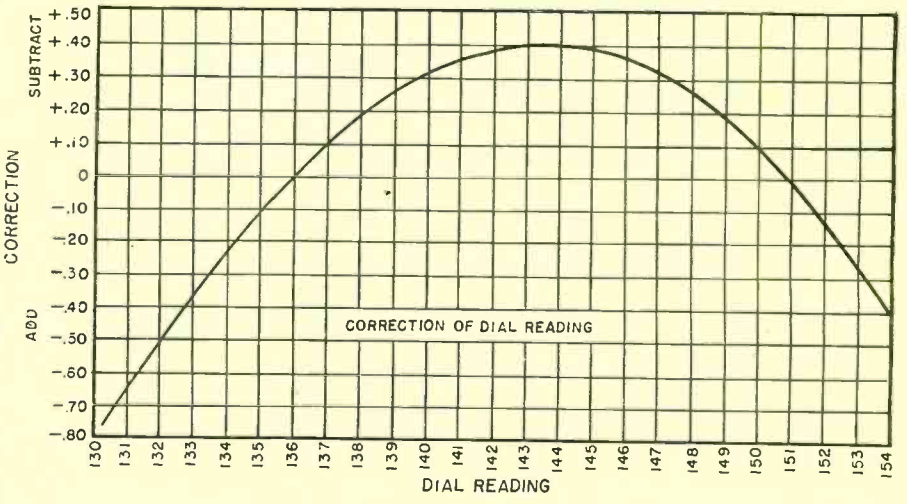
A loop placed in the vicinity of the end of the center post in the outer conductor should provide frequency sensitive loading which varies qualitatively in the proper manner to compensate the ringtime. The current in such a loop cannot be accurately solved with convenience, but it may be closely approximated as follows:

For the region up to the end of the center conductor the current is assumed to be distributed as in an ideal coaxial resonator, i.e.,

$$I = k\,I_0 \cos\frac{360\,d}{\lambda} \quad . \quad . \quad . \quad . \quad . \quad (11)$$

where d is distance from short, varying from 0 to L.

Fig. 3. Curve showing dial reading corrections in megacycles.



Freq In Mc.	R_o Inherent Resistance In Per-cent Normalized To 142 Mc.	R Desired Resistance In Per-cent Normalized To 142 Mc.	R_c Compensation Available in Per-cent Normalized To 142 Mc.	R_L Compensated Resistance In Per-cent $\frac{R_o+0.08R_c}{1.08}$	Relative Ringtime In Per-cent $\frac{R}{R_L}$	Reduction In Ringtime In Per-cent $\frac{1-R_o}{R_o+0.08R_c}$
130	104.51	109.23	167.220	109.15	100.07	11.34
135	102.55	105.19	137.512	105.14	100.05	9.69
140	100.71	101.43	110.243	101.41	100.02	8.05
142	100.00	100.00	100.00	100.00	100.00	7.41
145	98.96	97.93	85.616	97.97	99.96	6.47
150	97.29	94.67	63.807	94.81	99.85	4.99
154	96.02	92.21	51.763	92.91	99.25	4.31

Table I. Ringtime compensation-loop at 41.5 cm. from short. K=8.0%.

Dial Reading Corresponding To Correction	Frequency Correction In mc.
130.00	+0.80
130.65	+0.70
131.30	+0.60
132.00	+0.50
132.70	+0.40
133.40	+0.30
134.20	+0.20
135.05	+0.10
136.00	0.00
137.00	−0.10
138.10	−0.20
139.70	−0.30
143.40	−0.40
147.40	−0.30
148.90	−0.20
150.00	−0.10
151.00	0.00
51.80	+0.10
152.60	+0.20
153.30	+0.30
153.95	+0.40

Table II. Dial reading corrections.

L = length of inner conductor

λ = wavelength in free space

I_o = current at $d = 0$ is constant for compensated echo box

k = coupling coefficient

For the region beyond the end of the center conductor, the current is assumed to fall off with distance as in a waveguide below cutoff, excited in the $TM_{0,1}$ mode (the mode excited by an end probe in a cylindrical guide).

$$I = k I_o \cos\left(\frac{360\,L}{\lambda}\right) e^{-\frac{2\pi d'}{\lambda_c}} \quad . \quad (12)$$

where λ_c for $TM_{0,1}$ mode $= \dfrac{2.405}{2\pi b}$

$$d' = d - L$$

$$b = 25.4 \text{ cm.}$$

$$I = k I_o \cos\left(\frac{360\,L}{\lambda}\right) 10^{-\frac{(d-L)}{25.4}} \quad (13)$$

The introduction of the loop into the cavity introduces resistance so that the problem can best be treated by dealing with resistances normalized to the cavity shunt resistance at 142 mc. The equivalent resistance introduced by the loop is proportional to the square of the current as given by Eqts. (11) and (13). The resistance loading at the loop will be taken as equal to the cavity shunt resistance at 142 mc. and the coupling varied to give the proper compensation.

By trial and error the best position of the loop and the optimum coupling was determined to be as follows:

a. Loop at 41.5 cm. from short

b. Coupling $k = 8.0\%$

Table III is a compilation of the data showing the inherent resistance, desired resistance, compensation available, compensated resistance, relative ringtime, and reduction in ringtime as a result of compensation, all normalized to 142 mc. as determined from Eqts. (13) and (15) and the corresponding values of λ and L from Table III. By means of loop compensation it has been possible to reduce the variation of ringtime with frequency to less than 1 per-cent. Knowing the reduction in ringtime due to compensation, the loop coupling can simply be adjusted experimentally by inserting it to such a depth as to cause the echo box under test to produce a ringtime less by the specified reduction percentage than the ringtime without the compensating loop. This adjustment at 142 mc. and a recheck at another frequency is all that would be required in production testing.

It has been found desirable to adjust all echo boxes of a single type to have ringtimes within 1 per-cent under identical conditions, so that measurements made with one echo box could be duplicated with another echo box. The simplest method found to accomplish this is to insert a frequency insensitive loop close to the short in the outer wall of the cavity. In the first production run a box of average ringtime is selected as the standard and the loop in it is adjusted to decrease the ringtime 2 to 3 per-cent. Thereafter all other echo boxes are compared to the standard and the insertion of their standardizing loops are experimentally adjusted to give the same ringtime as the standard. A loop identical to the input loop but with variable insertion has been found satisfactory for this application.

Table III. Resonant length of inner conductor, dial reading, and error.

Freq in mc.	λ in Centimeters	$\frac{L}{\lambda}$	L in Centimeters	L in Inches	Dial Reading in mc.	Error in mc.
130	230.61	.21491	49.560	19.511	129.03	−0.97
131	228.85	.21465	49.122	19.339	130.24	−0.76
132	227.12	.21439	48.692	19.170	131.42	−0.58
133	225.41	.21413	48.267	19.003	132.59	−0.41
134	223.73	.21388	47.851	18.839	133.74	−0.26
135	222.07	.21361	47.436	18.675	134.89	−0.11
136	220.44	.21335	47.031	18.516	136.00	0.00
137	218.83	.21309	46.630	18.358	137.11	+0.11
138	217.24	.21280	46.229	18.200	138.21	+0.21
139	215.68	.21257	45.847	18.050	139.26	+0.26
140	214.14	.21231	45.464	17.899	140.32	+0.32
141	212.62	.21205	45.086	17.750	141.36	+0.36
142	211.12	.21179	44.713	17.604	142.38	+0.38
143	209.65	.21153	44.347	17.459	143.40	+0.40
144	208.19	.21128	43.986	17.317	144.39	+0.39
145	206.76	.21101	43.628	17.177	145.37	+0.37
146	205.34	.21076	43.277	17.038	146.35	+0.35
147	203.94	.21050	42.929	16.901	147.31	+0.31
148	202.56	.21024	42.586	16.766	148.25	+0.25
149	201.21	.20998	42.250	16.634	149.17	+0.17
150	199.86	.20973	41.917	16.503	150.09	+0.09
151	198.54	.20947	41.588	16.373	151.00	0.00
152	197.23	.20921	41.262	16.245	151.90	−0.10
153	195.95	.20896	40.946	16.120	152.77	−0.23
154	194.67	.20870	40.628	15.995	153.65	−0.35

Ringtime

To determine the ringtime obtainable from the echo box it is necessary to know the theoretical unloaded Q, identified as Q'. This can be found from:[2]

$$Q' = \frac{386.84\, f^{1/2}}{\frac{1}{a}+\frac{1}{b}+\left(\frac{2.575}{L+(\lambda/15.57)\sin(720L/\lambda)}\right)} \quad . \quad . \quad . \quad . \quad . \quad . \quad (14)$$

For $a = 7.055$ cm., $b = 50.8$ cm., and values of f, L, and L/λ from Table III, Q' can be calculated.

For 130 mc. $Q' = 19{,}600$

" 142 mc. $Q' = 20{,}000$

" 154 mc. $Q' = 20{,}480$

The ringtime without compensation can be found from the following equation:

(*Continued on page* 31)

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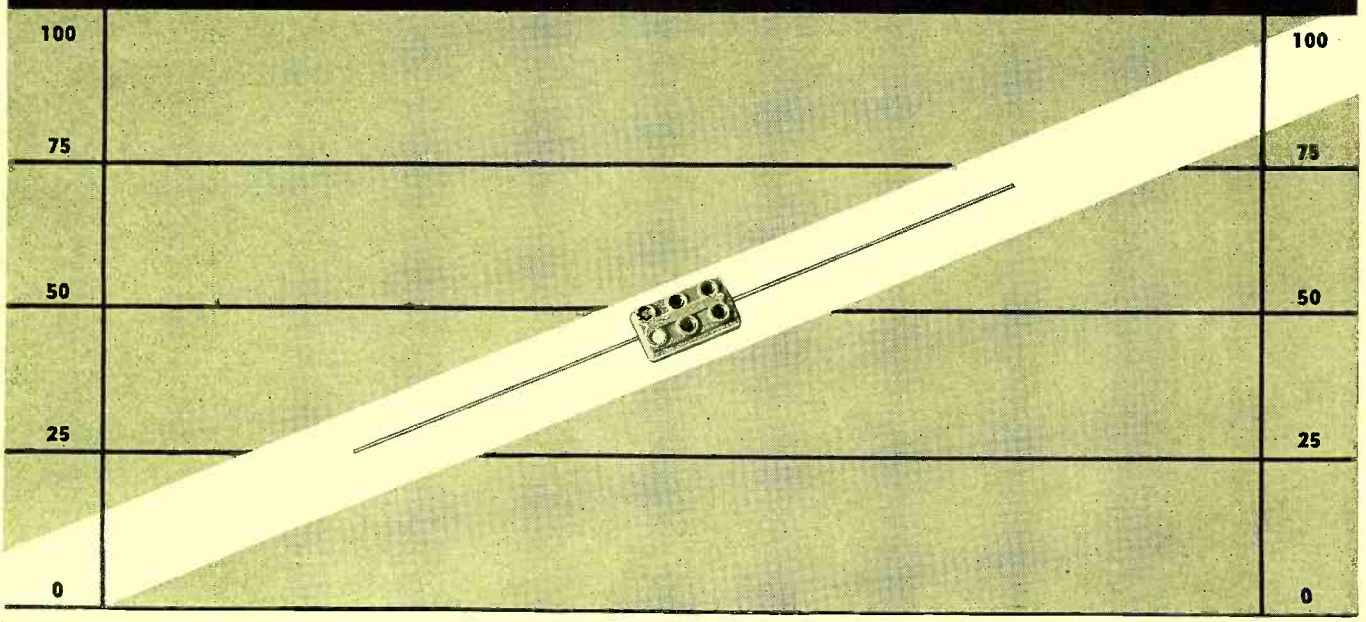

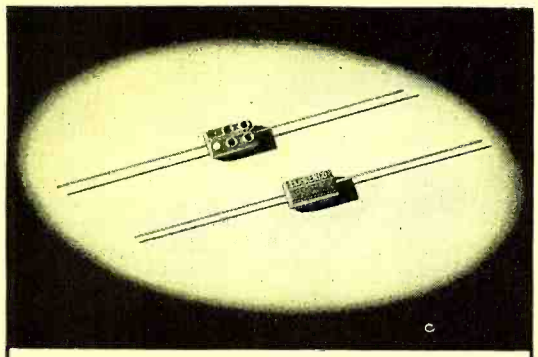

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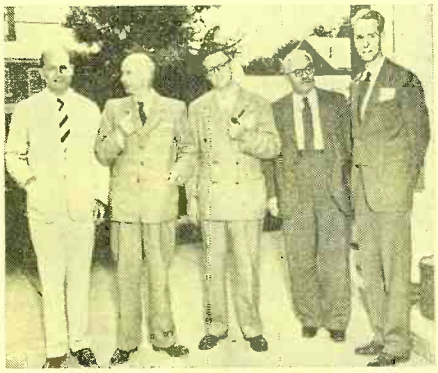
NEWS BRIEFS

SCIENTISTS DISCUSS POWDER METALLURGY

The physics of powdered metals was the subject of a Symposium arranged by Walter E. Kingston of the Metallurgical Laboratories of *Sylvania Electric Products Inc.*, Bayside, New York recently.

Among the outstanding authorities who participated and are shown below, left to right, were Dr. Morris Cohen of



the Massachusetts Institute of Technology; Dr. G. F. Huettig of the University of Graz, Austria; Walter E. Kingston, chairman of the Symposium and manager of *Sylvania's* Metallurgical Laboratories; Dr. Adolf Smekal of the University of Darmstadt, Germany; and Dr. A. J. Shaler of the Massachusetts Institute of Technology.

More than 125 attended the three day sessions which were held in the Post Theatre, Fort Totten at Bayside.

OSBORNE TO HEAD USNC

Dr. H. S. Osborne, Chief engineer of the *American Telephone and Telegraph Company*, has been elected by the United States National Committee of the International Electrotechnical Commission to serve as its chairman for the coming year.

Other officers elected were Vice-Presidents: P. H. Chase, chief engineer, *Philadelphia Electric Co.;* Frank Thornton, Jr., engineering manager, association activities, *Westinghouse Electric Corp.;* Treasurer, G. F. Hussey, Jr., (Vice-Admiral, USN, Ret.), secretary American Standards Association.

Through the USNC, the electrical groups in the United States take part in international work on standards in the electrical field, working with the national committees of 26 other countries that are members of the International Electrotechnical Commission.

NEW QUARTERS FOR V&V

Voice and Vision, Inc., Chicago, designers and installers of built-in television and radio equipment for the home, have moved into their new quarters at 314 North Michigan Avenue.

According to Dr. R. E. Samuelson, President, the expanded facilities will enable the firm to better handle the increasing demand for integrating sight and sound with modern architecture and interior decoration.

WESTINGHOUSE FORMS SPECIAL PRODUCTS DIVISION

A Special Products Development Division that will bring new products from the research to the commercial production stage and will handle special military developments has been formed by *Westinghouse Electric Corporation,*

Pittsburgh, Pa. The Division will be managed by Frank W. Godsey, Jr., who formerly directed the New Products Department, now absorbed by the new division.

In addition to conducting market surveys and recommending action on new product lines, the Division will carry on "pilot plant" work on new products. Such special military projects now under way include work on guided missiles, aircraft armament systems, and new weapons for Navy ships.

GE TV TUBE PRODUCTION

Production of 8½-inch metal television picture tubes has been started by the *General Electric Company* at its Electronics Park plant at Syracuse,

N. Y. The new size tube gives 50 percent more picture area than the seven-inch tube now used in low-priced receivers.

To house the new Syracuse tube facilities which will be in addition to its picture tube operation at Buffalo, N. Y., the company is converting and adding to an existing building. When completed later this year, the building will have 15,000 square feet of manufacturing space in addition to engineering and office areas.

NATIONAL MOLDITE EXPANDS

Expanded facilities now available for the production of molded iron cores has been announced with the erection of *National Moldite Company's* new plant at 1410 Chestnut Avenue, Hillside, N. J.

The announcement came from Sales Manager Sidney Lowenberg who states that newly developed, modern machinery in the powder and mixing rooms will increase the efficiency of production operations. A new division completely equipped for the production of molded coil forms has been installed.

TWO SCIENTISTS RECEIVE AWARDS

Dr. John W. Mauchly, physicist, and J. Presper Eckert, Jr., electronic engineer, of Philadelphia who have developed UNIVAC, the electronic computing machine used by the U. S. Census Bureau in compiling 1950 census information, have received the coveted Howard N. Potts Medals.

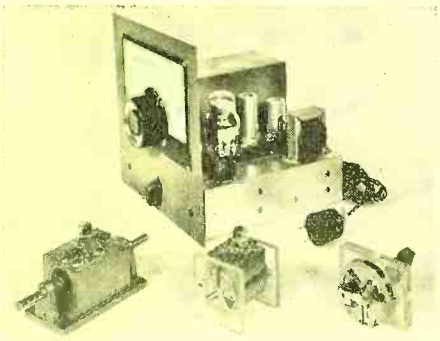
Awarded by the Franklin Institute, Philadelphia, the medals were presented to the two scientists for their work in the design and construction of the

world's first large-scale, general purpose, digital electronic computing machine which is known as ENIAC. These partners also developed and built BINAC, and formulated the basic plans and suggested the general design for EDVAC, the electronic computer developed by the University of Pennsylvania.

CONVERTER FOR UHF TV

A program of development of u.h.f. television converter units has recently been carried out by Stanford Research Institute's Department of Electrical Engineering under the sponsorship of John H. Poole of Long Beach, California.

The project has consisted of two parts, the first being the development of an inexpensive fixed-tuned converter which adapts existing sets to receive experimental u.h.f. broadcasts from Mr. Poole's station, KMZXAZ, which is now under construction.



The second phase of the program has consisted of investigating circuits and techniques by means of which partial or entire coverage of the 475-890 megacycle band may be attained.

COLOR TELEVISION COMMITTEE

The National Bureau of Standards has organized a Color Television Committee, at the request of Senator Edwin Johnson of Colorado, for the purpose of surveying the present status and future prospects of color television. The Committee will confine its attention to the scientific and technical phases of the problem and will present a report to Senator Johnson in his capacity as chairman of the Senate Committee on Interstate and Foreign Commerce.

The membership of the NBS Color Television Committee is as follows: E. U. Condon, Dir. NBS, Chairman; Newbern Smith, Chief, Central Radio Propagation Laboratory, NBS, Vice-Chairman; Stuart L. Bailey, Consulting Engineer of Washington, D.C. and President of IRE; W. L. Everitt, Dean, College of Engineering, University of Illinois; and Donald G. Fink, Editor, *Electronics*.

FREQUENCY MONITORING SYSTEM

A frequency monitoring system has been devised by R. E. Gould and H. A. Bowman of the National Bureau of Standards by which any Bureau laboratory may obtain the proper correction to be applied to a commercial interval timer driven by the city power line.

The system, which depends on a frequency error indicator, also designed at the Bureau, is simple and straight-forward in application. The cumulative error, arising from variations in the frequency of a commercial electric power supply used to drive the interval timer, is obtained over the period of observation by comparing the speeds of the two small black

(*Continued on page* 28)

NEW TUBES

TELEVISION TUBE

Raytheon Manufacturing Company's new Cathode Ray Tube Division at Newton, Mass., is now producing an 8½" television picture tube which is interchangeable with their standard 7JP4.

The new Raytheon 8BP4 at the right alongside their type 7JP4 (left) is said to offer an increase in useful screen area of approximately 50%.

Sales to set manufacturers in the East are being handled by E. Kohler

with headquarters at 50 Broadway, New York City, while sales to Mid-Western manufacturers are being handled by C. R. Hammond at 445 Lake Shore Drive, Chicago, Illinois.

SYLVANIA TUBES

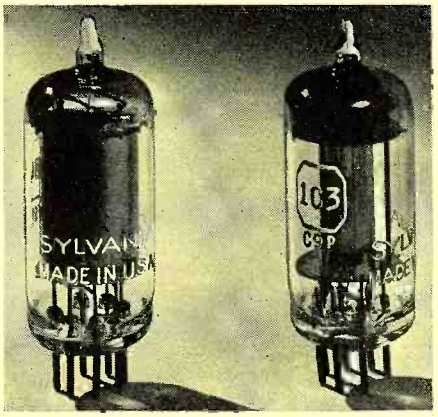
Noise Diode

A noise generating diode suitable for measurements at frequencies up to 500 megacycles has been announced by *Sylvania Electric Products, Inc.*, 500 Fifth Ave., New York City. The new T 5½ tube, type 5722, is designed for

standard laboratory measurement and is operated with 150 volts on plate and at filament voltages ranging between 2 and 5.5 volts depending on desired plate current or noise output.

Miniature Electron Tubes

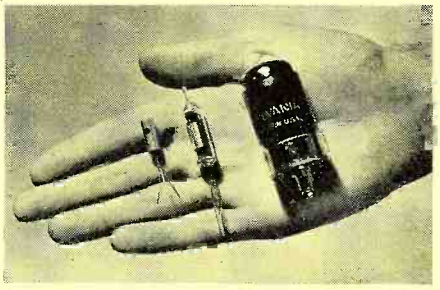
A T 5½ pentode power amplifier type 1W4 and a T 5½ triode amplifier or oscillator type 1C3 have also been announced. Both tubes are designed for



battery operation and have 1.4 volt d.c. filaments requiring only 50 milliamperes. Rated power output of the 1W4 pentode is 35 milliwatts with 45 volts on the plate and 200 milliwatts with 90 volts. The 1C3 general purpose triode is designed for 90 volts operation. This tube has an amplification factor of 14.5.

Miniature Crystal Mixer

Sylvania, Inc., is also showing the increasing possibilities of miniaturization in radio circuits.



Shown are mixer tubes of the standard and subminiature types together with a laboratory model of a four-terminal germanium crystal mixer.

CATHODE RAY TUBE

A multiple-intensifier-type cathode ray tube featuring a highly sensitive vertical-deflection system is announced by *Allen B. Du Mont Laboratories, Inc.*, 1000 Main Ave., Clifton, N. J. Potentials of the Type 5XP- as low as 24 to 36 volts peak-to-peak are sufficient for one inch vertical deflection on the screen.

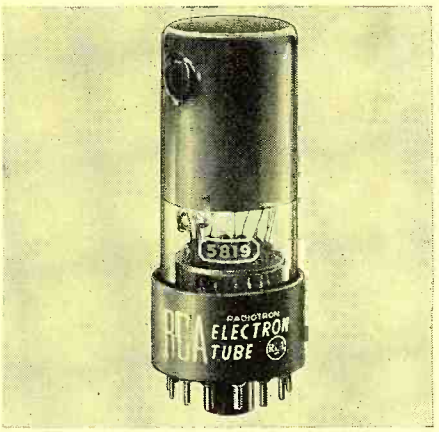
Of the many features of this 5XP- is the satisfactory operation at high ratios of E_{b3} to E_{b2} voltages and this ratio may go as high as 10:1. A shield placed between deflection-plate pairs D_1-D_2 and D_3-D_4 prevents interaction between plate pairs. At present the Type 5XP- is available with a choice of phosphors including P1, P2, P4, P5, P7, P11, screens.

The Instrument Division will furnish additional information upon request.

RCA TUBES

Multiplier Phototube

The *RCA* head-on, multiplier phototube 5819 is intended for use in scintillation counters for the detection and measurement of nuclear particle radiation, and in other applications involving low-level, large-area light sources. It



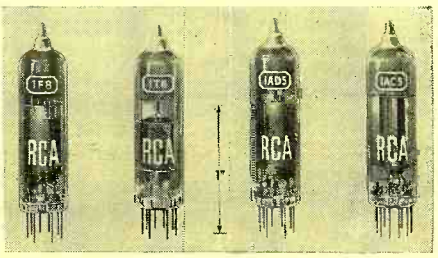
has high sensitivity to blue-rich light and negligible sensitivity to infrared radiation.

An outstanding feature of the 5819 is its semi-transparent photocathode which has a diameter of 1½ inches and an area of 1.8 square inches. This relatively large cathode area permits efficient collection of light from large-area light sources, such as are encountered in scintillation counters.

Subminiature Line

A line of subminiature tubes consisting of four types is being offered to equipment designers by the Tube Department at Harrison, N. J.

The four types are: a power pentode 1AC5, a pentagrid converter 1E8, a



sharp-cutoff pentode 1AD5, and a diode-pentode 1T6. These tubes have a seated length of 1½" and a diameter only slightly greater than ⅜" and are con-

(*Continued on page* 28)

TECHNICAL BOOKS

"ELECTRICAL TRANSMISSION OF POWER AND SIGNALS", by E. W. Kimbark. Published by *John Wiley & Sons, Inc.*, 440 Fourth Avenue, New York 16, N. Y. 461 pages. $6.00.

This first textbook to apply transmission-line theory to all three fields of power, telephone, and ultrahigh-frequency transmission, is rigorous and authoritative in its presentation. The theory is given in three main parts: transmission-line parameters, steady-state phenomena, and transient phenomena.

Transmission-line (hyperbolic function) charts; and tables and graphs of the characteristics of power-line conductors, power transmission and distribution lines, telephone lines and cables, submarine telegraph cables, and radio-frequency lines are included.

An extremely useful reference book for professional engineers, its greatest value will be found in electrical transmission courses, particularly those on general theory with a range from direct current to microwaves.

"ELECTRIC AND MAGNETIC FIELDS", Third Edition, by Stephen S. Atwood. Published by *John Wiley & Sons, Inc.*, 440 Fourth Ave., New York 16, N. Y. 475 pages. $5.50.

Written to provide a smooth transition from the study of mathematics, mechanics, and physics to advanced professional-level electrical engineering, this book offers fundamental field theory in simple mathematical terms.

In this third edition the author has divided the book into four parts: the electric field, the magnetic field, the ferromagnetic field, and the fourth part treats, in an elementary manner, the interactions between electric and magnetic fields.

Practice in expressing simple physical ideas in simple mathematical language is presented as is practice in the methods of "field mapping". A large number of drawings give the correct shapes to the lines of flux and the equipotential surfaces. Formulas throughout have been recast in the rationalized M. K. S. system.

"TRANSFORMATION CALCULUS AND ELECTRICAL TRANSIENTS", by Dr. Stanford Goldman. Published by *Prentice-Hall, Inc.*, 70 Fifth Avenue, New York 11, New York. 439 pages. $8.35.

Dr. Stanford Goldman, currently professor of electrical engineering at Syracuse University and consulting physicist to the United States Air Force, has written this thorough, modern and practical discussion of transients.

Included among the many features of this book are simple solutions to many problems previously considered complicated, such as the Nyquist criterion for stability, and the relation between amplitude and phase characteristics. The Laplace Transformation and the method of contour integration in the solution of transient problems is given thorough treatment. Asymptotic solutions of electrical problems is handled systematically, and all mathematics beyond calculus is developed in detail in the book.

Dr. Goldman's principal aim in presenting this volume is to develop the methods of the Laplace transformation and its inverse for the solution of problems in electrical circuit transients.

"MICRO-WAVES AND WAVE GUIDES", by H. M. Barlow. Published by *Dover Publication, Inc.*, 1780 Broadway, New York 19, N. Y. 122 pages. $1.95.

To meet the need of a large group of engineers and physicists for a complete exposition of the subject of microwave techniques, Professor Barlow of the Electrical Engineering Department of University College, London, has included in his book all the essentials for an advanced understanding.

A physical picture of wave-guide modes, synthesized from constituent plane waves in association with ordinary transmission line elements, is presented in this helpful volume. The mathematical analysis is comparatively straightforward, lending itself to profitable comparison in some respects with ordinary transmission line theory. The coaxial cable, representing as it does the common meeting ground of wave-guide modes and the simple transverse electromagnetic wave, is thoroughly discussed.

The measurements and applications of microwaves are given to furnish the reader with an appreciation and knowledge of the methods adopted in actual practice.

A co-ordinate system has been chosen to define the components of the electric and magnetic fields. The M. K. S. system of units has been used throughout and as far as possible the symbols employed are those generally accepted for the purpose. The usual convention has been employed in the graphical presentation of the electromagnetic field as lines of force.

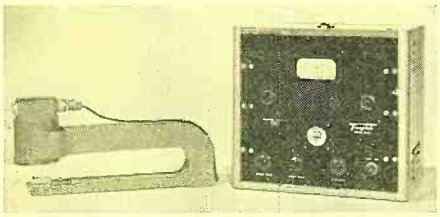
Engineers and physicists will find this volume a complete survey of this important field.

NEW PRODUCTS

BETA GAUGE

The second of a series of industrial measuring and control instruments using radioactive isotopes currently under development at *Tracerlab, Inc.*, 130 High St., Boston, Massachusetts is the SM-3 Beta Gauge.

The essential components of the gauge are a source of beta radiation from Strontium-90 and a radiation detector. One of the outstanding advan-

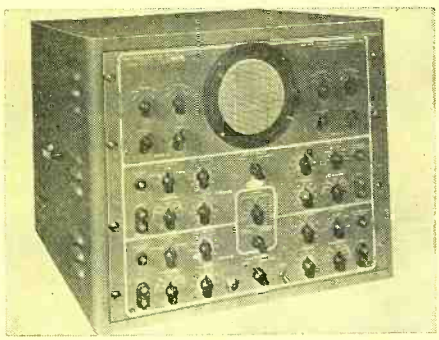


tages of the instrument is the fact that no physical contact is made with the material being measured. The sheet material to be measured is interposed between the source and the detector and a part of the radiation is absorbed by the sheet material in proportion to its weight per unit area.

A few typical uses of the *Tracerlab* Beta Gauge are measuring cellophane and other thin plastic films, plastic and rubber sheets up to 3/16" thick, paper ranging from heavy board to extremely thin condenser paper less than .0002" thick and sheet metal including steel and brass up to .040" thick.

CATHODE-RAY INDICATOR

The Special Products Section of *Allen B. DuMont Laboratories, Inc.*, 1000 Main Avenue, Clifton, New Jersey has



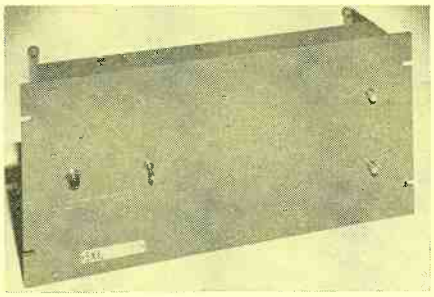
developed a new Four-Beam Cathode-ray Indicator which is capable of displaying simultaneously four related or unrelated, independent phenomena on a single cathode-ray tube screen.

The indicator is similar externally to the *DuMont* Type 279 Dual-Beam Cathode-ray Oscillograph, but is equipped with the specially designed *DuMont* Type K1027P11 Cathode-ray Tube, which contains four independent electron guns, rather than the Type 5SP-Dual-Beam Cathode-ray Tube used in the *DuMont* Type 279.

Details concerning the facilities of the Special Products Section may be obtained by writing the Instrument Division.

WIDE BAND CHAIN AMPLIFIER

Spencer-Kennedy Laboratories, Inc., 186 Massachusetts Avenue, Cambridge 39, Massachusetts has added to its line of traveling wave amplifiers the Model 204 Wide-Band Chain Amplifier for use



in the general laboratory measurements field as well as in nuclear physics and television testing.

The instrument has a bandwidth of 200 megacycles and a gain of 40 db. With an impedance of only 200 ohms, and a nominal transmission characteristic of ± 1.5 db. from 100 kc. to 200 mc., the amplifier has a substantially linear phase shift.

Further information may be obtained by writing to Department RT.

MOBILE COMMUNICATION EQUIPMENT

A highly-selective two-way mobile communication system for operation in the 3-50 megacycle portion of the frequency spectrum has been announced by the Communications Section of the *RCA* Engineering Products Dept., Camden, N. J.

The Fleetfone, a companion system to the recently announced Carfone mobile equipment, is available in three models to meet individual needs. For operation from a 6-volt battery, the Fleetfone is available with either 30 or 60-watt output. In addition, there is a 30-watt model which operates from a 12-volt battery.

This unit is completely contained in a single metal-shielded unit which permits mounting the equipment in practically any position, on either a horizontal or a vertical surface. The controls and loudspeaker are combined in a single compact unit for attachment under the dashboard. This unit is now available from either the Communications Section of *RCA*, or from local field representatives.

TUNING FORK RESONATORS

Temperature-compensated tuning fork resonators are available in frequencies from 1000 to 3000 c.p.s. and in

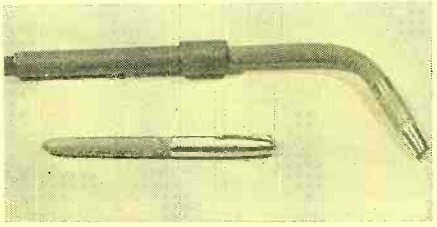
accuracies from 1 part in 3000 to 1 part in 100,000 from *Philamon Laboratories*, 5717 Third Avenue, Brooklyn 20, N. Y.

These tuning forks are provided complete with their drive and pickup coils mounted in solder-sealed evacuated steel cans and are thoroughly aged for maximum stability of operation. They are available as individual components, as a part of sub-assemblies, or in completed equipment.

MINIATURE INERT-ARC ELECTRODE HOLDER

General Electric's Welding Division, Schenectady, N. Y., has announced a miniature Inert-Arc electrode holder which features a flexible front-end assembly made of malleable copper tubing surrounded by a sheath of silicone rubber so that it can be bent in any direction to reach hard-to-get-places.

Specifically designed for the fluxless welding of non-ferrous metals in the



thinner gages, the holder is available in two models: one for 0.010- and 0.020-in. tungsten electrodes and the

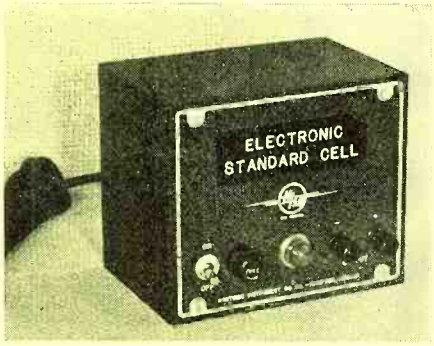
other for 0.040- and 1/16-in. tungsten electrodes.

Small, light, and extremely adaptable, the new welding tool will find application in the manufacture and repair of surgical instruments, cutlery, business machines, control and measurement equipment, capillary tubing, electronic tubes, duct work, wire fittings, small sheet metal enclosures, metal novelties, etc.

ELECTRONIC CELL

An Electronic Standard Cell available for any specified d.c. output voltage from 0 to 100 and for any load up to 30 ma. is announced by *Hastings Instrument Company, Inc.*, Box 1275, Hampton, Virginia.

This electronic cell is not subject to freezing and is not damaged by momen-



tary short circuits. It can be used either as a reference voltage in bridge or potentiometer circuits or for supplying current continuously as an instrument power supply.

Precise output voltages such as 0.10, 1.00 or 100.00 volts d.c., or the usual standard cell voltage of 1.018 can be supplied. Electronic Standard Cells designed on the same circuit principles for output voltages above 100 volts d.c. for operation on other input voltages, higher current drains, or with non-standard chassis construction are available on special order.

TWIN POWER SUPPLY

Model 1210 electronically regulated twin power supply featuring a unique

switching arrangement has been announced by *Furst Electronics*, 12 S. Jefferson Street, Chicago 6, Illinois.

The output voltages of the Twin Power Supply can be adjusted over wide ranges by the operation of two control-knobs on the front panel. A selector-switch, also located on the front panel, allows two ways of operation: two independent outputs which can be used independently of each other; and one single output capable of supplying twice this current, obtained by connecting both regular circuits in parallel.

In addition, a "stand-by" position on the selector-switch is provided for use when the voltage should be removed from the high-voltage terminals.

UHF MEGALYZER

Kay Electric Company, Pine Brook, N. J. has incorporated a coaxial type wide band mixer in its VHF Megalyzer to obtain improvement in performance and sensitivity.

The frequency band of the UHF Megalyzer is now 30 to 500 mc. The sensitivity has been increased to the point that signals down to 100 microvolts may be easily seen on the included oscilloscope.

Equivalent input noise is approximately 20 microvolts and the frequency response is within 4 db. Signals may be studied within a 30 mc. range on the oscilloscope at one time.

ELECTRONIC RESISTOHMETER

The Crown Industrial Products Co., 1336 W. 69th St., Chicago, Illinois announces a new Electronic Resistohmeter. This unit is a Wheatstone

bridge designed for measuring resistance and insulation resistance in both low and extremely high ranges.

The indicator used with the bridge is a 6E5 electron ray tube. The Resistohmeter is guarded internally so that leakage across the bridge components due to high humidity does not enter into, or affect the operation or accuracy of the bridge.

(*Continued on page* 29)

Personals

HENDLEY BLACKMON, managing editor of *Electrical World* since 1947, has been appointed Assistant Manager of Engineering Association Activities for *Westinghouse Electric Corporation.* He will be headquartered at the East Pittsburgh Works and will assist Frank Thornton, Jr., Manager of the Activities. Mr. Blackmon will work with *Westinghouse* engineers in the preparation of papers to be presented before Engineering Associations.

WILLIAM WARREN DAVIS, formerly on the staff of the Naval Ordnance Laboratory at White Oak, Maryland, has been appointed to do research on the high speed electrostatic memory of the electronic digital computing machines at the Electronics Division of the National Bureau of Standards. Mr. Davis received his degree of bachelor of science in engineering physics from Ohio State University and did graduate work at the University of Maryland.

H. B. FANCHER has been appointed Section Engineer of Broadcast Studio Equipment for *General Electric Company* in Schenectady, New York. Mr. Fancher joined the Transmitter Division in 1940 and during the war was active in the development of microwave relay equipment and radar countermeasures. He was named assistant section engineer in charge of television equipment in February 1948 and served in that capacity until his present appointment.

ALFRED H. MASSALLEK has been appointed Executive Design Engineer of *Shure Brothers, Inc.*, Chicago, where he will supervise new designs and act as consultant to other departments concerning design problems. Associated with the radio industry for the past fifteen years, Mr. Massallek was Chief Mechanical Engineer of the *Majestic Radio and Television Corp.*, Chief Draftsman of the *Zenith Radio Corp.*, and Design Engineer for the *Stewart-Warner Corp.*

DR. OLIVER D. SLEDGE has joined the staff of the National Bureau of Standards to do research in the Microwave Standards Section of the Bureau's Central Radio Propagation Laboratories. Formerly a professor of electrical engineering at the Georgia School of Technology, Dr. Sledge has done extensive work in the fields of electronic and radio engineering. He is an associate member of Sigma Xi, and is a senior member of the IRE.

DR. CHEN TO TAI of Soochow, China, has been appointed senior research physicist in the department of electrical engineering at Stanford Research Institute, Palo Alto, California. Dr. Tai, who received his Doctor of Philosophy degree in 1947 at Harvard University, will be in charge of the theoretical section of the Institute's Aircraft Radio Systems Laboratory. He is an associate member of the IRE, and a member of the APS and Sigma Xi.

Field Intensity

(*Continued from page* 13)

chart for Radial B is shown in Fig. 3. The small numbers along one margin are log reference numbers and were marked on the chart each time pertinent data was recorded in the log. The numbers on the opposite margin are the field car speedometer readings. It should be mentioned that the median value is not obtained by averaging the signal intensities recorded on each section of these charts but is found by determining the field intensity received 50 per cent of the distance throughout each sector. These field intensity values must then be corrected for a receiving antenna elevation of 30 feet and for any effects due to the field car body as determined by the method given previously in this paper. The data for each sector of each radial thus obtained was then plotted on log-log coordinate paper with distance as the abscissa and field intensity as the ordinate. A smooth curve was drawn through these median field points for all sectors and this curve determines the distance to the desired contour. This is illustrated in the graph of Fig. 2 for Radial B. These distances were then plotted on the map of predicted coverage to determine the service area of the 1000 microvolt per meter contour. The 50 microvolt per meter contour was then found by employing Fig. 1 of the FCC Standards for FM Broadcast Stations which gives instructions for this procedure, and this contour also plotted on the map. This map shown on page 11 gives the predicted contours in dashed lines and the measured contours in solid lines. The map was assembled from 4 state maps obtained from the United States Geological Survey, Department of the Interior.

A technical statement giving a description of the procedures and methods employed, type of equipment, method of installation, and operation and calibration was prepared to accompany the collected data. All must be submitted in triplicate, except that only the original or one photostatic copy of the recording charts need be submitted.

Needless to say, considerable time is required to make a survey of this kind and properly prepare the data for presentation to the Commission and much of the work is of a tedious nature. The author wishes to acknowledge the splendid assistance and cooperation rendered by Arthur H. Hallam, WOL engineer, in making the field intensity measurements in which approximately 900 miles of driving the field survey car was required.

Stabilized Element

(*Continued from page 7*)

signal current will vary with the amplitude of the a.c. component.

Example of Application

One application in which the cathode follower voltage stabilizer has been employed is the regulation of the screen grid voltage supply for beam power amplifier tubes operated in class AB.

As an example, the case of push-pull class AB_1 operation of type 6L6 tubes will be considered in some detail: From the published data for these tubes, the following operating conditions will be assumed:

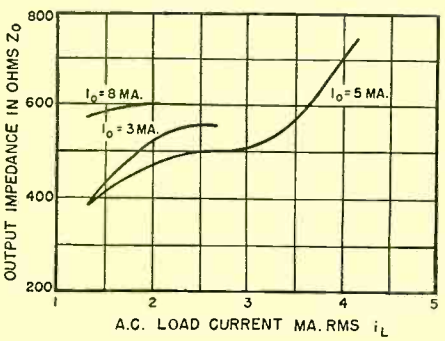
Plate voltage, E_{bb}	360 volts.
Screen grid voltage, E_b	270 volts.
Screen grid current	
zero signal	5 ma.
maximum signal	17 ma.
Cathode resistor	250 ohms.

The plate voltage at which the stabilizer will operate is:

$$E_p = E_{bb} - E_b = 360 - 270 = 90 \text{ v.} \quad (7)$$

The tube selected must be capable of supplying the maximum current required by the load with zero bias, or preferably, with some negative bias, at this plate to cathode voltage. From published curves for the type 6J5 tube, with 90 volts applied to the plate and zero grid bias, the plate current would be approximately nine milliamperes, thus this tube would not be suitable. However, the type 6SN7 with the two triodes connected in parallel should pass 18 ma. under the required conditions. Cutoff grid voltage at 90 volts plate potential is approximately 6 volts, and over the range of 0—17 ma, the variation in grid voltage is about 5.5 volts. By Eqt. (2), the direct current regulation will thus be 2.04%; or the effective supply resistance over this range is:

Fig. 5. Plot of a.c. load current vs. output impedance in ohms. These curves are somewhat sketchy due to the limited capacity of the a.c. load current generator employed, but serve to indicate certain limitations in the circuit.



$$R_{dc} = \frac{5.5}{17} 10^3 = 458 \text{ ohms} \quad . \quad . \quad . \quad (8)$$

By Eqt. (6), taking an average d.c. operating current of ten milliamperes, the effective supply impedance to small components of signal frequency current is 160 ohms.[1]

The attenuation ratio to power supply ripple components by Eqt. (4) is 0.048.[1] This is equivalent to 26.4 db. attenuation.

It should be noted that, in this example, the direct current requirements of the screen grid circuit would load the tube selected for the stabilizer to its maximum capacity. For this reason, the stabilizer should not be required to handle the a.c. signal components of the screen current, or to provide appreciable filtering of ripple from the power supply. These functions of the stabilizer may be prevented by providing a suitable bypass or filter capacitor across its output terminals. Should the filtering and bypassing actions of the stabilizer be considered desirable, a larger tube should be employed, or two tubes of the type indicated should be operated in parallel. The latter arrangement would result in the same direct current supply resistance, a reduction of fifty per-cent in the small current alternating current supply impedance, and but slightly increased filter attenuation ratio.

The power required by the heater of the stabilizer tube is 3.78 watts. For comparison, a voltage divider dissipating this amount of power in a bleeder resistor would require 14 milliamperes of bleeder current while the equivalent direct current supply resistance would be 3800 ohms. The equivalent supply impedance to alternating current and the ripple attenuation ratio would be largely a function of the bypass capacitor employed. With such a voltage divider, the screen voltage would fall some 45 volts at maximum signal level, indicating a regulation of almost 17%. This is sufficient to limit seriously the power output of the amplifier.

It can be shown that a voltage divider capable of providing the same regulation in this application as the cathode follower stabilizer would require a bleeder current of about 190 milliamperes. The power dissipated in the bleeder would be approximately 52 watts.

1. *In the calculation of the effective supply impedance, R_0, and the ripple attenuation ratio, it was assumed that the a.c. impedance of the screen grid circuit was one-half of the d.c. resistance at 10 ma. current. A large error in this value will have but little effect on the results obtained, as may be seen by Eqts. (4) and (6) when $R_p = 3350$ ohms and $R_L = 31{,}500$ ohms.*

Timer and Clock

(*Continued from page* 5)

If more accurate time intervals were required, and assuming that an accurate frequency standard be available, the input pulse repetition rate could be raised to 1000 cycles, 10,000 cycles,

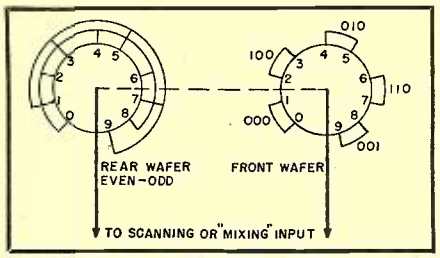


Fig. 8. Two deck wafer switch.

100,000 cycles, etc., and the necessary scaler units added. If this higher speed were contemplated, the scanning matrix of resistors would probably be replaced by an identical matrix of crystal diodes and use of these diodes would also make it possible to eliminate some of the vacuum tube mixing circuits.

The intervalometer was developed in connection with a research project headed by F. C. Bell, Project Engineer, and under the supervision of Dr. Erik Ackerlind.

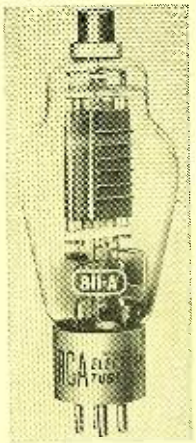
New Tubes

(*Continued from page* 22)

structed with a very small glass-button 8-pin base sealed to the glass bulb.

Power Triode

The 811-A power triode is an improved version of the popular 811 which utilizes a modified construction featuring a zirconium-coated plate having radiating fins to give greater dissipation capability, and grid and plate leads to have low r.f. loss.



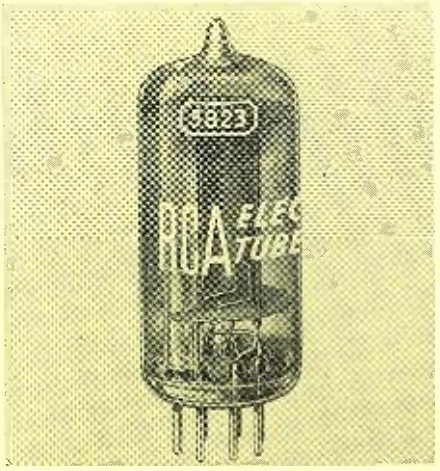
A pair of 811-A's in class B a.f. service with a plate input of 470 watts (ICAS) is said to require a driving power of only 4.4 watts and can modulate 100 per-cent an r.f. amplifier having an input of 680 watts. Operation with maximum ratings is permissible up to 30 megacycles, and with reduced ratings to 100 megacycles.

Image Orthicon

The new television camera tube 5820 is designed for outdoor-pickup use but it is also suited for studio cameras. It features exceptionally high sensitivity, a spectral response approaching that of the eye, stability of performance at all incident light levels on the subject ranging from bright sunlight to a deep shadow, and a resolution capability of better than 500 lines at the center of the picture.

Glow-Discharge Triode

The Tube Department of the *Radio Corporation of America*, has also announced a miniature, glow-discharge triode 5823 designed to be used as a



relay tube for the "on-off" control of low-current electrical circuits.

Utilizing a cold cathode, the 5823 requires no warm-up time and consumes no stand-by power. When operated on 60-cycle a.c. supply and triggered every cycle, it has an average life expectancy of about 45 million starts.

TV MINIATURE RECTIFIER

Hytron Radio & Electronics Corp., Salem, Mass., has announced the *Hytron* 1X2, another in its line of special tubes for low-cost television receivers.

The 1X2 is a compact, T 6½, 9-pin miniature of a filamentary-type, half-wave, high-voltage rectifier. It has maximum ratings of 15,000 volts inverse peak and one milliampere d.c. load current. A special feature is the inclusion of two unconnected base pins offering tie points for filament dropping and high voltage filter resistors.

Further information is available by writing the Commercial Engineering Department.

News Briefs

(*Continued from page* 21)

synchronous motors (shown in the close-up on page 21, just right of center), one driven by the power line, the other by a standard crystal-controlled frequency.

CZECHOSLOVAKIA REPORTS ON ITS ELECTRONICS ACTIVITIES

Tesla National Corporation, Prague, Czechoslovakia, has published the first issue of "Tesla Technical Reports" to acquaint the technical circles throughout the world with the activities, problems and results achieved in its research and development laboratories as well as with the work done in the production department.

The first issue contains a brief summary of the electronics industry in Czechoslovakia and several papers covering television in their country, underground loudspeakers, etc.

Readers who are interested may obtain a copy of this report by writing Kovo Ltd., Enterprise III, Publicity Department, Hybernska 32, Praha II, Czechoslovak.

NEW LITERATURE

Report on Engine-pressure Instruments

A new type of electrical engine-pressure-indicating system for research and testing is proposed in a report now available to the American public. The report, prepared at the David Taylor Model Basin of the Navy Department, provides a review of engine-pressure instruments.

The report includes an as-yet untested plan for a high-frequency ("H-F") transducer, or pickup element, in which indications are derived from circuit resonance.

Orders for PB 96928, An Electrical Engine-pressure-indication Device, should be addressed to the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25 D. C. The report sells for $2.00 in microfilm, $3.75 in photostat.

Brochure on Research Laboratory

A 42-page illustrated brochure describing the research services, personnel and facilities of *Cook Research Laboratories* which are available at Government agencies and private industry on a contract basis has been issued. Photographic views of the physical facilities of the *Laboratory* are shown along with illustrations of newly developed electronic instrumentation equipment, including magnetic tape data recorders.

Requests for this brochure, No. B-2, should be made on business letterhead to *Cook Research Laboratories*, 1457 Diversey Parkway, Chicago 14, Ill.

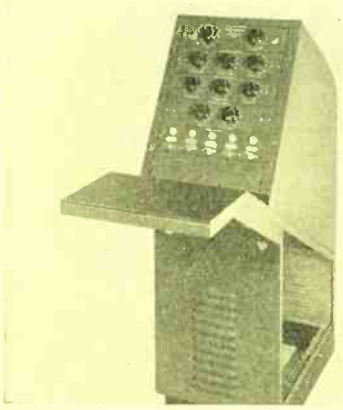
New Products

(*Continued from page* 25)

The Resistohmeter has a range from 1000 ohms to 100,000 megohms. Three test voltages are used: 10, 100 and 500 volts d.c. The unit operates on 115 volts 60 cycle, a.c. current.

TV STUDIO EQUIPMENT

Television broadcasting studio remote control panels designed for mounting in the upper compartment of the *RCA* MI-26266 studio control console



housing is now available from the *RCA* Engineering Products Department, Camden, N. J.

The panels, 11" x 2⅝", are shown mounted in the studio control console housing. Up to six of the new panels can be installed and if less than six control panels are used, blank panels can be obtained to fill the remaining space in the compartment.

This versatile new equipment can be used to provide remote control of various rack-mounted television units or a central control position for units mounted in separate rooms, or it can be incorporated as a desk section in multiple-unit control consoles.

TRANSFORMER CORES

The Electronic Components Division, *Stackpole Carbon Company*, St. Marys, Penna. is now offering their new *Stackpole* Ceremag flyback transformer cores for television.

The new cores are much smaller, have higher resistance, and operate cooler due to lack of eddy current losses. According to the manufacturer, they offer permeability on the order of 10 to 1 by comparison with previous *Stackpole* types for similar applications.

Complete details will be sent upon request.

COUNTING RATE METER

A Beta-Gamma Counting Rate Meter which has a Geiger-Mueller tube in a probe as the detector element has been announced by the Instruments Division of *The Kelley-Koett Mfg. Company*, F-222, W. Fourth St., Covington, Ky.

Used by prospectors, health physicists, technicians and others concerned with detecting and measuring Beta-Gamma radiation, the Model K-800 can measure three ranges of Gamma activity. A scale selector switch permits choice of 0.2, 2.0 and 20.0 mr./hr. The scale is also calibrated in 360, 3600 and 36,000 counts per minute. An earphone is provided for aural monitoring.

Further details including description of this unit and other *Keleket* electronic instruments for the detection and measurement of radioactivity are available on request.

ADJUSTABLE SPEED DRIVE

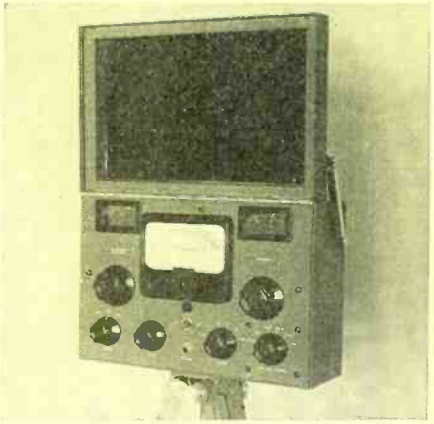
Westinghouse Electric Corp., Box 868, Pittsburgh 30, Pa., has announced Mot-O-Trol packaged adjustable speed drive, employing electronic precision to provide a wide, stepless range of speed control for d.c. motors from a.c. sources.

This unit starts motors, brings them up to a pre-set speed smoothly and rapidly, permits change of speed at any time, applies dynamic braking for stopping, and reverses motors. A special feature of the Mot-O-Trol drive is the sub-assembly construction which can be removed for easy maintenance. A single dial gives finger-tip control.

Further information on this unit will be supplied upon request.

FIELD STRENGTH METER

Designed particularly for the communications and industrial heating fields, a field strength meter operating



in the range of 200 kc. to 560 kc. has been announced by *Clarke Instrument Corporation*, 910 King Street, Silver Spring, Maryland.

Entirely self-contained and weighing only 12½ pounds, this field strength meter is a low-frequency version of a similar instrument widely used by broadcast stations. Field strengths between 10 microvolts per meter and 10 volts per meter are read directly with-

CALENDAR of Coming Events

OCTOBER

31, Nov. 1-2—**RMA-IRE Fall Meeting** will be held at the Hotel Syracuse, Syracuse, N. Y., rather than Rochester, as in the past. This meeting will feature the latest developments in radio and television engineering and manufacturing. Papers will be presented on such subjects as TV receivers, quality control, and audio frequencies. Kenneth W. Jarvis will speak on "The Engineering Aspects of Sin" at the stag dinner on Nov. 1.

Technical papers include the following:

Monday, Oct. 31: "Measurement of Transient Response of TV Receivers," "TV Transient Response Measurement," "Underwriters' Requirements for TV Receivers," "Quality Control from the Producer and Consumer Viewpoints," and "Quality Control Gets a Job in Television Manufacturing."

Tues. Nov. 1: "Intercarrier Sound System for TV Receiver using 6BN6," "Simplification of TV Receivers," "Universal Application—CR Sweep Transformer with Ceramic Iron Core," and "Characteristics of High-Efficiency Deflection and High-Voltage Supply Systems for Kinescopes."

Wed. Nov. 2: "Pickup Tracking," "New Audio Amplifier Circuit," "The Safety-Vox," "New Type of Dual Cone Loudspeaker," "New Miniature HF Transmitting Pentode," "A VHF Remotely Tunable Receiver," and "Advantages of Toroidal Transformers in Communication."

31, Nov. 1-2—**Nucleonics Symposium,** including the second annual Conference on Electronic Instrumentation in Nucleonics and Medicine, Hotel Commodore, N. Y. Included this year will be manufacturers' exhibits of equipment in this field.

31, Nov. 1-2—Fall Meeting of **URSI** and **IRE,** National Academy of Arts and Sciences and State Dept. Bldg., Washington, D. C.

NOVEMBER

14-18—**NEMA** Annual Meeting, Haddon Hall Hotel, Atlantic City, N. J.

DECEMBER

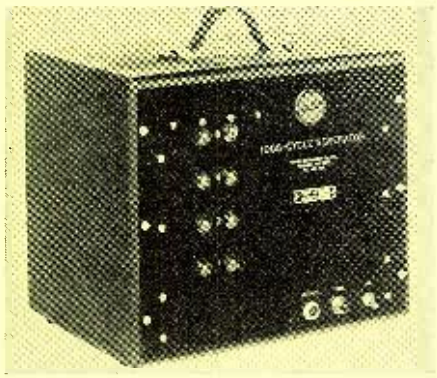
9-10 — Second annual Southwestern IRE Conference, Dallas Texas.

out recourse to charts, curves, or computations of any kind.

TIMING MARK GENERATOR

A 1000 cycle pulse generator for exposing 1/1000 second timing marks on the film in the high speed Fastax cameras is now available from *Potter Instrument Company, Inc.*, 136-56 Roosevelt Avenue, Flushing, N. Y.

According to reports, the output pulse power is adequate for supplying timing



marks to as many as 14 cameras simultaneously or 14 one quarter watt argon glow lamps. A 100,000 cycle per second crystal oscillator included in the instrument precisely controls the timing marks.

The unit is completely self-contained and can be used for either laboratory or airborne work as the power supply will operate from 50, 60 and 400 cycle supplies at 110 volts.

TELELINK EQUIPMENT

General Electric's Transmitter Division at Electronics Park, Syracuse, N. Y., has announced that its Telelink equipment for three types of television microwave relay systems is now available commercially.

The new equipment, all of which operates in the 1900-2110 mc. band, includes transmitters, receivers and antennas for intercity, studio-to-transmitter, and semi-portable relays. Transmitter output for all three ranges from 5 to 10 watts. The frequency response of the system is flat to plus or minus 1 db. out to 5 mc., with modulation and demodulation linear within plus or minus 5 per-cent.

Further information about this TV relaying equipment can be obtained by writing *GE* Transmitter Division.

ASBESTOS TUBES

Originally designed as a heat resisting base for electric coils and bobbins, the asbestos tube manufactured by *Precision Paper Tube Co.*, 2045 W. Charleston St., Chicago 47, Ill., can also be used for insulation in such units as electric heaters, thermal heating devices, for insulating rods, etc., for both heat and as a dielectric.

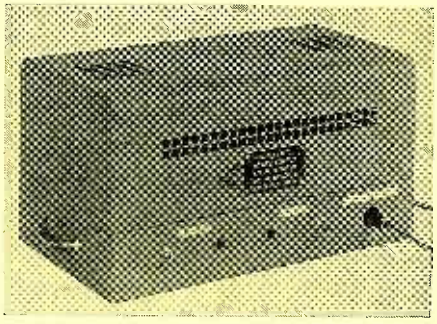
These tubes can be made in any length, with wall thicknesses from .010 up. They are made by spirally winding specially prepared asbestos tape to predetermined sizes around a mandrel, then di-forming into either square, rectangular or oval cross sections.

The company has invited users of electric coils and manufacturers who have a problem which they believe this tube may solve to send for a sample made to their specifications.

POWER SUPPLY

A regulated power supply, Model A, designed to provide a stable source of d.c. for experimental setups has been announced by *The Howard Co.*, 934 Argyle Rd., Drexel Hill, Pa.

According to the manufacturer, the unit is light, compact and inexpensive, and can be supplied in the cabinet shown or panel mounted for rack installations. All component parts are of high quality (filter capacitors are oil-



filled paper) and each unit is guaranteed against defective workmanship and materials, except tubes, for one year.

Specification information may be obtained by writing the company.

SAMPLING DEVICE

A high speed subminiature mechanical sampling device having two poles, each of which contains sixty contacts, has been announced by *The Applied Science Corporation of Princeton*, Princeton, N. J. These poles may be synchronized in any phase desired.

Driven by a 12 or 28 volt d.c. motor and having a power consumption of only a few watts, the sampling rate of this device is nominally 300 r.p.m. Over-all dimensions are 3⅛" x 2⅛" x 4⅜".

PHOTO CREDITS

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These switches facilitate investigation of a large number of separate quantities or of a single quantity under a number of various conditions.

In addition to telemetering applications, they may be used for the display

of characteristic curves and multichannel voltage comparison.

Heater-Compensated

(*Continued from page* 8)

to a common line voltage and the screen grid voltage of the amplifier tube set at its proper value, the heater-compensated power supply shows a maximum deviation of 0.01 volt from the nominal 350-volt output for a ten-volt change in the input. This is a variation of less than 0.0005 per-cent in output voltage for a one per-cent change in the line. The extremes in line voltage were taken as 100 and 120 volts.

The compensating voltage exhibits a time lag dependent on the time necessary for the cathode temperature to come to equilibrium. The effect of this time lag can be reduced by connecting a series resistance-capacitance circuit between the input terminal and the screen grid of the amplifier. When a sudden change of line voltage occurs, this *RC* circuit applies the proper voltage to the screen grid of the amplifier to compensate for the thermal time lag of the cathode temperature. The time constant of the *RC* network was chosen to equal that of the cathode temperature change.

Heater compensation gives much better operation in most power supplies using degenerative voltage stabilizers, without sacrifice of design simplicity. The principles of heater compensation can also be applied to good advantage in both a.c. and d.c. amplifiers.

NOTE:

For further tehnical details on this work, see "Cathode Heater Compensation as applied to Degenerative Voltage Stabilized D-C Power Supplies" by Robert C. Ellenwood and Howard E. Sorrows, J. Research NBS 43, 3 (September 1949) RP 2027.

Quadrature Networks

(*Continued from page 9*)

$$\frac{e_1}{e_2} = \frac{I_1 R\,(1-j)}{e_2} - 1 \quad . \quad . \quad (5)$$

From (2):

$$I_1 R = I_2 R\,(2-j) = e_2\,(2-j) \quad . \quad (6)$$

Substitute (6) in (5):

$$\frac{e_1}{e_2} = (2-j)\,(1-j) - 1 = -3j \quad (7)$$

$$\frac{e_2}{e_1} = -\frac{1}{3}\,j \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (8)$$

This shows that the output voltage lags the input by exactly 90 degrees and has an amplitude of ⅓ the input. The essential requirements of this special case are that this source impedance be very low and that the loading on the network be extremely light.

These conditions are easily met by feeding the circuit from a cathode follower. See Fig. 1G.

When two precision resistors and two precision capacitors are calculated and assembled into the circuit shown, an accuracy of plus or minus ½ per-cent may be realized.

Design of An Echo Box

(*Continued from page 18*)

$$t_r = \frac{0.7333\,Q'}{f(1+\beta_a)} \left\{ \log \beta_a\,(1 - e^{-\frac{3.14 f \tau (1-\beta a)}{Q'}}) + \frac{\Delta}{20} \right\} \quad . \quad . \quad (15)$$

Where t_r = ringtime in microseconds
f = frequency in mc.
τ = pulse width in seconds
Δ = level difference between peak pulse power and receiver sensitivity at the echo box input in decibels.
$\beta_a = Q'/Q_L - 1$

For the application for which this echo box is required $\Delta = 100$ and $\tau = 5 \times 10^{-5}$ seconds. It has been found experimentally that the maximum ringtime is obtained, while still permitting sufficient loading for crystal current output measurements, if β_a has a value in the vicinity of 0.1. This value depends on the degree of output coupling required to give adequate crystal current for the particular repetition rate and pulse width of the system under test and must be determined experimentally in conjunction with the system with which it is to be used. For the present consideration $\beta_a = 0.1$ is sufficiently accurate to permit determining the relative order of magnitude of the ringtime.

d. From Eqt. (15) the ringtime at 142 mc. is found to be 363×10^{-6} seconds. From Table I the reduction in ringtime due to compensation at 142 mc. is 7.41 per-cent so that the resultant ringtime is about 336 microseconds.

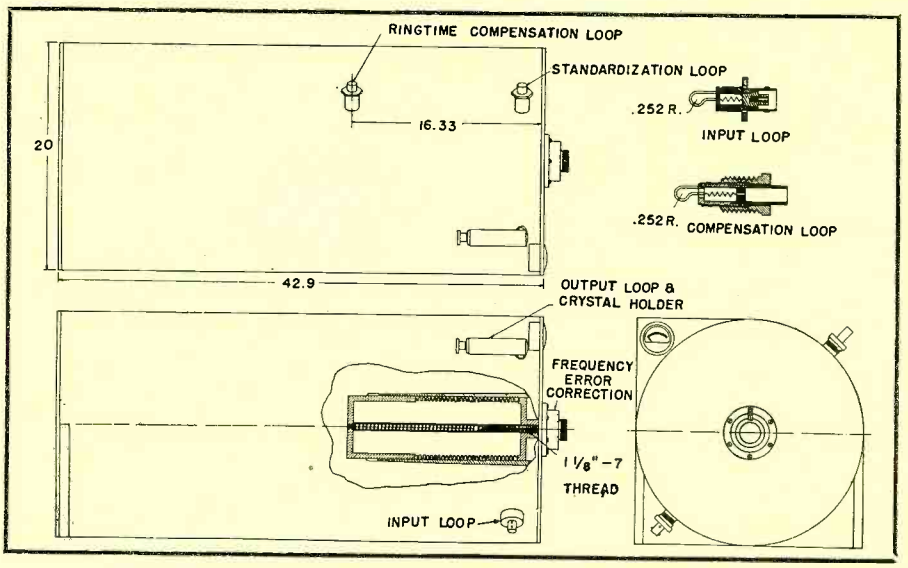

Fig. 4. Drawing showing construction of 130-154 mc. coaxial echo box.

Since β_a is $Q'/Q_L - 1$, then for $\beta_a = 0.1$ at 142 mc., $Q_L = 18500$.

From the definition of $Q_L = f/\Delta f$ the bandwidth of the coaxial cavity for 142 mc. is found to be approximately 7.7 kilocycles.

The loop dimensions can be closely approximated from the relationship:

$$A_L = .005048 \sqrt{\frac{R_0\, b^3}{\sqrt{f}}} \quad . \quad . \quad . \quad (16)$$

where A_L = loop area in square cm.
R_0 = input transmission line impedance
b = inner radius of outer conductor in cm.
f = frequency in mc.

Though the value of A_L is only an approximation it has been found sufficiently accurate to provide a good starting point for the final experimental determination of the loop dimensions. For the mid-band frequency of 142 mc. the loop area A_L is found to be 1.29 square centimeters, corresponding to a loop diameter of 0.641 centimeters or 0.252 inches.

Conclusions

A quarter-wavelength coaxial echo box has been designed having the following electrical and mechanical parameters:

a. Diameter—20 inches outer conductor, 5.555 inches inner conductor
b. Length—42.9 inches over-all
c. Plunger Variation—3.516 inches
d. Tuning—Direct reading frequency dial with 100-division vernier dial
e. Tuning accuracy with dial correction = 0.1 mc.
f. Average unloaded Q — 20,000
g. Average Loaded Q — 18,000
h. Average Cavity Bandwidth—7.7 kilocycles
i. Average Ringtime—336 μsec.
j. Ringtime Variation with Compensation is equal to 1.0 per-cent
k. Loop Radius—0.252 inches

The resulting echo box design meets the requirements of the system with a good margin of safety. An over-all construction diagram (Fig. 4) shows the outline of the physical layout of the echo box. The input and compensating loops have 50-ohm resistors built in so as to provide matching for the transmission line and the loops.

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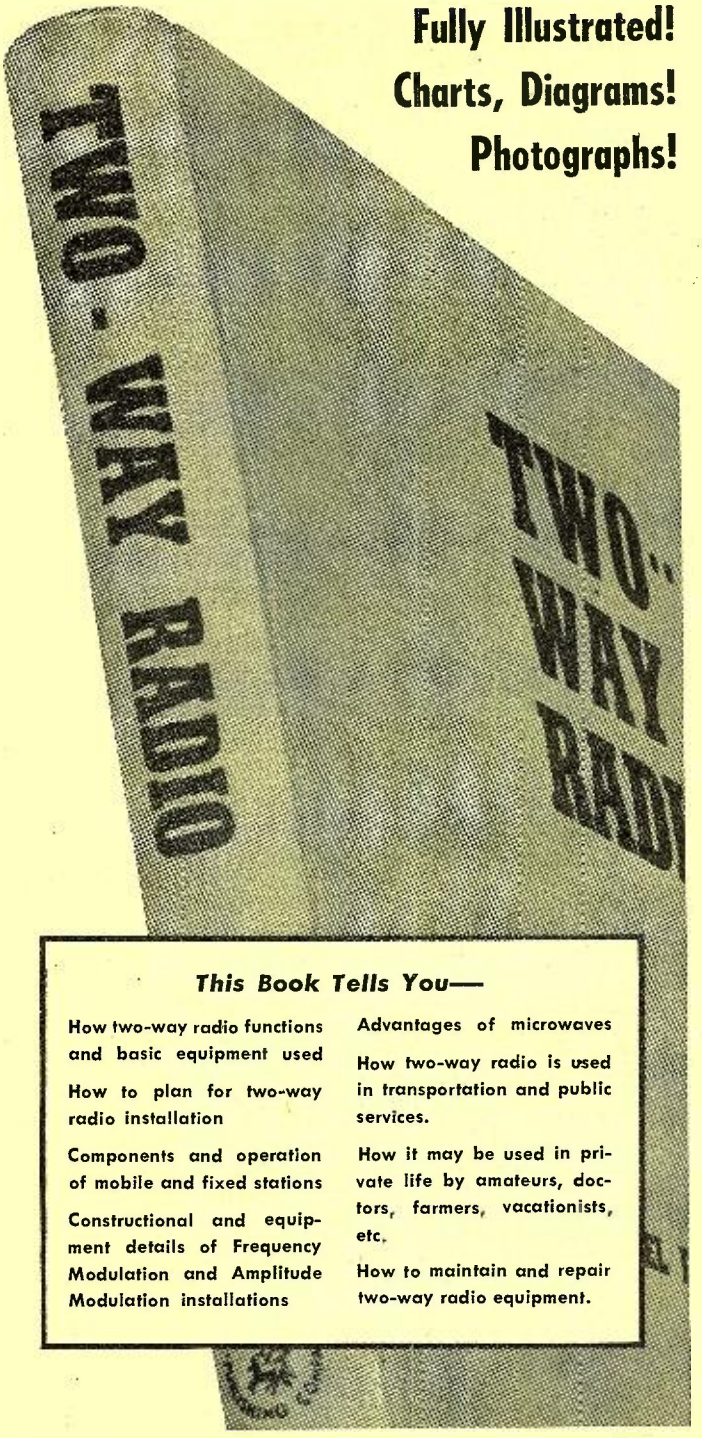

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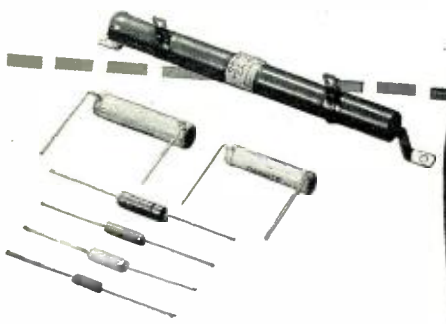

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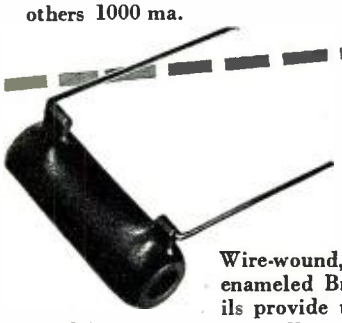

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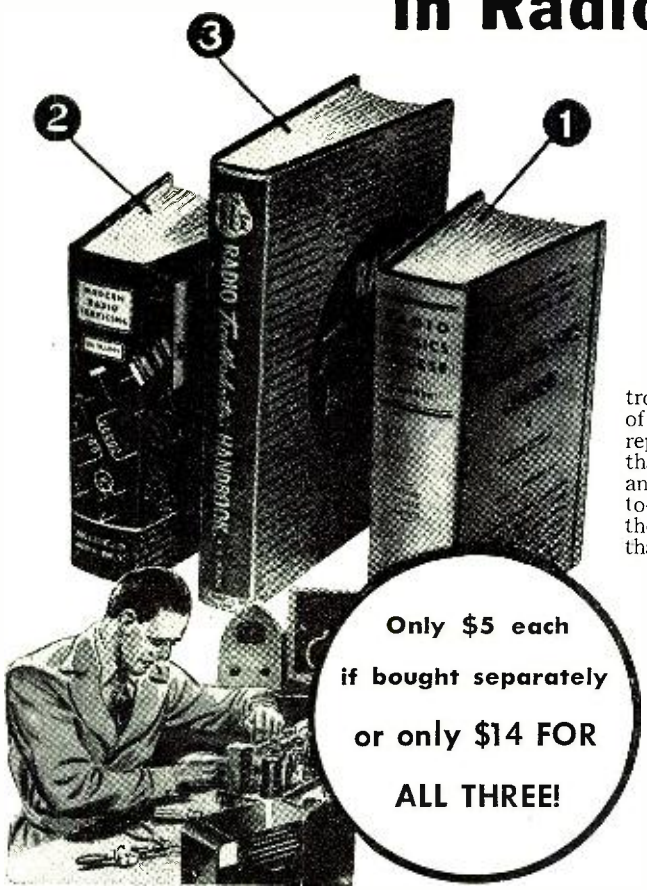

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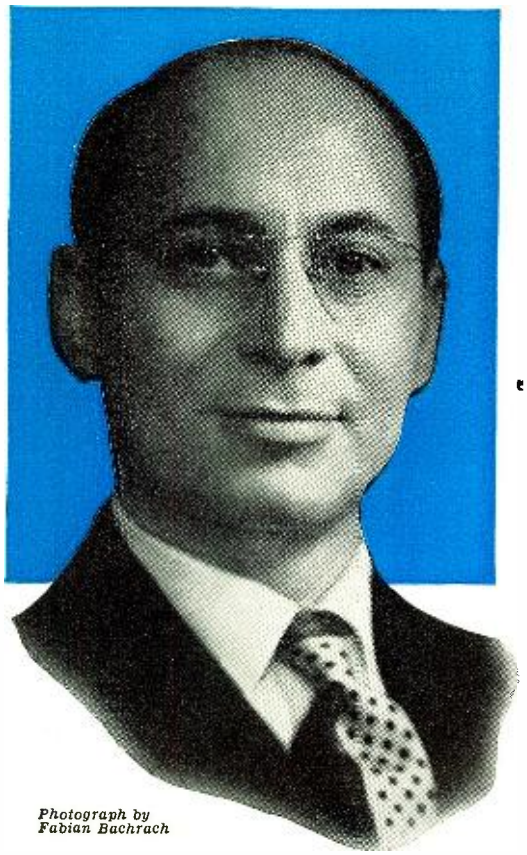

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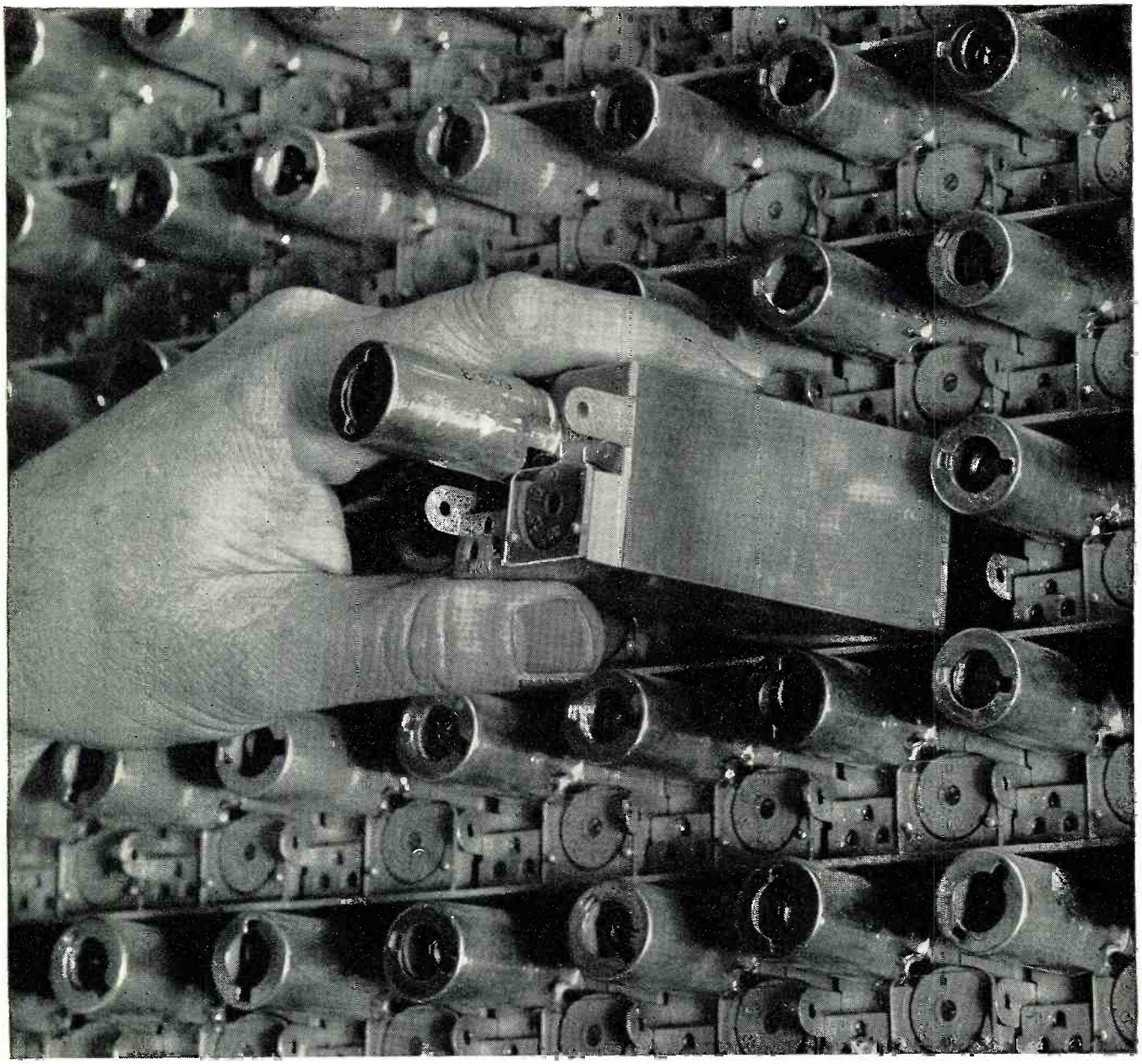

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This kind of size reduction throughout the System means that more parts can be housed in a given space. Telephone buildings and other installations keep on giving more service for their size — and keep down costs.

The new amplifiers, which will soon be used by the thousands throughout the Bell System to keep telephone voices up to strength, are but one example of this important phase of Laboratories' work.

BELL TELEPHONE LABORATORIES EXPLORING AND INVENTING, DEVISING AND PERFECTING, FOR CONTINUED IMPROVEMENTS AND ECONOMIES IN TELEPHONE SERVICE

The Offer Still Stands!

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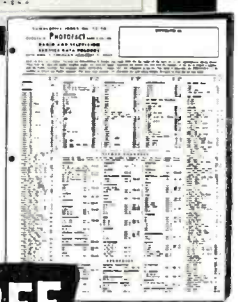
NOW—the new "Pay-as-you-Profit" Plan brings the famous PHOTOFACT Library within the reach of every Serviceman! Now you can easily own the world's finest radio service data—seven complete volumes, *plus* continuous PHOTOFACT Folder Set service—full coverage of *all* post-war AM, FM and TV models! Everything you'll ever need for quicker, more profitable servicing! You pay only $18.73 down—the remainder in small monthly payments. *Absolutely no carrying charges and no interest!* Make the down payment—and you get the complete Library immediately. Your Jobber has all the details of this amazing new purchase plan. See him today, or write us direct for full information.

Get the Easy-Pay Details Now!



FREE PHOTOFACT Cumulative Index

Select your FREE PHOTOFACT Folder (covering any AM, FM or TV model) from the PHOTOFACT Cumulative Index. Get the FREE Index today. Covers all post-war receivers right up to the present. Helps you find the Folders you want in a jiffy—Folders that make your work quicker, easier, more profitable. Get this FREE Index at your Jobber or write direct for it now.

NOW—learn for yourself—at our expense—how PHOTOFACT will make your service work quicker, easier, more profitable! Examine an actual PHOTOFACT Folder. Use it. You'll learn first-hand why this indispensable service data is used daily by over 25,000 successful service technicians. You'll discover quickly that no other service gives you PHOTOFACT'S outstanding advantages: *completeness*, *accuracy*, *uniformity* and *ease-of-use*. PHOTOFACT *alone*, is the *only* radio service data prepared from laboratory analysis of the actual equipment. Nothing in the field equals PHOTOFACT. Know the facts—get your FREE Folder now. Examine it—use it—compare it—and you will understand why no modern service shop can afford to be without PHOTOFACT.

NOTE: This FREE offer is limited to Service Technicians. Attach coupon below to your letterhead and mention the name of your jobber. If you have no letterhead, send coupon to your jobber. Experimenters and others may obtain the Photofact Folder by remitting 50c.

CURRENT PHOTOFACT *BEST-SELLERS*

The Recording and Reproduction of SOUND, by Oliver Read. The complete, authoritative treatment of the entire subject of Sound, written by the editor of *Radio & Television News* **$5.00**

Photofact Television Course. The book used by thousands; gives you a clear understanding of TV principles, operation and practice . **$3.00**

Television Antennas. Shows you how to select and install the proper antenna, and how to overcome antenna problems **$1.25**

1948 Record Changer Manual. Covers 45 models made in 1948, including new LP and dual-speed changers, plus leading wire recorders. Based on actual analysis of the equipment **$6.75**

Auto Radio Manual. Complete Photofact service data on more than 100 post-war auto radio models—a time-and-money-saver . . **$4.95**

HOWARD W. SAMS & CO., INC. INDIANAPOLIS 1, IND.

HOWARD W. SAMS & CO., INC.
955 N. Rural St., Indianapolis 1, Ind.

☐ Send FREE Photofact Cumulative Index

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I am a Service Technician:
☐ Send FREE Photofact Folder for set model . . . .

I am an Experimenter:
☐ Send Photofact Folder for set model . . . . . (50c enclosed)

Name . . . . . .

Address . . . . . .

City . . . . . *Zone* . . . *State* . . . . . .

Within the TV INDUSTRY

DR. RALPH L. POWER, well known in advertising and publicity, will handle the press liaison work for the Los Angeles Chapter of "The Representatives" of Radio Parts Manufacturers, Inc., although George Davis will continue with the group in his capacity of chairman of the publicity committee.

Having just recently returned to his own business from his retirement, Dr. Power, who has had many years of active experience in his field, will continue operations from his offices at 767 Castelar St., Los Angeles 12, Calif.

* * *

GERTSCH PRODUCTS, INC., of 11846-48 Mississippi Ave., Los Angeles 25, Calif., one of the most recent companies to enter the electronic and engineering manufacturing field, is currently in production of a Navy department order. The firm was organized following the purchase of the assets of the *Kappler Engineering and Manufacturing Corp.*

Head of the organization is E. P. Gertsch, who was works manager for the *Hoffman Radio Corp.* for four years before taking on his present duties. The factory is completely equipped for custom engineering and manufacturing on electro-mechanical lines. M. O. Kappler will remain with the corporation as chief engineer.

* * *

R. J. CACCAVELLI has been named manager of the Chicago sales force of the *Superior Electric Company,* Bristol, Connecticut, and until permanent quarters are established, will carry on operations through Post Office Box 48, Oak Park, Ill.

Prior to his appointment, Mr. Caccavelli was in the engineering, sales, and service departments, having been employed by the firm for seven years.

* * *

UNIVERSAL MOULDED PRODUCTS CORPORATION will enter the electronic field with the introduction of a new type of tape recorder and other products that are the developments of *International Electronics Company,* 808 N. Broad St., Phila., Pa.

Chester C. Pond, president of *International Electronics,* will be the manager of this new division of *Universal Moulded Products Corporation.*

* * *

THE PLANET MANUFACTURING CORPORATION, a company newly organized for the manufacture of dry electrolytic condensers, will occupy a modern fire-resistant building located at 225 Belleville Ave., Bloomfield, New Jersey.

Corporation officers include Philip Greenspan, president; George F. Jephson, vice-president in charge of sales; Irving A. Greenfield, treasurer; and Joseph Unger, secretary.

At present the firm is producing tubular and can-type electrolytics and plans to include paper tubular condensers and noise suppression filters in its line.

* * *

MYRON F. EDDY, Lieut., USN Ret., will have charge of the writing and production of all of the home study lesson text and work books of the *Cleveland Institute of Radio Electronics,* in his new capacity of director of training.

In addition to these duties, Lieut. Eddy proposes to develop and expand the TV course written for this Cleveland, Ohio, school by Professor Paul H. Nelson, streamlining the engineering portions so as to better fit it to the needs of present-day service technicians.

After specializing in electrical engineering in college, Lieut. Eddy served as a radio operator and communications officer in the Naval Reserve and regular Navy for fifteen years. He is the author of "Aircraft Radio," one of the first textbooks of its kind. After retiring from the Navy, he entered the teaching field and published three other books and many articles on the subject of radio-electronics.

* * *

ALLEN B. DuMONT LABORATORIES, INC., made the announcement that *R. H. Macy & Co.* has been re-enfranchised as an authorized *DuMont* television dealer, continuing the business connection that was begun last July 5 and later withdrawn as a result of a misunderstanding concerning promotion of the *DuMont* receivers.

In the statement issued a short time ago, *DuMont* and *Macy* representatives said that all misunderstandings have been straightened out, and the New York store will continue to carry a full line of *DuMont* TV sets.

* * *

SHELDON ELECTRIC CO., Irvington, New Jersey, a division of *Allied Electric Products, Inc.,* proposes to enter the television field with a line of flat-face, all-glass picture tubes, according to a recent announcement, producing 10, 12½, and 16 inch sizes.

President of the firm, Nathan Chirelstin, is one of the pioneers in the radio tube field, and when *Sonatron Tube*

NEW for 1950

MIDWEST

Celebrates its 30th YEAR of FACTORY-TO-YOU Selling with a Sensationally NEW 1950 LINE of

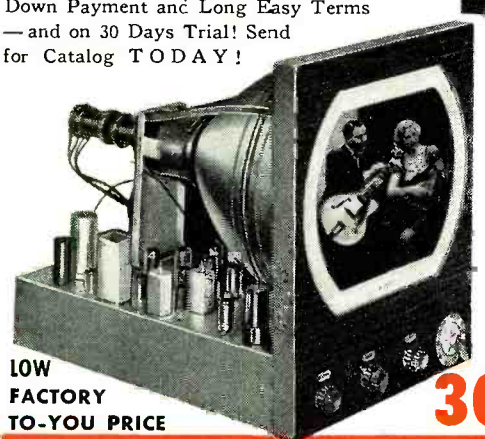
TELEVISION

CONSOLES and Complete CHASSIS

New GIANT 16" PICTURE

Here is Television at its finest! . . . brought to you by Midwest, for 30 years a leader in the field of radio and electronics. Immense 151-square-inch screen on new 16" metal-glass tube . . . clear, steady, bright pictures . . . Synchronized sound and picture that a child can tune in perfectly . . . Highest quality FM sound . . . Big 12" Electro-Dynamic Panasonic Speaker. Available in beautiful Television-Radio-Phonograph Consoles, as illustrated, or in complete chassis (not a kit) ready for custom installation in your own cabinet. And you can buy Midwest Television at Low Factory Prices, with Low Down Payment and Long Easy Terms — and on 30 Days Trial! Send for Catalog TODAY!

NEW LOW Down Payment Long EASY TERMS



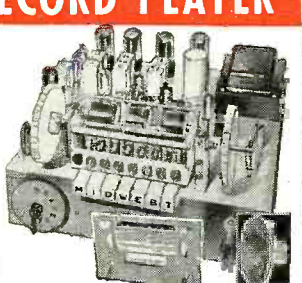
LOW FACTORY TO-YOU PRICE

30 DAYS TRIAL

. . . also a Magnificent Line of NEW 1950 MIDWEST RADIOS

featuring the latest Improved FM Circuit and the New 3-SPEED RECORD PLAYER

Powerful new 1950 Series 16 and Series 12 AM-FM Radio in complete chassis. Also beautiful new Console models including the magnificent Symphony Grand Radio-Phonograph with latest FM circuit and new 3-Speed Automatic Record Player.



BUY DIRECT FROM THE MIDWEST FACTORY and SAVE!

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• Write in Name and Address (Please Print) on Coupon or 1c Postcard. •

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Co., which he organized, became part of the *National Union Radio Corp.,* he served as president and director, later resigning to organize *Allied Electric Products, Inc., Sheldon,* and an affiliated corporation, into their present merger.

Sheldon's production of picture tubes exceeds 500 a day, and plans are under way to step up the production to 1,000 in the next few months. Other items manufactured by *Allied Electric Products, Inc.,* include spring-action plugs, fluorescent starters, fluorescent lampholders, reflectors, extension cord sets, and rectifier bulbs.

* * *

M. G. STATON, formerly communications systems engineer, has been appointed sales manager of microwave relay and channeling equipment for the *RCA* Engineering Products Department at Camden, New Jersey. In his first position with *RCA,* Mr. Staton worked on the field installation work on the New York-Philadelphia microwave radio relay circuit designed for the Western Union Telegraph Company.

Prior to joining the company in 1946, Mr. Staton supervised the conversion of telephone exchanges to automatic operation in the field of telephone plant engineering. He received his B.S. degree in electrical engineering from Oregon State College and served during the war as an officer in the Army Signal Corps, receiving the Legion of Merit award for his work in communications.

* * *

LE-HI ELECTRICAL COMPANY has removed its general offices and plant to 412 Halsey St., Newark 2, New Jersey. . . . A building and store at 3235 Prospect Ave., Cleveland 15, Ohio, is the new headquarters of the **RADIO AND ELECTRONIC PARTS CORP.,** distributors of radio and electronic equipment. . . . **ALLEN B. DuMONT LABORATORIES, INC.,** recently dedicated and opened its new television receiver assembly plant, which is located along the Passaic River in East Paterson, New Jersey. The plant covers 480,000 square feet, and the property comprises about 58 acres. . . . New home of the **JEWEL RADIO CORPORATION** plant facilities is located at 10-40 45th Ave., Long Island City, N. Y., covering more than 20,000 square feet.

* * *

THE DIAL CORPORATION, a newly formed company for the manufacture of instrument dials in luminescent materials has decided on 2323 W. Devon Ave., Chicago, Ill., as the location of its general offices, to be under the direction of Mr. Russ Diethert as general manager.

Mr. Diethert, who made the announcement, is well known in the electronic field through his work as head of

(*Continued on page* 112)

Now, For the First Time—

GUARANTEED TEST INSTRUMENT KITS

*READ DETAILS OF UNPRECEDENTED GUARANTEE IN BOX AT BOTTOM OF THIS PAGE

THE NEW MODEL KT-40 VACUUM TUBE VOLTMETER

FEATURES

- Uses 4½"—2% accurate D'Arsonval type Meter with high torque movement and Alnico V slug.
- Meter guaranteed against burn-out on ALL electronic ranges. Meter will not be damaged even when improperly switched to higher range.
- Stabilized degenerative circuit results in linear D.C. scale.
- Isolating test-prod for all D.C. Voltage ranges.
- Megohm input resistance on all D.C. ranges.
- Ohmmeter accurately measures from 1/10th ohm to 1 billion ohms.

Model KT-40 Completely Wired Ready to Operate $29.50

SPECIFICATIONS

- D.C. VOLTS: (At 11 megohms input resistance) 0 to 3/30/150/750/1500 Volts.
- A.C. VOLTS: (At 1,000 ohms per Volt) 0 to 3/30/-150/750/1,500 Volts.
- RESISTANCE: 0 to 1,000/10,000/100,000 ohms. 0 to 10 megohms/1,000 megohms.
- D.B. Based on 0Db equals .006 watts (6 milliwatts) into a 500 ohm line.

−24 db to + 4 db	+10 db to +38 db
− 4 db to +24 db	+30 db to +58 db

Model KT-40 Kit comes complete with all parts including test leads. V.T.V.M. prod, circuit, operating instructions, etc. Net only..... **$19.90 NET**

THE NEW MODEL 247 TUBE TESTER

Check octals, loctals, bantam Jr. peanuts, television miniatures, magic eye, hearing aids, thyratrons, the new type H. F. miniatures, etc.

FEATURES

- Newly designed element selector switch reduces the possibility of obsolescence to an absolute minimum.
- When checking Diode, Triode and Pentode sections of multi-purpose tubes, sections can be tested individually. A special isolating circuit allows each section to be tested as if it were in a separate envelope.
- The Model 247 provides a supersensitive method of checking for shorts and leakages up to 5 Megohms between any and all of the terminals.
- One of the most important improvements, we believe, is the fact that the 4-position fast action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in Pin No. 7 of a tube is under test, button No. 7 is used for that test.

Model 247 Completely Wired Ready to Operate $29.90

Model 247 Kit comes with all parts, new speed-read chart, handsome hand-rubbed oak cabinet sloped for bench use. A slip-on hinged cover is included for outside use..... **$21.90 NET**

THE NEW MODEL B-450 SIGNAL GENERATOR

SPECIFICATIONS

- Frequency Range: 150 Kilocycles to 50 Megacycles.
- F.M. as well as A.M. receivers can be speedily aligned with the aid of the Model B-450. Modulation in the B-450 is accomplished by Grid-blocking action which has proven to be equally effective for alignment of amplitude as well as for frequency-modulated receivers.
- R.F. is obtainable separately or modulated by Audio Frequency.
- Positive action Attenuator provides effective output control at all times.
- The R.F. Signal Frequency is kept completely constant at all output levels. This is accomplished by use of a special grid loaded circuit which provides a constant load on the oscillatory circuit. A grounded plate oscillator is used for additional frequency stability.
- Direct reading—all calibrations are etched on the front panel.

Model B-450 Completely Wired Ready to Operate $24.50

Model B-450 Kit comes complete with all parts including circuit, test leads, etc. Nothing else to buy..... **$18.50 NET**

*UNPRECEDENTED GUARANTEE!!

All kits advertised on this page are offered subject to the following guarantee: If, after completion, the instrument does not operate to your fullest satisfaction, you may return it and we will ship you a brand new factory wired and tested model for only the difference between the price of the Kit and the price of the complete Instrument. Full credit will be given no matter what stage of completion has been reached in wiring the Kit.

20% Deposit Required on All C.O.D. Orders

GENERAL ELECTRONIC DISTRIBUTING CO. Dept. RN-11, 98 PARK PLACE NEW YORK 7, N. Y.

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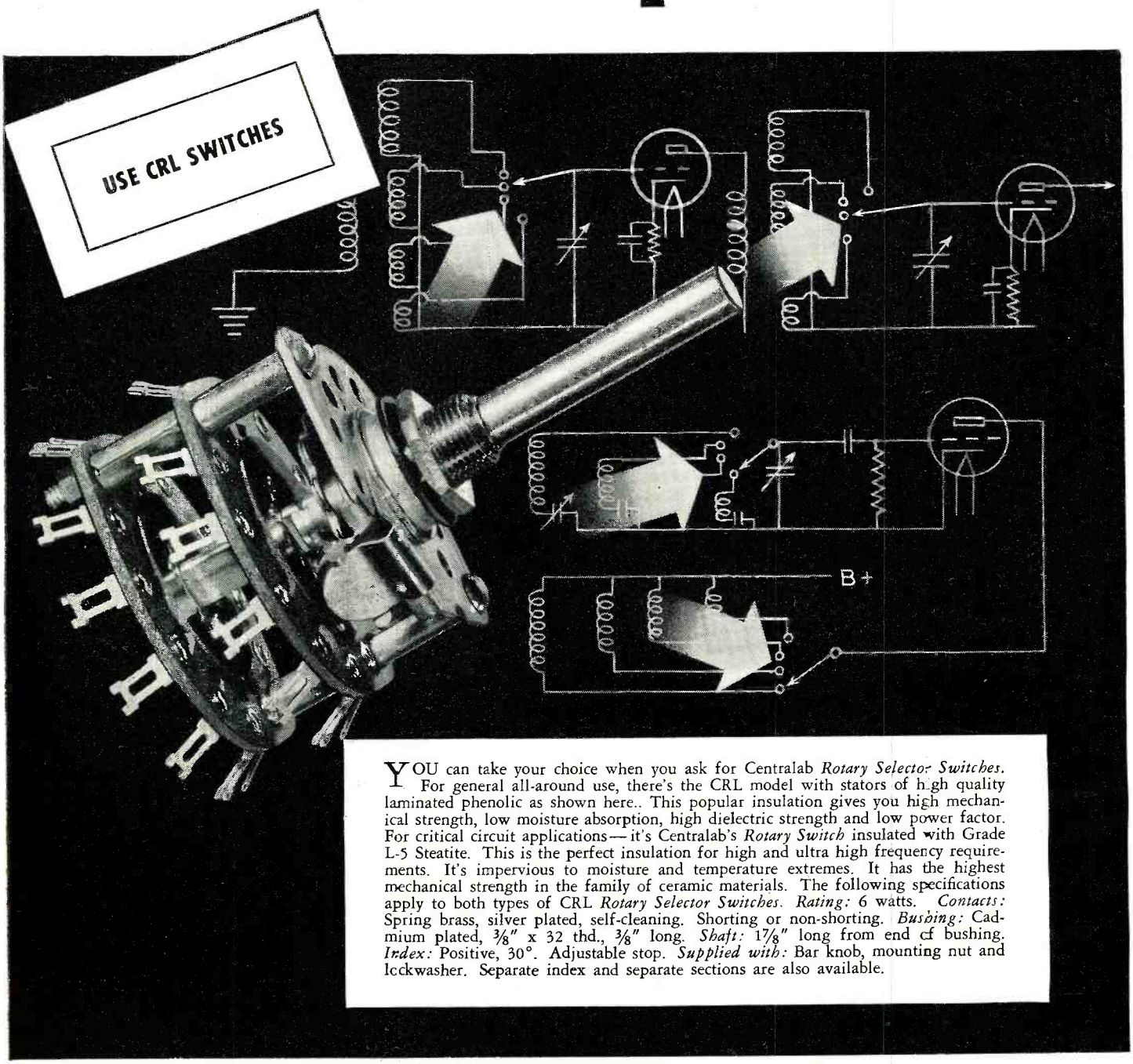
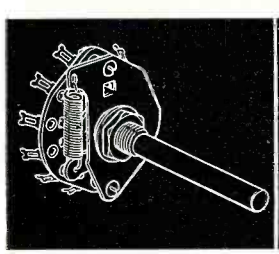
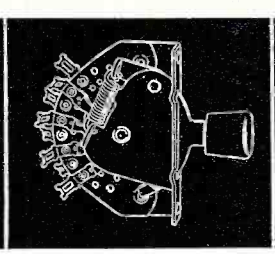


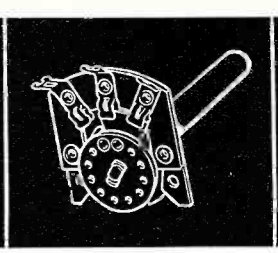
YOU can take your choice when you ask for Centralab *Rotary Selector Switches.* For general all-around use, there's the CRL model with stators of high quality laminated phenolic as shown here.. This popular insulation gives you high mechanical strength, low moisture absorption, high dielectric strength and low power factor. For critical circuit applications — it's Centralab's *Rotary Switch* insulated with Grade L-5 Steatite. This is the perfect insulation for high and ultra high frequency requirements. It's impervious to moisture and temperature extremes. It has the highest mechanical strength in the family of ceramic materials. The following specifications apply to both types of CRL *Rotary Selector Switches. Rating:* 6 watts. *Contacts:* Spring brass, silver plated, self-cleaning. Shorting or non-shorting. *Bushing:* Cadmium plated, 3/8" x 32 thd., 3/8" long. *Shaft:* 1 7/8" long from end of bushing. *Index:* Positive, 30°. Adjustable stop. *Supplied with:* Bar knob, mounting nut and lockwasher. Separate index and separate sections are also available.



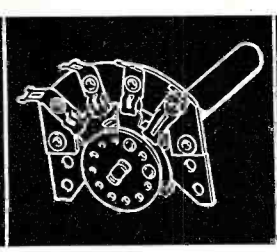
Coil spring of Centralab's new *Coil and Cam Index Switch* gives you smoother action... guaranteed minimum life of 150,000 cycles.



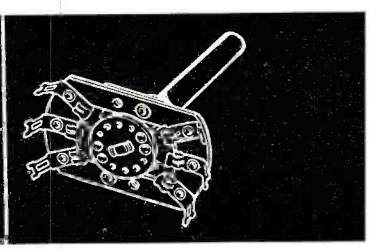
CRL *Lever Switch* provides positive indexing. Like Coil and Cam Index Switch, spring can be replaced without removing switch from chassis.



Tone Switches are used for step-type tone control circuits; off-on, talk-listen and band change applications; inter-com station selectors.



This *Tone-Switch* is single-pole, three-position selector type with shorting contacts. Like all CRL *Tone Switches,* it gives you long life.



Double-pole, double-throw *Tone Switch,* is versatile, may also be used as single-pole, double-throw or single-pole, single throw switch.

Se vice Eng neers

The right switch, control or capacitor carries the name "Centralab." It's right for your customers because high quality Centralab parts mean better performance . . . longer life. It's right for you because the satisfaction it gives your customers means more repeat business . . . more new customers. Yes, compare quality . . . compare performance . . . compare wide selection . . . compare easy availability, and you'll see why successful radio servicemen everywhere use CRL parts to build up their business. For the complete story on the Centralab line, see your Centralab Distributor today.

Centralab
CRL
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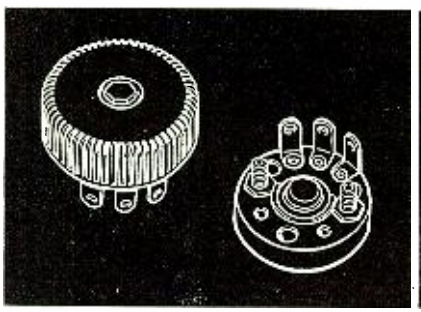
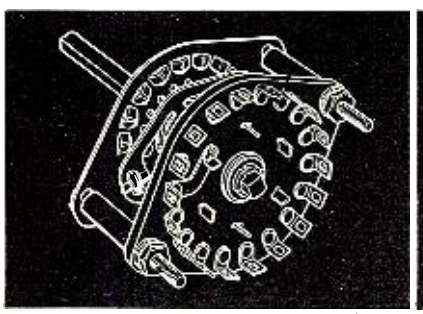
Division of GLOBE-UNION INC. • Milwaukee

Ask Your Distributor for These CRL Parts



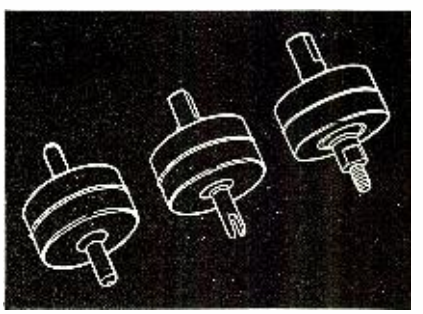
CONTROLS

MODEL "M" for voltage-divider antenna shunt and "C" bias control, tone control, AF grid control. MODEL "1" for all miniature applications such as hearing aids, portable radio receivers; rated at 1/10 watt, actually smaller than a dime. MODEL "R", wire wound, for voltage divider, antenna shunt, "C" bias, AF grid or tone control circuits.



SWITCHES

ROTARY for band change, meter, intercom circuits; made in ceramic and phenolic models. ROTARY SPRING RETURN for meter selection, intercom, phono-radio applications. MEDIUM DUTY for band changing in low power exciter-transmitters and receivers. LEVER ACTION for intercom, speaker, microphone and other applications.



CAPACITORS

TC HI-KAPS for correcting temperature drift in TV, FM, AM, VFO circuits. BC and KOLORDISK HI-KAPS for by-pass and coupling applications in non-resonant, TV, AM, FM, AF, HF, VHF, UHF circuits. HI-VO-KAPS for TV power supplies. CERAMIC TRIMMERS for padder applications in TV, AM, FM, and HF circuits.

Simpson

INSTRUMENTS THAT STAY ACCURATE

Presents

the **New!** MODEL 303

VACUUM TUBE VOLT-OHMMETER

. . . A Worthy Companion of the 260

SPECIFICATIONS

DC Voltage
Ranges—1.2, 12, 60, 300, 1200 (30,000 with Accessory High Voltage Probe)
Input Resistance—10 megohms for all ranges
DC Probe—with one megohm isolating resistor
Polarity reversing switch

Ohms
Ranges—1000 (10 ohms center)
100,000 (1000 ohms center)
1 megohm (10,000 ohms center)
10 megohms (100,000 ohms center)
1000 megohms (10 megohms center)

AC Voltage
Ranges—1.2, 12, 60, 300, 1200
Impedance (with cable) approx. 200 mmf shunted by 275,000 ohms

AF Voltage
Ranges—1.2, 12, 60
Frequency Response—Flat to 100,000 cycles

Decibels
Ranges—−20 to +3, −10 to +23, +4 to +37, +18 to +51, +30 to +63
Zero Power Level—1 M. W., 600 ohms

Galvanometer
Zero center for FM discriminator alignment and other galvanometer applications

R. F. Voltage
(Signal tracing with Accessory High Frequency Crystal Probe)
Range—20 volts maximum
Frequency—Flat 20 KC to 100 M.C.
105-125 V. 60 cycles

Size *5¼"x7"x3⅛" (bakelite case). Weight: 4 lbs. Shipping Wt.: 6½ lbs.*

Dealer's Net Price *Model 303, including DCV Probe, ACV—Ohms probe and Ground Lead—$58.75; Accessory High Frequency Probe, $7.50 Accessory High Voltage Probe, $14.85*

Also available with roll top case, Model 303RT—$64.75

Smaller and Handier for Greater Portability

A worthy companion of the world-famous Model 260 is this brand new addition to the Simpson line—the Model 303!

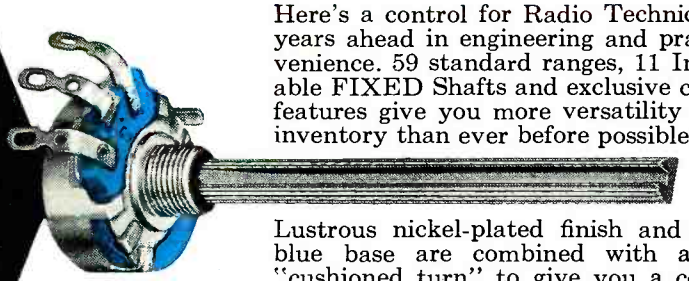
Skilled Simpson engineers spent months of painstaking research in the laboratory to produce the Model 303, which is one of the most versatile instruments ever made for TV servicing. This ruggedly constructed instrument offers the maximum in portability because it is approximately 60% smaller than other vacuum tube volt-ohmmeters. However, no sacrifice has been made in readability. The 303 has a large 4½" meter, despite its handy compactness.

One of the many features of the 303 is its low current consumption. The AC voltage range is wider than on any other similar instrument—from 1.2 volts minimum to 1,200 maximum. Like all other instruments bearing the Simpson name, the Model 303 is an instrument of highest quality at an amazingly low price.

SIMPSON ELECTRIC COMPANY
5200-5218 West Kinzie Street, Chicago 44, Illinois
In Canada: Bach-Simpson, Ltd., London, Ontario

ONLY THE NEW IRC TYPE Q CONTROL

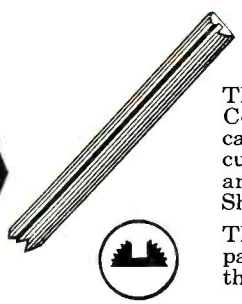
Gives You these Advanced Features for Modern AM, FM and TV Servicing



Here's a control for Radio Technicians that's years ahead in engineering and practical convenience. 59 standard ranges, 11 Interchangeable FIXED Shafts and exclusive convenience features give you more versatility with lower inventory than ever before possible.

Lustrous nickel-plated finish and distinctive blue base are combined with a smoother "cushioned turn" to give you a control that looks, "feels" and performs better than any you've ever used.

KNOB MASTER FIXED SHAFT



enlarged cross-section

This 3" long *fixed* shaft is standard on the Q Control. 90% of all AM, FM and TV ¼" knobs can be accommodated without alteration, except cutting to length. It is knurled, flatted and slotted, and ends spread easily for worn or oversize knobs. Shaft inserts are no longer needed.

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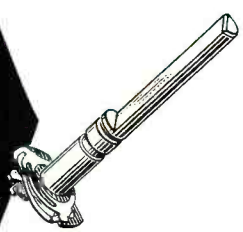

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LOUDSPEAKER ENCLOSURES

By
JOHN D. GOODELL
Minnesota Electronics Corp.

Compact corner cabinet design, using fifteen-inch cone, extends the low-frequency response per cubic foot of enclosure volume.

A review of the principles involved in selecting loudspeaker enclosures for various applications.

MUCH of the data given are presented in practical "rule - - of thumb" form rather than as rigorous theoretical exposition. There are several basic types of enclosures and innumerable variations of them.

Flat Baffles

This is the simplest mounting for a cone type, direct radiator loudspeaker. The baffle functions to separate the front and back waveforms and to prevent cancellation effects between them. The success with which this is accomplished depends largely upon the size of the baffle, which, ideally, would be infinite. This is approximated where the loudspeaker is mounted in a wall between two relatively large rooms. The advantages of a flat baffle are that it is a simple structure physically, it does not tend to introduce undesirable cavity resonances, such as are obtained with many cabinet designs, and, where it consists of a wall, no floor space is taken up by the loudspeaker.

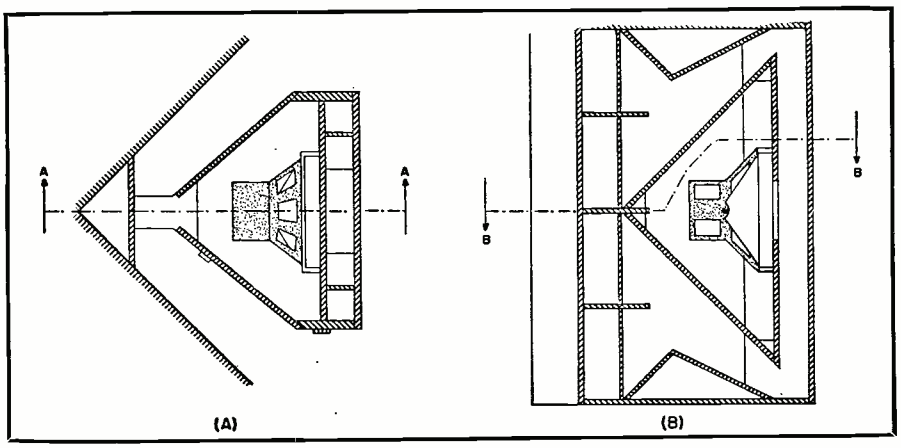
The principal disadvantages are that there is poor loading of the loudspeaker cone at low frequencies, and the low-frequency energy is transmitted to the air with poor efficiency. Another disadvantage is that the directional effects of the very-high frequencies are not compensated for by a flat baffle, and the high frequency distribution is unsatisfactory. With flat baffles, as with all loudspeaker housings, it is important that the material used be sufficiently heavy and well damped to prevent vibration of the baffle. This means that plywood baffles must be at least ¾" thick and, if large, should be braced by heavy cross pieces or deadened with pads of acoustic material. The characteristics of flat baffles are desirable only when it is unnecessary or unimportant to reproduce the extremes of the audio spectrum. However, it is undoubtedly better to use a flat baffle, particularly a wall, than to mount the loudspeaker in the cabinet with other components, where the acoustic design is almost invariably unsatisfactory and tends to introduce hang-over effects and peaks in the response curve.

When the loudspeaker is mounted in a wall with a relatively large room on each side, it is practical to consider the structure in terms of a flat baffle. When the room at the rear is small, approaching the dimensions of a standard type of cabinet, other problems are involved. The effects begin to have importance when the speaker is mounted in the door of a relatively small closet.

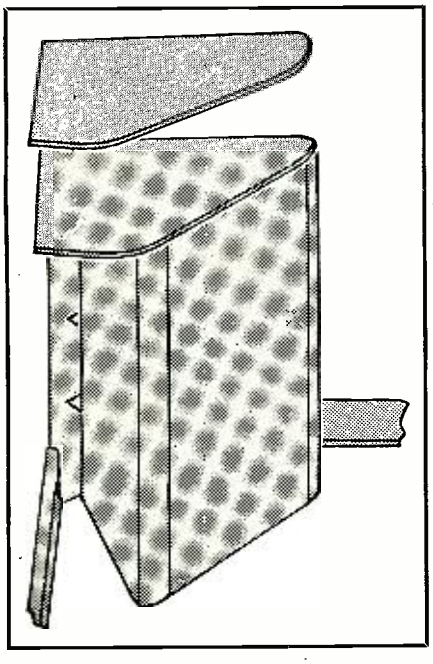
At any frequency where the maximum dimension of the enclosure is less than a quarter-wavelength, there will be an undesirable effect on performance. In general, this appears as an increase in the resonant frequency and faulty reproduction of low frequencies. If this approach is the only practical method for a particular installation, it is worthwhile to line the enclosure with absorptive material. In general, such installations should be avoided, and if a closet is used, the spaces should be modified in accordance with the design of furniture-type cabinets. In other words, a suitable cabinet may be built into a closet, but simple mounting of the speaker in the door of a closet is far from ideal.

Vented Cabinets

The "bass reflex" type of cabinet is probably the most popular and widely-used basic design. Although this structure has many advantages when properly designed, it is not as simple in principle as is generally believed. It is quite easy for the amateur to produce very undesirable results with a bass reflex enclosure that is not coordinated properly with the characteristics of the loudspeaker unit used. Within certain limits, it is possible to obtain better low-frequency response from a bass reflex cabinet of minimum dimensions than from any other type. This is used to advantage where cabinets must be built with very small cubic content, but the size has often been carried to extremes that are misleading to the average observer. Many people have condemned this type of design on the basis of observing the results obtained with a very small cabinet. It must be recognized that there is no known method of generating satisfactory low frequencies from very small cabinets, and that a bass reflex design may help but can never compensate completely for such limitations.



The Klipschorn corner cabinet with 15" motor reproduces frequencies down to 30 c.p.s., yet occupies only 15 cubic ft. Comparable theater systems require 60 cubic ft. or more.



Corner type cabinet, occupying only 15 cubic ft., with frequency range from 30 to 500 c.p.s. Space above the cabinet is a mounting space for high-frequency horn.

Well-designed bass reflex cabinets are capable of excellent results. Many manufacturers provide such cabinets to accommodate their loudspeakers, and others make drawings available. It is usually more desirable to use the dimensions given by the loudspeaker manufacturer rather than to attempt to design such a cabinet without adequate facilities for measurement of the results. However, it should be mentioned that the manufacturer also sometimes makes compromises between optimum performance and space requirements because he knows that the average customer will not tolerate a cabinet as large as is necessary for the best possible results. Bass reflex cabinets, when properly designed, are capable of increasing the low-frequency response with a given cabinet dimension, decreasing the cone excursion required for a given low-frequency intensity, and thus lowering the distortion from excessive cone motion. They rarely provide satisfactory radiation as low as 50 cycles, and designs that are improper have a tendency toward resonant hang-over effects at low frequencies. It is almost never satisfactory to place a loudspeaker made by one manufacturer in a cabinet designed by another.

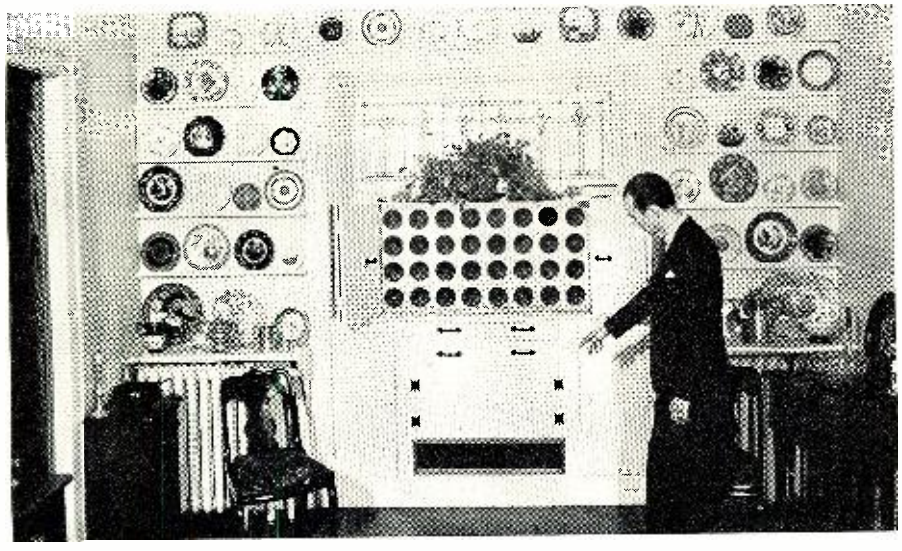
For the experimenter who wishes to investigate such cabinets on a cut-and-try basis, the following suggestions are given. It is well to start with a design that at least approximates the recommendations of the manufacturer. It is possible to adjust the characteristics considerably by changing the placement and size of the damping pads used inside the enclosure. The basic purpose of the damping pads is to absorb the middle and higher frequencies where destructive interference will result from radiation through the port. The port should be placed close to the loudspeaker opening so as to take advantage of the mutual radiation impedance (in-phase simultaneous compression of the air between the two openings tends to reinforce the transfer of energy to the air). The characteristics may also be changed by adjusting the size of the port. The port should initially be made larger than the expected optimum and then tuned with sliding panels. This means that the initial size of the port should be greater in area than the area of the cone used.

One method of adjusting the size of the port is to apply a signal from a dry-cell flashlight battery to the speaker terminals periodically. When the signal is applied, there will be a distinct click as the d.c. impulse displaces the speaker cone. When the signal is removed, the speaker cone will return to its normal position and will generate another sound. If the sound generated when the speaker returns to its rest position is also a relatively sharp click, the enclosure may be considered as providing satisfactory damping of the cone, and low-frequency hang-over effects will be minimized. If the damping is poor, the speaker cone will oscillate before returning to rest and generate a sound that hangs on slightly, ringing with a "rain barrel" effect. Adjusting the port will aid in obtaining the desirable double click.

Another method of adjusting the port is to apply a signal from an oscillator and adjust the port for maximum output at the lowest frequency it is possible to generate with reasonable intensity. One danger in this system is that it is often difficult to differentiate, when listening, between the true fundamental and the second harmonic, although with practice this can be learned.

Since the characteristics of the room greatly affect the low-frequency response, it is often worthwhile to make adjustments of this kind even in cabinets that are assumed to be properly designed by the manufacturer. Surprisingly, it is sometimes desirable simply to remove the back from such a cabinet and close up the port; success of the experiment will depend on the specific room in which the cabinet is used and the location of the cabinet therein. This does happen often enough

Custom home installation using 32 special small speakers, producing exceptionally wide-range response with low distortion and desirable spatial distribution of source. Note particularly the wide labyrinth port near baseboard.



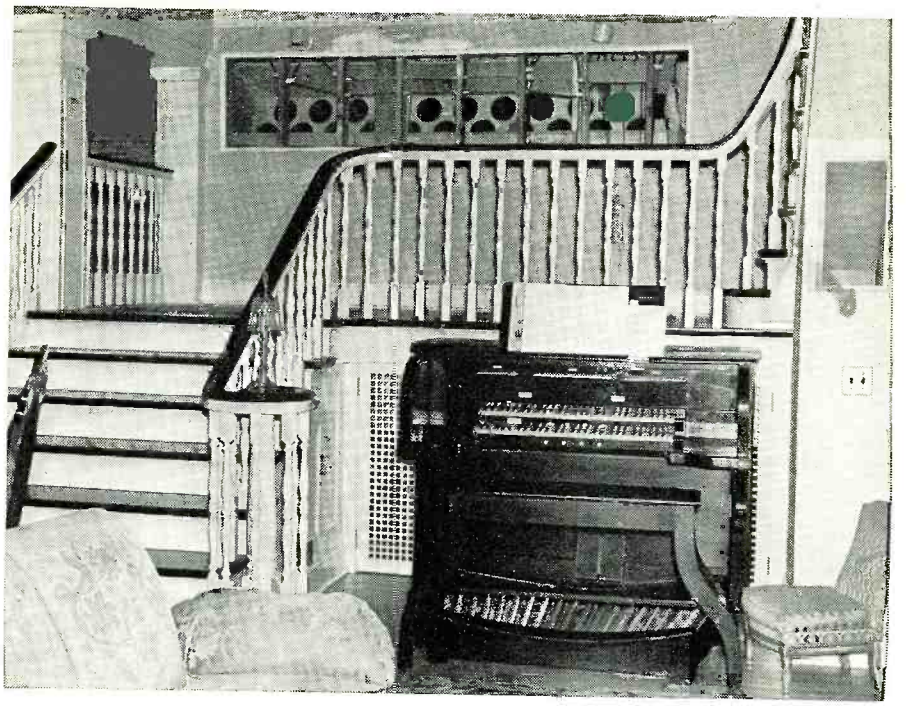
to make it worthwhile trying in most locations. In any event, it is an interesting opportunity to observe the characteristics of the bass reflex enclosure as opposed to the simple, open-back cabinet in various room locations.

The only method for obtaining optimum results is to listen to a wide variety of signals with the cabinet in various positions and with all possible adjustments varied periodically. However, it takes a great deal of listening to a great many different types of signals on various systems to develop the ability to make such judgments with accuracy. It is very, very easy to be fooled by the signal source, the characteristics of your own hearing at any given time, and dozens of other variables. The same observations should be made while listening in various parts of the room. A system may be adjusted for excellent reproduction from one listening position and yet turn out to be most unsatisfactory for other locations. Hours may be spent in making adjustments while listening in one location, and how disappointing it is to find that the results are far from optimum for the general spaces in the room.

Corner Cabinets

A distinct line cannot be drawn between wall mounting of loudspeakers that should be considered strictly flat baffle arrangements and those that partake of horn characteristics. In general, it is desirable to mount a loudspeaker, whether it be in a cabinet or in a wall, as close as possible to 2 or more wall junctions. The simplest explanation for this is that the walls then function roughly as the sides of a horn and aid in projecting the energy into the room. Obviously a corner placement is ideal from this standpoint. The principal reinforcement obtained with corner locations is at the low frequency end of the spectrum. However, since the high frequencies tend to beam, it is clearly desirable to locate the loudspeaker in a position where the angle between the center beam of the loudspeaker and the listener is minimized. In a corner location the maximum angle that will appear in any listening position between the focus line of the loudspeaker and the listener is 45 degrees. This same principle dictates the placement of a cabinet at the end of a rectangular room rather than along the side wall.

In many corner cabinets the rear radiation is guided back along the walls of the room to reinforce the low-frequency response from the loudspeaker. The corner cabinet designed by Paul Klipsch constitutes a folded horn that radiates frequencies as low as 30 cycles with remarkable efficiency. In this design the radiation from only one side of the loudspeaker is used. The walls of such an enclosure absorb the majority of the energy above approximately 1500 cycles, and it is necessary to use a separate unit for high-frequency reproduction.



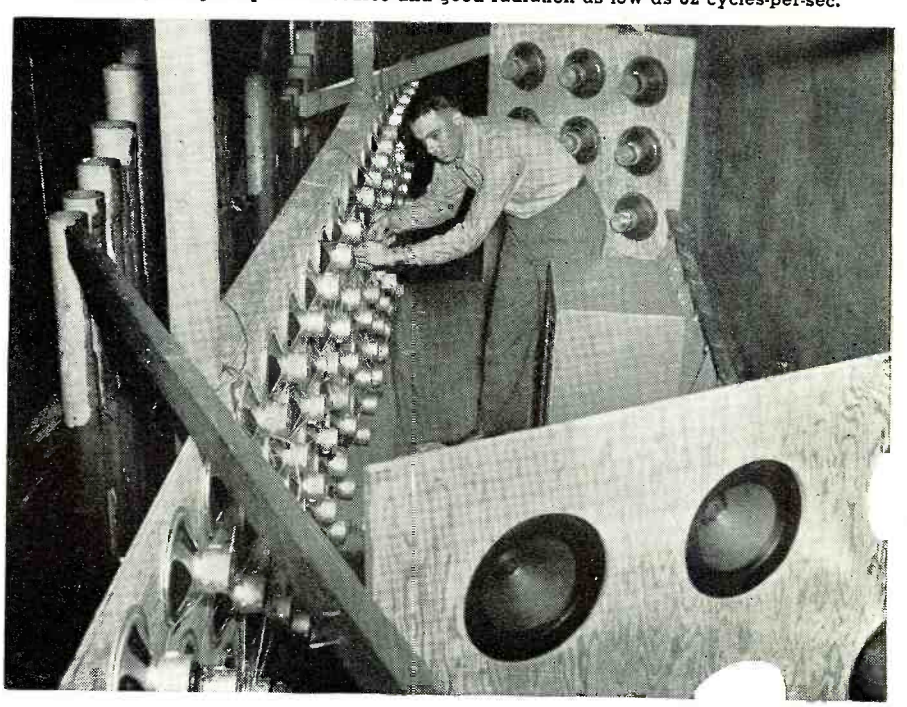
Multiple loudspeakers in custom radio-phonograph-pipeless organ installation.

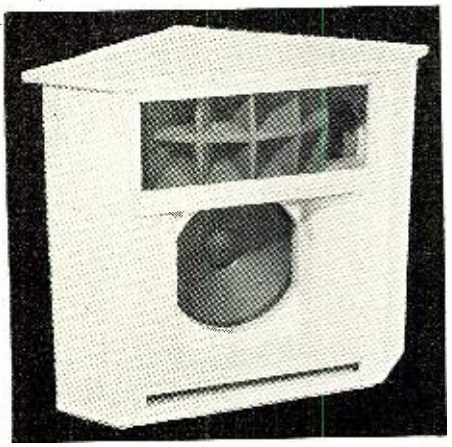
It is entirely possible to combine the bass reflex principle with corner cabinet design. However, with corner cabinets it is usually practical to achieve equal or superior results with the rear radiation guided along the walls, and there is less danger of cabinet resonance. On the other hand, the bass reflex design is attractive because of its ability to minimize cone excursions for a given low-frequency radiation. Where adequate space is available it is probably better not to combine the two designs, but where maximum low-frequency radiation is desired with a minimum of space, the bass reflex corner cabinet is definitely indicated.

One other feature of the corner arrangement that is now becoming important is the fact that combining a television screen with a corner speaker cabinet results in the most efficient use of the room area for visual observations at minimum angles.

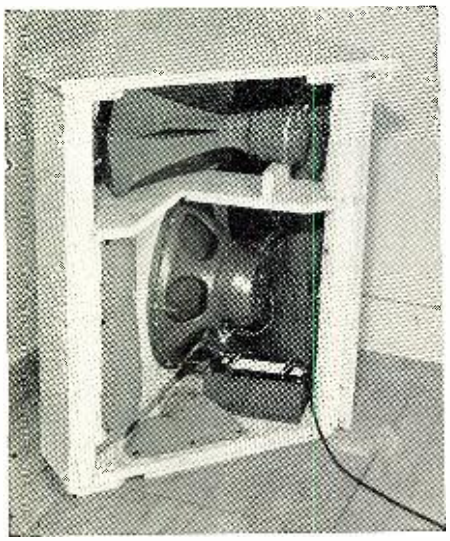
In motion picture theater installations, one of the important considerations is the matter of preserving the

An experimental installation of one hundred special 8-inch loudspeakers and twenty-four 10-inch units on the catwalk above the organ chamber. Provides diffuse high-frequency sound source and good radiation as low as 32 cycles-per-sec.





Front view of a corner cabinet designed for a dual-channel speaker system.



Interior of above installation with side removed. Cut-away section of top shelf allows upper section to form a second port for low-frequency reinforcement.

illusion that the sound comes from the performer on the screen. In working with these problems, it has been determined that the ratio of sound coming directly from the loudspeaker system and the sound coming from reflecting surfaces is extremely important. In these installations the engineer strives to keep the ratio high, with the majority of the sound reaching the listener directly from the loudspeaker units. In music reproducing installations, particularly in the home, the opposite effect is often desired. Live music rarely emanates from a point source as restricted in size as a loudspeaker cabinet.

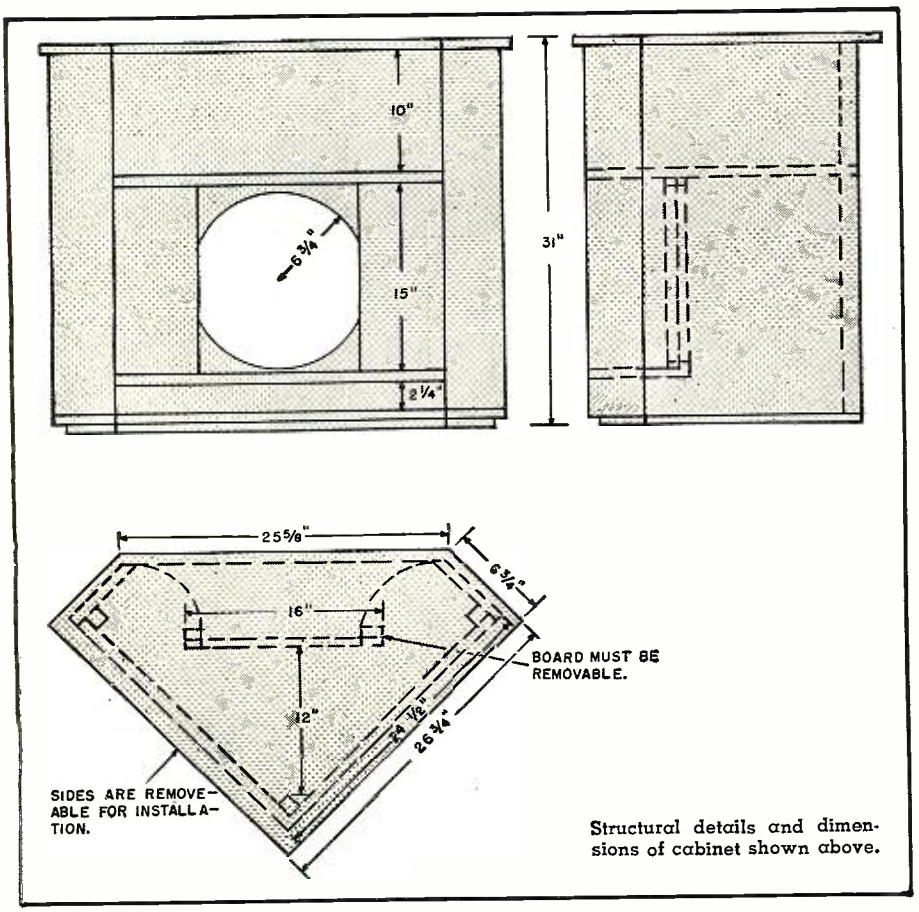
Auditory perspective is an important part of the illusion, and it may be approximated by deliberately introducing a condition where a large portion of the sound reaches the observer from reflecting surfaces rather than directly from the loudspeaker. It is partially because of the important contribution to realism made by this effect that many people have found it desirable to place loudspeakers in rooms adjacent to the listening location. Other experimenters have found that placing loudspeaker units so that they face the wall away from the listening location at angles to produce reflections via the side walls increases the illusion of auditory perspective. In most installations it is worthwhile to experiment with effects of this kind, and often the results obtained will be startlingly successful.

There is one disadvantage in using the reflecting walls exclusively to distribute the sound energy. This is the fact that the very high frequencies tend to become absorbed under these conditions, and brilliance is sacrificed. The extent to which this will be observed depends partly on the reflecting characteristics of the walls. Obviously, very hard plaster walls will tend to reflect a large percentage of the energy. Draperies, wood, and absorptive materials of all kinds will reduce the high-frequency response observed from such a system. It is well to bear in mind that almost all materials tend to absorb high frequencies to a greater degree than they do the middle and low frequencies. In spite of this consideration, there is often sufficient contribution to the realism of reproduction to compensate for some loss of brilliance. The audio engineer has a tendency to lose sight of the over-all effectiveness of a music reproduction system in the effort to retain the widest possible frequency response. With many commercial signal sources, some losses at the extreme high end are not only tolerable but desirable since the majority of the content is noise rather than music.

Another method of achieving a "spread" source of sound, together with other desirable results, is to use a large number of small coned speakers. Thirty or more properly designed five- or six-inch loudspeakers mounted in a bank at one end of a long living room are capable of remarkably realistic reproduction. In such installations each speaker unit is required to handle so small a portion of the energy that distortion is reduced to a minimum, the lightness of the small cones makes good high-frequency reproduction possible, and the mutual radiation impedance of large clusters provides efficient low-frequency radiation. At very low frequencies, the cones function as a single unit to move a wall of air. At high frequencies they act individually to provide wide-angle distribution of the energy.

Since relatively inexpensive units may be used, it is often possible to make such an installation at a cost equal to or lower than a conventional system. It is usually desirable to mount the speakers very close together with a slight arc across the surface of the baffle to effect optimum distribution and reduce any tendency to focus. In large rooms as many as a hundred units in a bank have been used successfully. This sounds as though it would require a great deal of space, but a little consideration will reveal that the space factor is not serious. A bank of five-

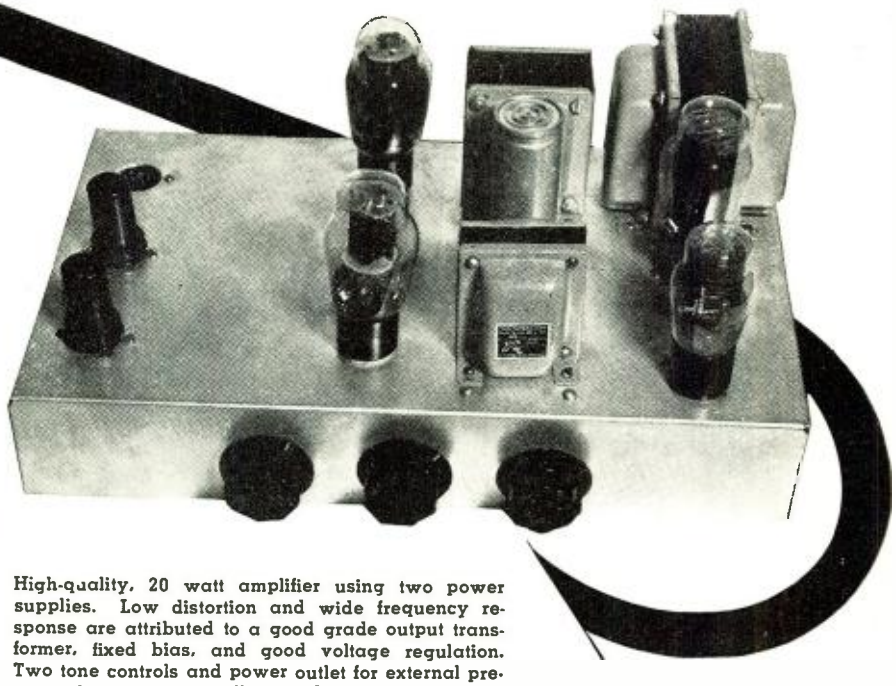
(*Continued on page* 118)



Structural details and dimensions of cabinet shown above.

High-Quality AMPLIFIER DESIGN

By
GLEN SOUTHWORTH



High-quality, 20 watt amplifier using two power supplies. Low distortion and wide frequency response are attributed to a good grade output transformer, fixed bias, and good voltage regulation. Two tone controls and power outlet for external preamp shown are not illustrated in the schematic.

Simple testing techniques used to evaluate various forms of distortion prevalent in audio amplifiers.

THE audio amplifier appears to rank high in popularity with the constructor and experimenter. Several reasons might be advanced for this; however, an advanced appreciation of good reproduction, brought about by high-quality FM broadcasts and new recording developments, is undoubtedly a very important consideration. As a result, a desire for good equipment at moderate cost has encouraged many technically-minded listeners to assemble their own equipment from component parts, often with considerable savings over ready-made assemblies.

Unfortunately, home constructors and experimenters are many times faced with the serious handicap of unfamiliarity with new circuits, combined with a lack of adequate testing facilities. As a result, equipment on which considerable time and money has been spent may fall far short of the desired performance. A knowledge of simple testing techniques and likely sources of distortion is therefore very desirable.

In judging audio amplifiers, a number of factors are usually considered, including power output, frequency response, harmonic distortion, and, in recent years, intermodulation distortion and the several other forms of not uncommon distortion. The relative importance of these various factors is subject to controversy and, of course, will be influenced by the particular application to which the amplifier is put and the associated equipment used.

Considering power output, an amplifier may be rated as follows: At maximum power output on a single frequency, at output at a certain percentage of harmonic distortion on a single frequency, or, more rigorously, at output over the entire usable frequency range at a given percentage of distortion. In recent years, ratings at percentages of intermodulation distortion are often given. Needless to say, the power rating of a particular amplifier will vary greatly, depending upon the standards used.

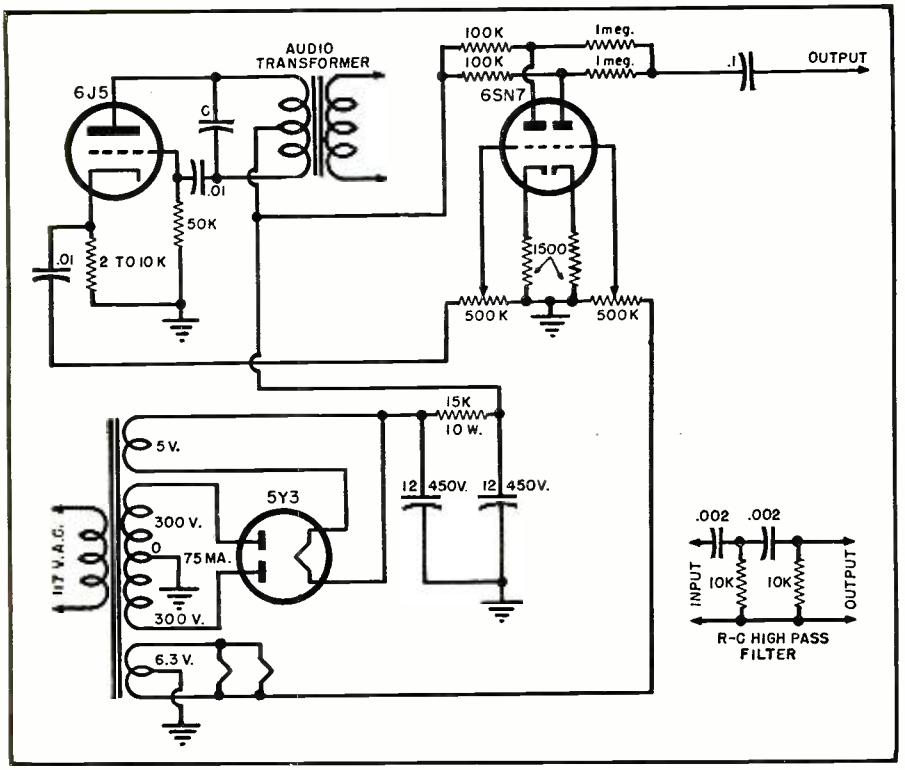
An important consideration in power requirements for sound reproduction is loudspeaker efficiency. Some high-quality loudspeakers may have efficiencies approaching fifty per-cent, while it is generally considered that less expensive, conventional speakers have efficiencies on the order of ten per-cent. As a result, it may require a 50 watt amplifier used with low-efficiency speakers to achieve the same sound intensity produced by a 10 watt amplifier driving high-efficiency speakers.

Another important problem relating to power output requirements is the fact that in reproducing speech and music, an amplifier is almost always handling complex waves which may impose a severe limitation on the amount of undistorted power output. The reason for this is that conventional amplifiers are essentially two-dimensional devices; therefore, when two or more frequencies are being handled at the same time, the higher frequencies will be superimposed upon the lower. As a result, the undistorted output available will decrease as the complexity of the waveform handled increases. In high-quality reproduction, this may mean a power reduction of 10 to 20 db. compared to the single frequency sine wave capabilities of the amplifier.

An interesting method of increasing amplifier efficiency is through the use of multiple-channel amplification. The simplification of complex waveforms through frequency division in a two channel system may give efficiencies approximately double that of a conventional system, although this will depend to a degree on the crossover frequency used and the frequency range of the input signal.

Because it more closely approximates actual operating conditions, intermodulation distortion measurement has been the subject of considerable interest in recent years. Intermodulation distortion may result from several factors, one of which is the fact that the low-frequency component of a complex wave acts as a continually-varying grid bias. Due to this condition, the high-frequency component is amplified under ideal conditions, e.g., the center portion of the straight part of the tube curve, for only small portions of the low-frequency cycle. On peaks of the low-frequency cycle, the high frequency may be biased to a point near plate saturation or cut-off with resulting severe harmonic distortion and reduction in output.

Push-pull output transformers may represent a serious cause of distortion if their efficiency is dependent upon having low values of unbalanced direct current in the primary wind-

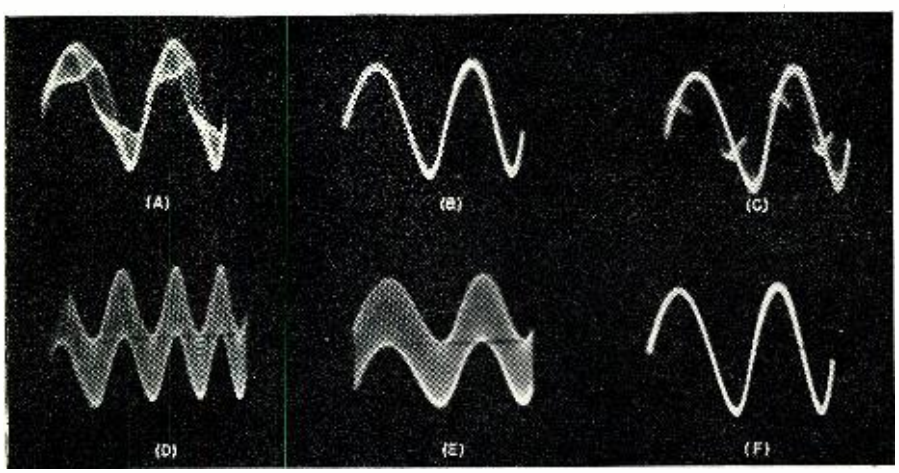


Schematic of two-frequency audio signal generator. The two-section RC high-pass filter (lower right) is for use with low-impedance circuits; an additional element may be added if greater low-frequency attenuation is desired.

ings. Under actual operating conditions, low-frequency components will cause considerable dynamic unbalance in the output transformer with consequent distortion and lowered output in a poorly-designed unit. One test of output transformer quality is to remove one of the push-pull output tubes, if this can be done without seriously upsetting the circuit, and operate the amplifier with single-ended output. With a good transformer, frequency response and power output capabilities should be fairly constant from about 100 cycles, on up.

In the case of a poor transformer the frequency response may drop off badly below 1000 cycles, and the undistorted power output at both high and low frequencies may be greatly diminished. In units of similar nature, the frequency response is often a function of the load impedance, and low frequency efficiency usually increases as the load resistance increases. This means that at speaker resonance, where the speaker impedance may rise to a fairly high value, the low frequency efficiency of the amplifier may increase materially, thereby contributing to speaker hangover.

Oscilloscope traces illustrating various patterns encountered in intermodulation analysis: (A) Excessive modulation of high-frequency component produced by self-biased, push-pull 6L6 amplifier at 10 watts. (B) Same amplifier using fixed bias and at 20 watts output. (C) Same amplifier overdriven with harmonic distortion of the high-frequency component resulting. (D) The 60 and 3000 cycles mixed one to one with sweep set to show 60 cycle component. (E) Same frequencies with sweep set to show 3000 cycle component. (F) Output of high-pass filter.



Inverse feedback may be used to reduce this effect and is often of decided benefit with low-grade output transformers, although the amount of feedback obtainable with these units is often not very great. Similar results may be obtained through the use of low impedance output tubes such as triodes; however, it is worthwhile to note that excellent frequency characteristics have been observed with high-quality transformers operating under conditions of excessive mismatch in circuits using beam power tubes without feedback.

Several factors should be mentioned in connection with intermodulation distortion. One is the fact that modulation is usually negative, with the result that an actual reduction in intensity of modulated frequency occurs. In some cases, a phenomenon known as "masking" may result from the suppression of low-level components in this manner. Low frequencies may suffer likewise in a nonlinear system due to the tendency of a high-intensity high frequency to "average" the tube characteristics, with a resultant decrease in gain of the low-frequency component. A similar effect is brought about by the use of high-frequency bias in magnetic recordings; an actual reduction in distortion may occur.

Although considerable emphasis has been placed on the fact that nonharmonic sum and difference frequencies of an objectionable nature may be produced by intermodulation distortion, it should be realized that in many cases true modulation does not occur; rather, the high-frequency component undergoes severe harmonic distortion. Fig. A of the oscilloscope photographs illustrates this.

The modulated portions of the wave show decided departure from sine-wave shapes. True modulation would be indicated by a thickening of the peaks of the wave without any departure from the sine-wave form. The resultant strong harmonic distortion may prove to be more objectionable than the sum and difference frequencies generated. Fig. C in the same group of photos shows high-order harmonic distortion being produced with very little intermodulation distortion.

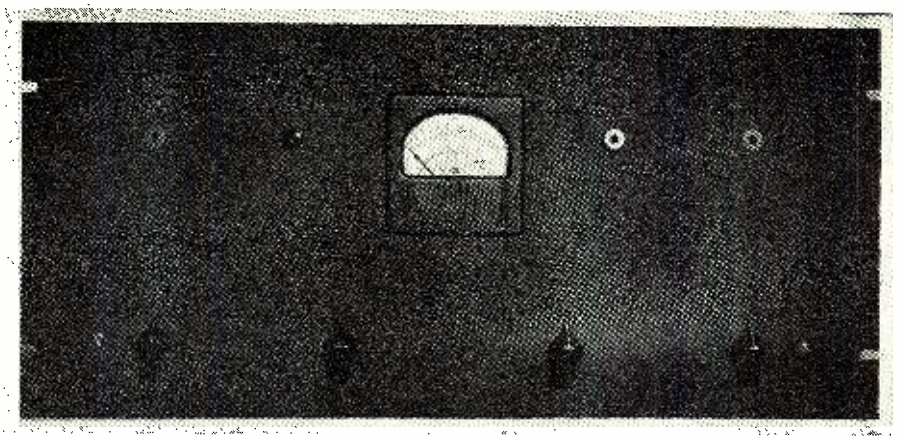
Intermodulation measurements are generally recognized as a sensitive measurement of nonlinearity and may be made with slight difficulty through the use of an oscilloscope and simple associated equipment. A schematic is shown illustrating one setup used by the author. Sixty cycle frequency is obtained from the tube filament supply for the low-frequency component, and a simple audio oscillator using an old audio transformer is used to obtain a frequency of about 3000 c.p.s. for the high-frequency component. A vacuum tube mixer is used, although it is not necessary, and the output is applied to the input of the equipment under test. The output of the amplifier is then applied to the

scope input through a simple resistance-capacitance high-pass filter which removes the low-frequency component. The scope sweep frequency is then adjusted until one or two cycles of the high-frequency component appear.

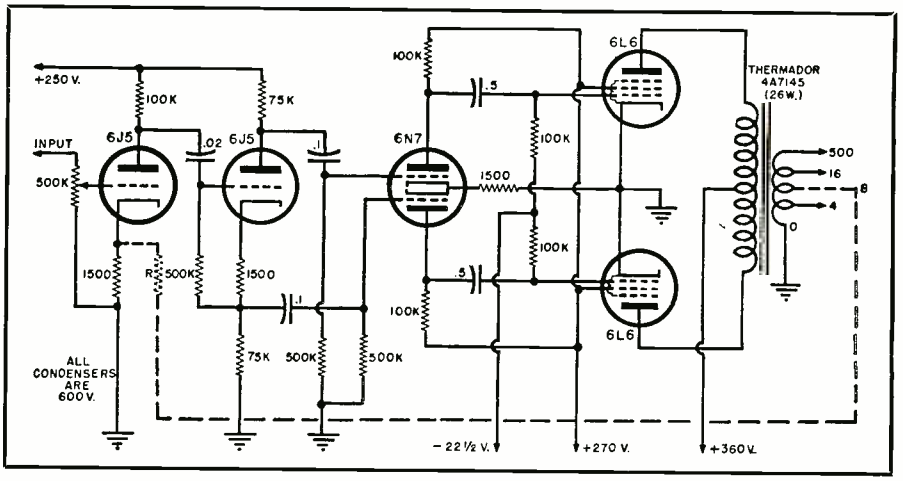
As all of the high-frequency cycles are thus superimposed, any modulation or distortion occurring during portions of the low-frequency cycle is easily detected, as shown in the accompanying photographs. Modulation percentage may be determined quickly by measuring the thickness of the trace at the peaks of the cycle and comparing the sum to the total height of the trace. If suitable precautions are taken, such as prevention of hum pickup, oscilloscope defocusing, and good suppression of the low frequency component, as low as one per-cent modulation may be observed on a five-inch scope. This corresponds, roughly, to one-fourth to one-third of one per-cent harmonic distortion, a sensitivity usually obtainable only by expensive commercial instruments. In addition, the visual method of observation is advantageous in that it permits quick recognition of distortion components and faults, such as improper bias, which may be characterized by excessive modulation appearing on only one-half of the cycle.

An example of the advantage of the use of this technique may be given by referring to the audio amplifier design included in this article. Conventional cathode bias was used on the original design and measurements made of the output at optimum load conditions. Although the amplifier was capable of delivering 25 watts output, the output level at five per-cent intermodulation distortion was of the order of two watts. Fixed bias was then substituted with the result that 20 watts was obtainable at the same distortion percentage and under optimum load conditions. Load resistances other than optimum were then used with a resultant increase in distortion percentage. Inverse feedback was then applied with the result that amplifier tolerance to changing load impedances was greatly increased, although the reduction in distortion under perfect load conditions was unimportant. As a result, variable impedance loads, such as loudspeakers, make the use of inverse feedback advisable where maximum output is desired.

Power supplies are an important design consideration in equipment where appreciable output is desired. Poor voltage regulation and insufficient decoupling appear to be two of the most important factors. Poor regulation means not only a reduction in sine-wave power output but also the introduction of a form of actual volume compression at the higher output levels. This form of distortion may be aggravated by the complex and intermittent waveforms found in speech and music and in one observed instance led to a seventy-



A front view, showing how the 60- and 3000-cycle source is mounted on a 19-inch rack panel, along with a simple v.t.v.m. used for making output measurements.



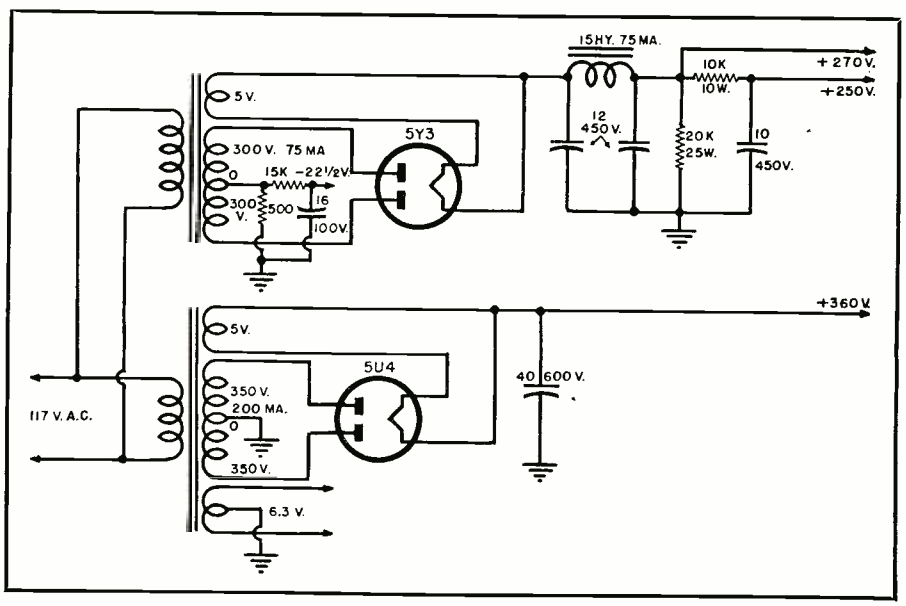
Schematic of high-quality amplifier using push-pull 6L6's and rated at 20 watts with low distortion. A separate power supply is used to provide screen and driver voltages as well as fixed bias for the output stage. Broken lines show optional inverse feedback system. Amount of feedback is determined by value of resistor *R*.

five per-cent reduction in output under conditions of dynamic drive.

In some instances the poorly regulated element of the power supply may have a fairly long time constant with a resultant tendency to suppress transient waveforms of high intensity. Resistance-capacitance filters are one of the worst sources of poor voltage regulation and may be commonly used in the screen-grid circuits

(*Continued on page* 153)

Diagram of dual power supply used in conjunction with audio amplifier described.



A C.W. FILTER

By
G. L. COUNTRYMAN
W1RBK, W3HH
Comdr., USN, Electronics Officer
Naval Shipyard, Boston, Mass.

An all-pass c.w. filter that will reject an interfering signal or amplify a desired one, without any receiver retuning. Bring that hard-to-get DX out into the open.

A metal box, 3" x 4" x 5", mounts all components.

TWENTY-FIVE years ago the new superheterodyne circuit solved most of the amateur's problems as far as receivers were concerned. Since that time, the available bands have been narrowed, and the number of amateurs using them has increased several hundred percent. The transmitting end of our business has made steady progress. Sharpness and stability undreamed of a decade ago are easily attained in even the simplest rig for the beginning ham.

What has happened in the receiver field? Few basic improvements have been forthcoming since the superheterodyne circuit. One was the crystal filter with improvements in design from time to time. Stability has been improved through the use of voltage regulators and temperature compensation, and more recently the "Q-5er" and other double conversion ideas have been presented. This double conversion has been a boon to the phone man but not of much practical help to the c.w. ham.

The idea, abandoned years ago, of using peaked audio circuits made its reappearance a couple of years ago. Initially the scheme was to sharply peak a desired signal using specially constructed chokes available on the surplus market at attractive prices. A twin-T bridge arrangement to peak the signal did away with the need for special chokes and was of about the same effectiveness. These ideas are good as far as they go, but a sharply peaked note devoid of harmonics is monotonous and very tiring to copy. The author presented a "QRM eliminator"[1] that has found fairly wide acceptance. This device may be used for peaking at an established frequency, and then eliminating an interfering signal, and for short-circuiting an interfering signal that is louder than the signal you want to copy. It is flexible, making possible several combinations of circuits by the throw of a switch.

Current IRE proceedings papers have been noted, and a recent article[2] discussing a new phase-inverter connection with an all-pass *RC* filter has been studied with interest. The c.w. filter to be described adapts these newest developments to ham requirements.

The all-pass filter is used as a selective amplifier for either accepting or rejecting any particular frequency, and the frequency that you can accept or reject is determined by turning a single knob. No longer do you have to carefully tune the receiver to bring an unwanted signal up to a pitch of 1020 c.p.s. in order to reject it; just turn the knob and at the proper point the interfering signal will fade away. Conversely if your particular head-set has a high response peak at say 800 c.p.s., a turn of a knob will bring the desired signal up to a high peak at the frequency you wish.

The filter is compact. The power requirements are so low that the average receiver power supply will furnish them, and, in addition, the circuit has the advantage of being practically fool-proof. It possesses many advantages over the conventional bridge circuits; it has a very sharp rejection slot, sharper than many receiver crystal circuits, and both null and oscillation occur at the same frequency for any given setting of the control. It can be used alone plugged into the output of the receiver with or without the crystal filter of the receiver. It can be utilized in conjunction with the surplus FL8 type of audio filter which most hams have acquired, and if desired it may be used as an audio signal source continuously variable from about 300 to about 9000 c.p.s.

Referring to the photographs, the bottom knob is the frequency control and is a dual 500,000 ohm potentiometer (R_4 and R_7 on the wiring diagram). The top knob is the selectivity control. The switch (S_1) is a double-pole, double-throw toggle switch, one position providing selective amplification at the frequency desired. In the other position, frequency rejection is accomplished at the same frequency, as determined by the bottom knob. As the selectivity control is advanced from the "broad" position, the unit will oscillate at about the point shown by the knob pointer in the photograph. Up to the audible oscillation point the selectivity becomes progressively greater, until just before oscillation it is so sharp as to be impractical to use. The important point is that it is adjustable continuously with smooth control.

All you phone men can stop reading now. The unit can be used on phone, yes, but only to eliminate heterodyne whistles. As indicated by the title, it is primarily a c.w. man's filter to re-

1. "CQ" June 1949
2. "Tunable A.F. Amplifier," Villard, "ELECTRONICS," July 1949

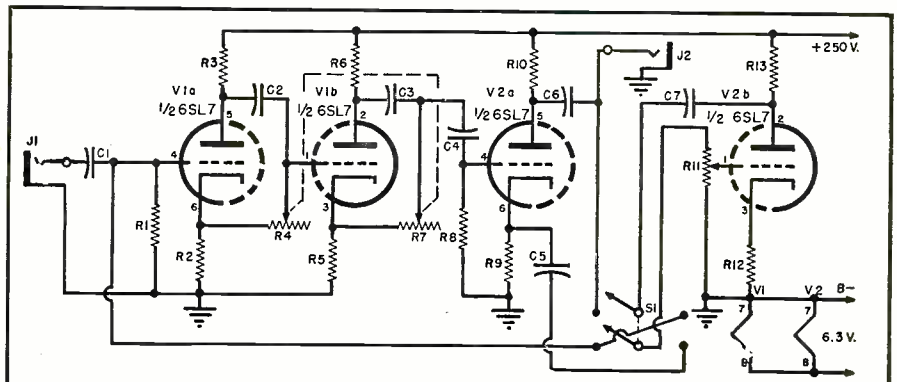
ject an interfering signal or amplify a desired signal more than the others with minimum effort and, what is important, without any receiver retuning which might lose that choice DX you are trying to bring out into the open.

Now let's scan the wiring diagram. It looks simple enough, and it is, if you build it on a fairly large chassis. No special wiring precautions are necessary. The author wanted the filter to fit into the smallest practicable space, so it was constructed in a 3"x 4"x5" metal box. A surgeon experienced in tying sutures in a small incision should be able to wire it up without difficulty. The practical way is to first wire up the sockets, including necessary leads, to the other socket and to components (and the 6.3 volt tie point) and then put the sockets in place. Internal wiring will be easier if the front socket is placed in position first and all possible interior wiring completed before mounting the rear socket. Even with this procedure the soldering is a bit tricky using the substantial iron usually found in the average ham shack. Of course, both sides of the metal box are removed, and in any event a couple of evenings are enough to do the job. Check the socket wiring carefully before installing them and connect wire resistors and ground connections to soldering lugs so that you can slip the lugs on the screws when you fasten down the sockets.

The wiring diagram is easy to follow, and no further comments are necessary. As to components, there are four items that are "fussy." The entire success of the operation will depend on how well the plate resistor and the cathode resistor in each section of the first 6SL7 are matched. Although 1000 ohm resistors are available, you can't just buy two "silver band" 1000 ohm resistors and put them in. These two resistors must have *exactly* the same value, which may be slightly over or slightly under 1000 ohms, but they must be matched and hence must be measured on an accurate bridge. Ohmmeter measurements are not of sufficient accuracy in this application. For long time stability, precision resistors should be used although in the model shown the regular 10 per-cent tolerance is used. It was necessary to check fifteen or twenty individual resistors before two were found that were exact pairs. Bear in mind that the resistance of a carbon unit will vary with the current passed through it.

The same procedure is necessary for the 2000 ohm resistors in the second plate and cathode section of the first 6SL7. Values usually available are 1800 ohms or 2200 ohms. Any value between these limits will be satisfactory, but it is mandatory that both resistors be of exactly the same value.

Standard audio tapers are satisfactory on both potentiometers. With the dual 500,000 ohm unit, it is necessary that both pots track at the same resistance reading. On several "run-of-the-mill" pots that were measured the tracking was adequate so no difficulty should be experienced.



R_1—*1 megohm, ½ w. res.*
R_2, R_3—*1000 ohm, ½ w. res. (See text)*
R_4, R_7—*Dual 500,000 ohm pot.*
R_5, R_6, R_9, R_{12}—*2000 ohm, ½ w. res. (See text)*
R_8—*5 megohm, ½ w. res.*
R_{10}, R_{13}—*47,000 ohm, ½ w. res.*
R_{11}—*50,000 ohm pot.*
C_1, C_4, C_6, C_7—*.01 μfd. mica cond.*
C_2, C_3—*.002 μfd. mica cond.*
C_5—*.05 μfd., 200 v. cond.*
J_1, J_2—*Open circuit phone jack*
S_1—*D.p.d.t. toggle sw.*
V_1, V_2—*6SL7 tube*

Diagram of c.w. filter. A separate power supply (250 v., 8 ma.) is required.

Many modern receivers have a "utility" outlet from which 6.3 volts a.c. and approximately 250 volts d.c. are available. The two 6SL7's draw only .6 amps at 6.3 volts, and at 240 volts the total plate current drain is only about 8 mils. Practically every receiver can supply this without the power supply overheating or without a voltage drop. If your receiver does not have a utility outlet it is easy to bring out the necessary leads. A small power supply can be built if desired; one consisting of a 6.3 volt transformer with two selenium rectifiers in a voltage doubling circuit will do the trick. A conventional, small transformer type power supply may be used without worrying about which side of the a.c. line is grounded.

Considerable variation in tubes has been noted. Some 6SL7s that tested as satisfactory in a tube tester did not give the same results as other tubes. Plate voltage is not critical within wide limits. From 200 to 250 volts will be satisfactory.

Again referring to the photographs, the jack at the back of the unit receives a patch panel cord, the other end of which plugs into the phone jack on the receiver. The headset plugs into the jack on the front of the filter. That's all there is to it; get the voltages to the unit, insert it between your receiver and your headset, and start turning knobs. Select a signal, peak it up sharply, and then throw the switch and hear it disappear. The filter is simple and effective for either peaking and amplifying or for rejecting a signal without having to adjust the pitch of the signal with the receiver.

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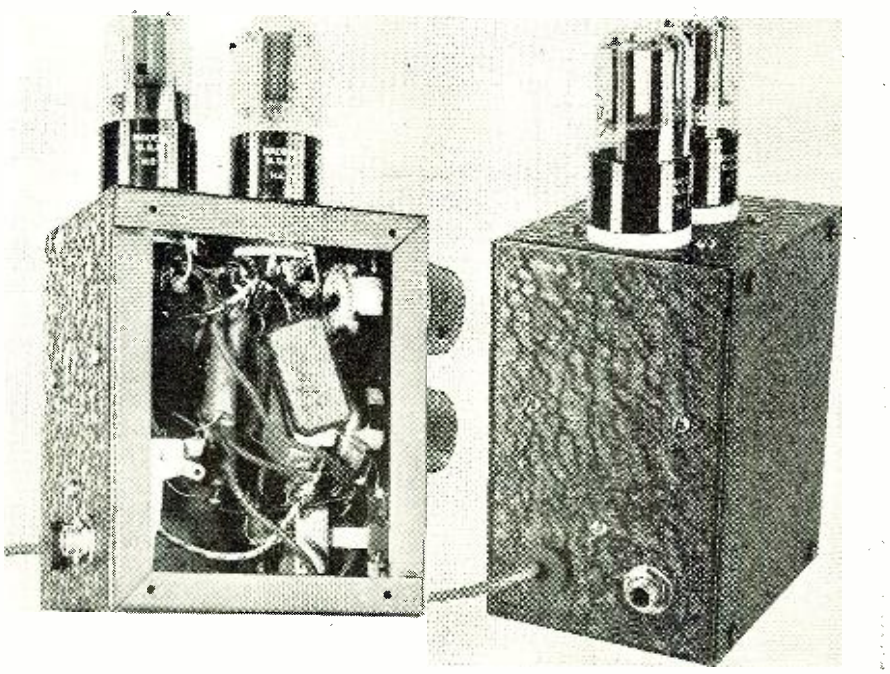
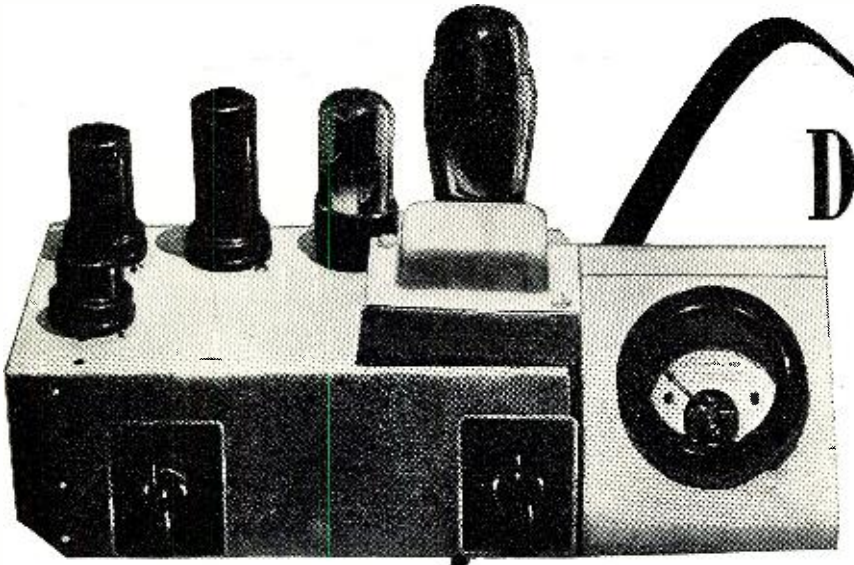
Side panel is removed to show details of internal wiring and assembly.



A Simple DISTORTION ANALYZER

By
MICHAEL WOLFE



Distortion analyzer built by author takes up little space. Included on chassis for convenience is a vacuum tube voltmeter using a 6H6 and a 6SN7.

Distortion in any amplifier can be checked with this test analyzer. An audio oscillator and an oscilloscope make up the balance of equipment.

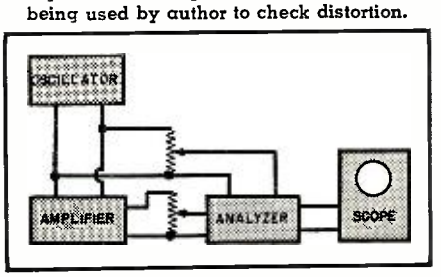
ANYONE interested in constructing high-quality amplifiers will find a distortion analyzer a very useful piece of equipment. It is a fairly well-known fact that the hearing tastes of individuals differ widely. The average enthusiast builds an amplifier and judges it on whether it sounds all right or not. This is all very well and good if he is going to use it for his own enjoyment, but if he is building it for someone else, there must be more rigid criteria of performance, the usual technical standards being frequency response, percentage of harmonic distortion, and, more recently, the percentage of intermodulation distortion.

An audio-frequency signal generator and an a.c. voltmeter will suffice for the first measurement, but to measure distortion it will be necessary to employ either a wave analyzer or a distortion analyzer. Commercial wave analyzers are complex devices costing in the neighborhood of several hundred dollars, while a simple distortion analyzer may be constructed with little expense and, in conjunction with an oscilloscope, will prove to be a very versatile instrument.

The theory of operation of the distortion analyzer is quite simple. A reference signal from an audio oscillator is fed into the input of the amplifier being tested. The output of the amplifier is shifted to 180 degrees out-of-phase with the original signal and then electronically mixed with a portion of the reference signal. The two signals 180 degrees out-of-phase will cancel each other out if they are of the same amplitude, and if the amplifier under test has not introduced any distortion. Any distortion caused by the amplifier will remain, however, when the fundamental is cancelled out. These distortion products may then be easily seen on the screen of a cathode-ray oscilloscope and classified as to harmonic distortion, improper bias, or over-excitation.

The unit built by the author consists of a 6N7 electronic mixer with cathode follower output (Fig. 2) to minimize distortion in the mixer stage, and a 6J5 distortion products amplifier. A block diagram of a typical test setup is shown in Fig. 1. The audio oscillator may be one of the *Wien* bridge type such as was described in the November, 1946, RADIO NEWS. It is highly desirable to use an oscilloscope to observe the output of the distortion analyzer, as this will increase its usefulness by indicating the kind as well as percentage of distortion in the output. If a scope is not available, however, an a.c. voltmeter may be placed across the output. To determine distortion percentage, the amplifier input is disconnected, and the reference signal input is adjusted to give 100 per-cent deflection on the output meter or scope. The amplifier input is then connected and the potentiometer adjusted to give minimum deflection. The meter or scope may then be read directly in terms of distortion percentage.

Fig. 1. Block diagram shows test setup being used by author to check distortion.



The reference signal type of distortion analyzer is somewhat more flexible than the bridged-T type of distortion meter, as it permits the testing of various frequencies throughout the audio range. It is, however, sensitive to phase shift in the equipment under test, and corrective networks may be needed to give accurate results. If the reference signal and the signal being tested are in phase, an increase in meter reading will take place when an attempt is made to balance the circuit. If 90 degrees phase shift is present, no change in meter reading will be noticed until one of the signals becomes greater than the other. Phase shift of a few degrees will cause erroneous distortion readings.

Phase shift is held to low proportions in the analyzer unit due to the use of twin triodes and cathode follower output; however, it is desirable to provide some means of compensating for phase changes in the equipment under test. Fig. 4 illustrates several simple circuits. Push-pull output on the audio signal generator provides an easy means of changing the phase of the reference signal 180 degrees for use with amplifiers whose output may be in phase with the input. B and C are phase shifting networks, similar to ordinary tone controls, that may be used to obtain exact 180 degree phase relations. These networks should preferably be used in connection with the reference signal as the tone control effect may tend to suppress or accentuate distor-

tion components from the amplifier under test.

Phase distortion may easily be determined through use of an oscilloscope. The reference signal is applied to one set of deflection plates, and the output of the amplifier under test to the other set. Phase shift other than the desired 180 degrees will produce an oval pattern on the screen. The phase shifting network may then be adjusted until a slanted line results. If harmonic distortion is present in the amplifier, irregularities in the line may be observed, and this can be used as a simple means of locating distortion in an amplifier. Once the phase adjustment is made for a particular frequency, the distortion analyzer may be balanced for minimum meter reading and the harmonic distortion percentage read directly. If a scope is unavailable, an alternate procedure is to set the amplifier output to a low value where, presumably, distortion products are not very great and then adjust the phasing control for minimum reading. As the phasing and amplitude controls are somewhat interdependent, this will usually require a series of adjustments.

In most instances amplifier phase shift will be most pronounced at very high and very low frequencies. In the former case, shunt capacities are usually the cause, while at low frequencies insufficiently large coupling condensers will cause phase shift. Similarly, poor output transformers and tone controls are common locations of phase distortion. As effective use of inverse feedback usually depends upon exact phase relations, it is usually a good policy to explore amplifier phase characteristics at various frequencies. In this manner it is sometimes possible to insert phase compensation in the feedback loop and secure higher feedback ratios than are otherwise obtainable. Likewise, although for many years phase distortion has been considered of little importance, recent studies indicate that it may have a definite effect upon the quality of reproduction.

Although the ability of the distortion analyzer to compare the output of an amplifier directly to the input means that a perfect sine wave signal source is not necessary, it is undesirable to use a signal source with a high harmonic content, as a non-linear frequency response in the amplifier under test may give incorrect readings. An example of this is shown in Fig. 3.

In making distortion checks, it is a common practice to measure distortion at various power levels and at various points throughout the audio range. Distortion due to noise or hum may be relatively high at very low power levels, decrease at moderate power levels, and increase again as the maximum power output is approached. Distortion checks at various frequencies may show a considerable variation in power output at a constant percentage of distortion.

A seldom mentioned characteristic is sometimes found in amplifiers where hum reduction is achieved by use of a push-pull circuit. In this case, the circuit tends to act somewhat like a balanced modulator and superimpose hum modulation upon a reproduced signal. This may result in unpleasant quality and apparent high distortion percentages in the low frequency response. The solution is, of course, better filtering rather than a new output transformer. A simple test is to observe the hum level with one of the output tubes removed. If hum is very noticeable, additional filtering may be required. In a like manner it is sometimes desirable to check the distortion characteristics of a push-pull amplifier with one of the output tubes removed, as this gives a rough approximation of intermodulation tests used to determine the complex wave characteristics of a unit. In a poor amplifier, power output may fall off greatly, accompanied by considerable distortion in the high and low frequencies. Similarily, the frequency response may be greatly altered.

The unit diagrammed in Fig. 2 was designed primarily for simplicity of construction for those who may have only occasional use for distortion measurements. The experimenter or custom builder who has constant use for a device of this kind would be advised to build a more elaborate unit including a built-in vacuum tube voltmeter and incorporating the phasing networks shown in Fig. 4. For convenience in securing accurate adjustments, two potentiometers may be used at the reference signal input to the distortion analyzer, with the output of one control being fed to the input of the other. This allows one control to be used for coarse balancing and the other for fine balancing adjustments. A similar arrangement may be used in connection with the phasing controls, and this type of operation is usually found in commercial distortion meters of this kind.

A vacuum tube voltmeter is to be preferred in reading the output of the analyzer but if unavailable, an oscilloscope with a calibrated screen may be used. It should be noted that although the circuit diagram in Fig. 2 shows direct coupling between the cathode of the 6N7 and the grid of the 6J5 it is important that the cathode voltage of the 6J5 be at least two

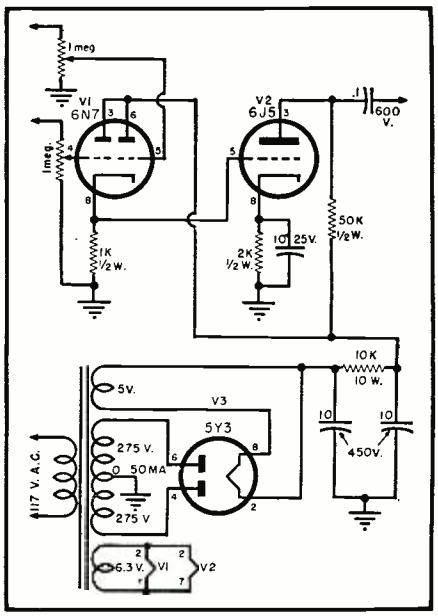


Fig. 2. Diagram of distortion analyzer.

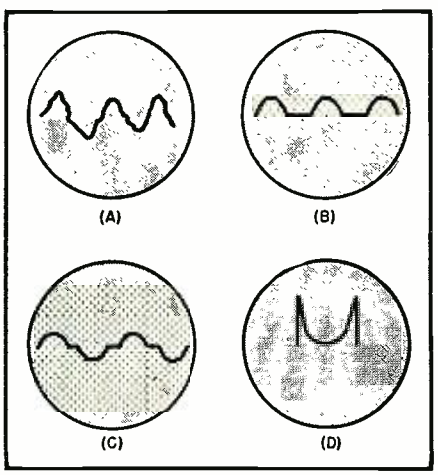


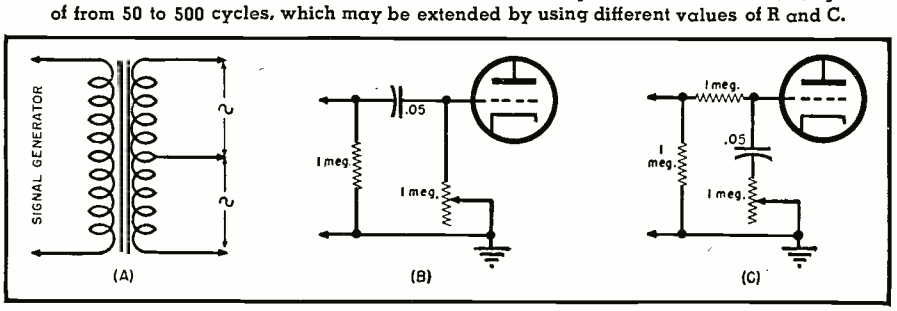
Fig. 3. Various types of distortion as viewed on a scope. (A) Harmonic distortion; (B) improper bias; (C) over-excitation; and (D) result of passing a square wave through an amplifier with limited frequency response.

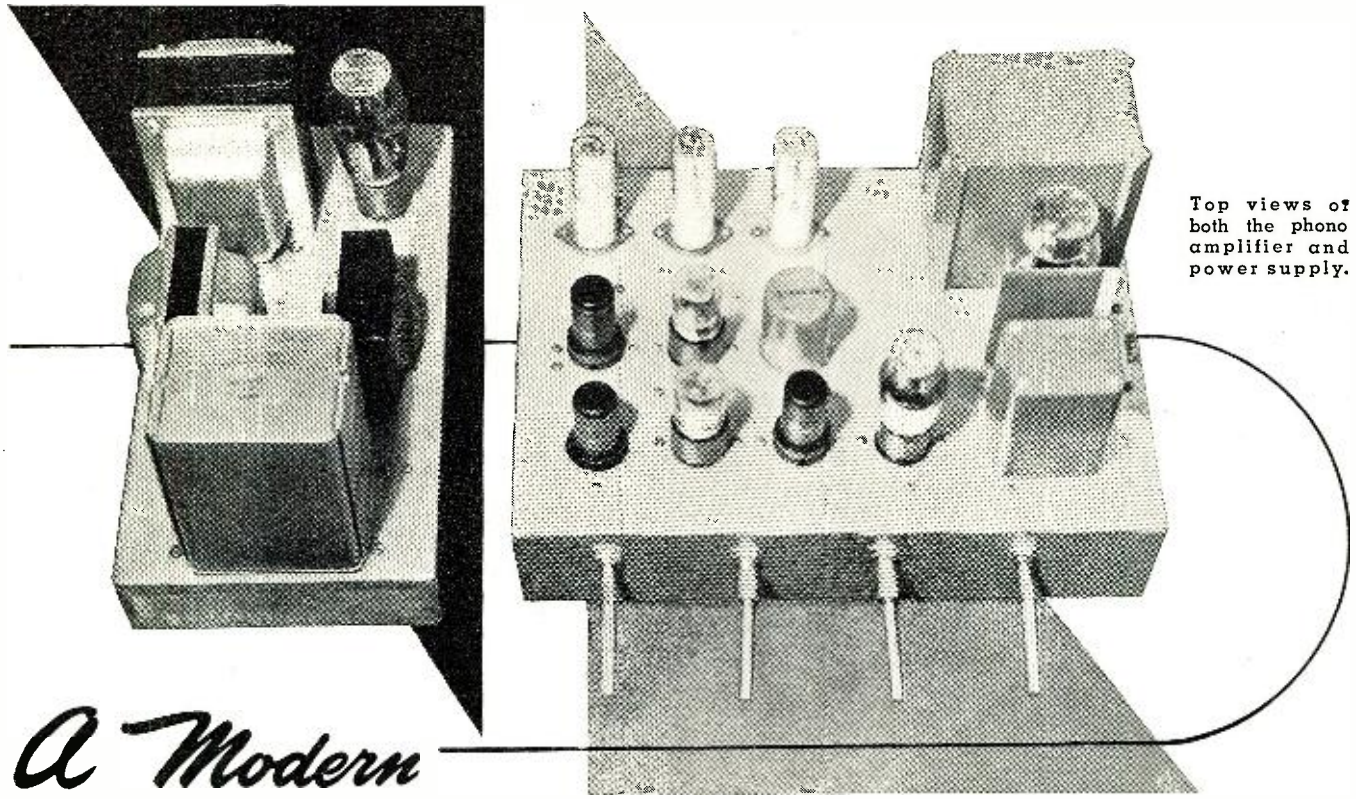
volts higher than that of the 6N7 in order to produce proper bias.

In measuring small amounts of distortion, considerable care should be taken in the construction of the analyzer. A good way to check the accuracy of the analyzer is to invert the reference signal 180 degrees and feed it into the other input of the analyzer; if you can then obtain a zero reading,

(*Continued on page* 173)

Fig. 4. (A) Means of obtaining two voltages 180 degrees out-of-phase from your signal generator. (B and C) Method for correcting for either leading or lagging phase shift. Values shown will allow a considerable amount of phase variation over a range of from 50 to 500 cycles, which may be extended by using different values of R and C.





Top views of both the phono amplifier and power supply.

A Modern Wide-Range PHONO AMPLIFIER

By **CHARLES S. MAYEDA**
Radio Dept., Northwest Airlines

A well-designed audio amplifier, featuring a simplified dynamic noise suppressor and Thordarson bass and treble tone control circuits

THE amplifier and power supply unit to be described here was designed to fit the requirements of a custom-built cabinet, the power output being sufficient for home living room use. It possesses a flat response from 20 to beyond 15,000 cycles, as well as flexibility in altering this response characteristic in the form of bass and treble tone controls. Some form of scratch suppression for phono use was also judged desirable.

For average home living room use, 10 watts of output power was considered more than sufficient. This allows for the use of triodes without resorting to parallel operation or the need for inverse feedback of beam power tubes. The many advantages of the 6AS7G dual triode have been well covered in previous issues, so this article will limit the discussion to design consideration for this particular amplifier. It was decided to operate the tube at approximately 200 volts plate-to-cathode, increasing the bias 10 volts over published data to 100 volts, reducing plate dissipation to below rating. With these voltages, grid-to-grid voltage swing requirements are approximately 200 volts peak, to drive the tube to rated output. The drive requirements are rather large in comparison with other output tubes; however, these can be met without going into special circuits or other devices. While a push-pull amplifier would be ideal to secure the required grid voltage swing, the grids of this stage would necessarily be also driven in push-pull relationship, which would require an additional expensive transformer or the necessity of resorting to some form of phase inversion.

Looking over data for voltage amplifiers, the 76 type tube is rated among the low mu triodes as having the greatest output voltage capabilities; with a 300 volt plate supply, rated output varies from around 70 to over 100 volts peak output, depending on load conditions. With an input transformer turns ratio of 2.5 to 1 over-all, this tube is capable of supplying the required driving voltage. To allow for some reserve, it was decided to increase the plate supply voltage to 350 volts. Plate supply may be further increased without exceeding plate voltage rating. The 76 tube, while an older version of the low mu triode, serves excellently the requirements of this amplifier.

The 76 voltage amplifier is preceded by a 6J5 used for tone control purposes, and *Thordarson* units are used. Briefly the operation is as follows. The cathode resistor is of high value and unbypassed, causing degeneration of all frequencies. Introducing the choke into the cathode circuit results in a low impedance path for the lower frequencies. This same choke is introduced into the grid circuit of the following tube, resulting in shunting of the lower frequencies. A low value condenser introduced into the cathode circuit by the tone control results in a low impedance path for the higher frequencies, thereby causing treble boost. The same condenser is shunted across the grid of the following tube on the other extreme of the tone control, resulting in treble attenuation.

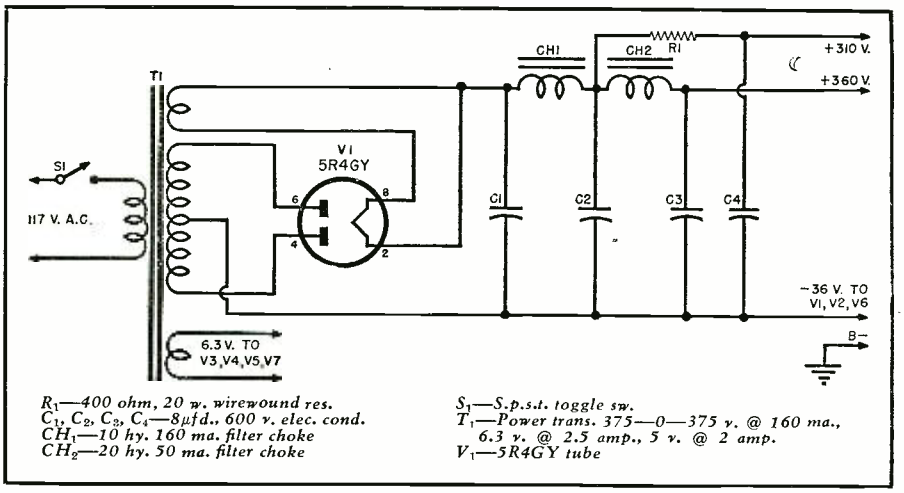
In order to reduce hum output to an absolute minimum, it was decided to run the heaters of the low level stages on d.c. This consideration dictated the choice of a 150 milliampere heater, a low mu triode, and a 12AH7GT for the equalizer amplifier,

as well as for the tuner amplifier. The plates are tied together, and the grids are separated, one for the tuner and the other for phono use where the volume control is introduced. This stage provides about 20 db. gain. Approximately one volt tuner output is more than sufficient to drive the amplifier to full output.

The phono equalizer uses a 12SC7, this circuit having appeared in previous publications. Resistor and condenser values are such as to provide a cross-over point around 500 cycles with the 6 db. de-emphasis occurring around 1500 cycles. The choice of condenser C_{12} will determine where bass boosting will begin. A larger value will result in a lower frequency cross-over point. Condenser C_{13} determines the point where de-emphasis occurs.

To offer something better than a standard *RC* filter shunted across the pickup for scratch suppression, the simplified dynamic noise suppressor designed by C. G. McProud, and which appeared in the August, 1948, "Audio Engineering," was incorporated in this amplifier. The 6SL7GT serves as a side amplifier, and the 12SG7 is the capacity reactance tube shunting the pickup. Briefly, operation of the circuit is as follows. The circuit components are of such value that maximum gain results on frequencies above 500 cycles. The rectified components of the signal are introduced into the grid of the reactance tube through the adjustable suppression control; on signals having higher frequencies the grid is driven negative, thereby reducing the gain of the reactance tube, which in effect reduces the capacitance shunting the pickup. As mentioned in McProud's article, the circuit is effective only with a magnetic cartridge offering relatively sharp cut-off above a certain frequency.

In an amplifier of this type, where the output level is constant even down

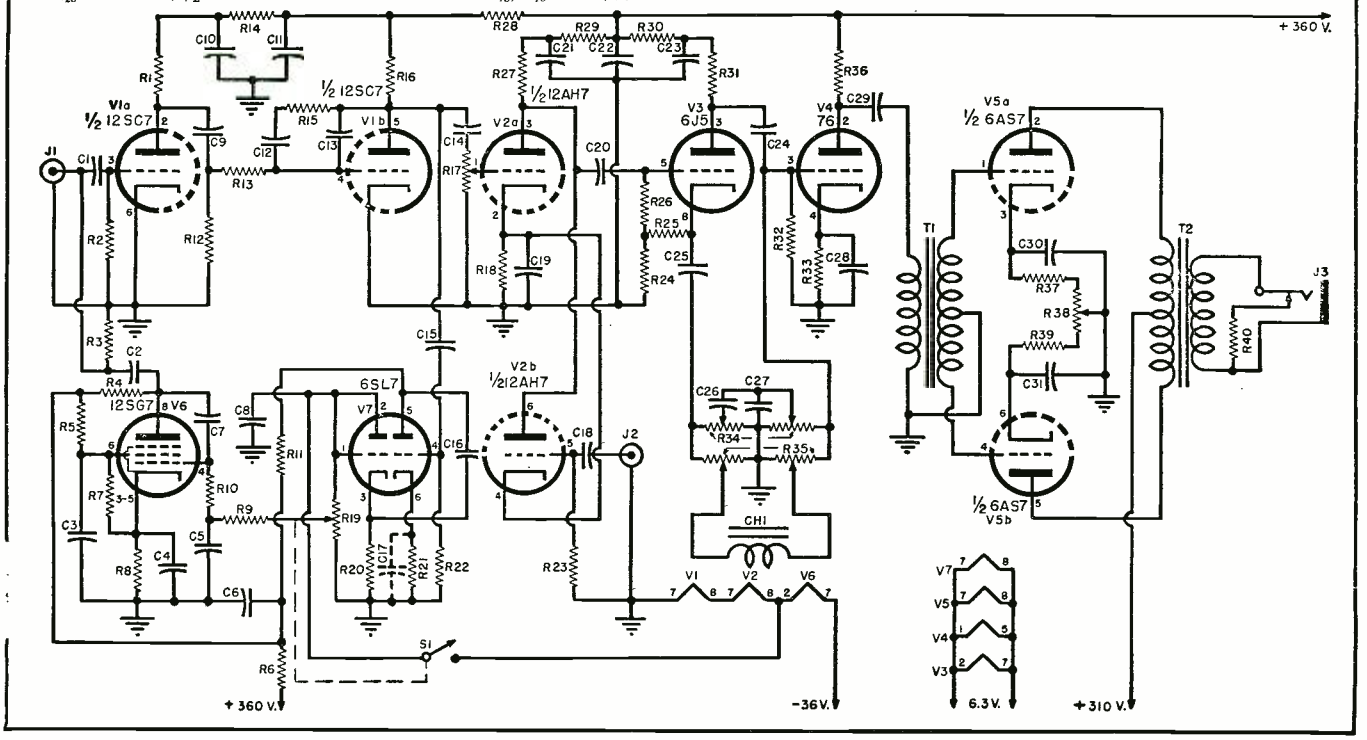


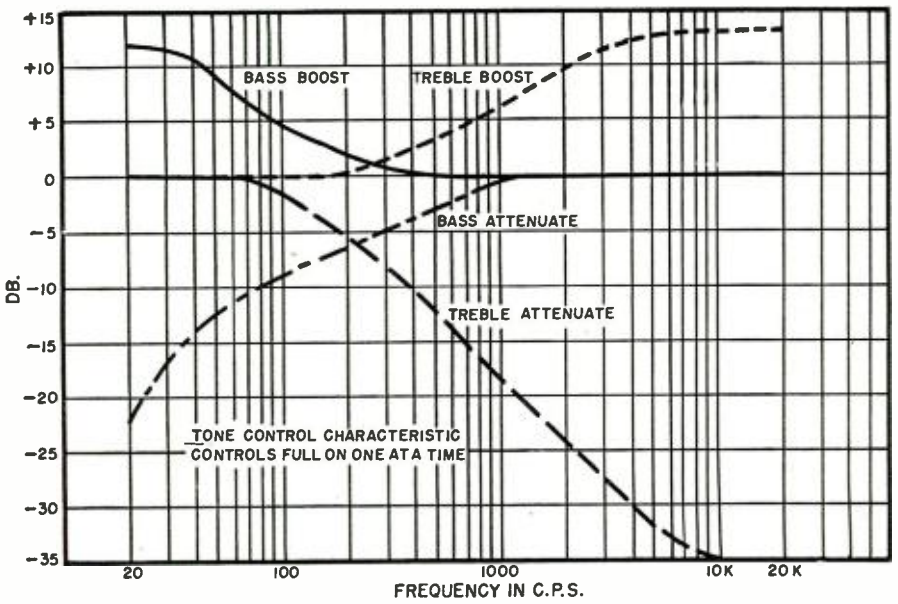
R_1—400 ohm, 20 w. wirewound res.
C_1, C_2, C_3, C_4—8 μfd., 600 v. elec. cond.
CH_1—10 hy. 160 ma. filter choke
CH_2—20 hy. 50 ma. filter choke
S_1—S.p.s.t. toggle sw.
T_1—Power trans. 375—0—375 v. @ 160 ma., 6.3 v. @ 2.5 amp., 5 v. @ 2 amp.
V_1—5R4GY tube

Wiring diagram of power supply. Unit is built on separate chassis.

Complete schematic diagram of the wide-range phono amplifier. Both phono and radio inputs are provided.

R_1—390,000 ohm, ½ w. res.
R_2, R_{12}—10 megohm, ½ w. res.
R_3—10,000 ohm, ½ w. res.
R_4—270,000 ohm, ½ w. res.
R_5—330,000 ohm, ½ w. res.
R_6, R_{29}, R_{31}—10,000 ohm, 1 w. res.
R_7—68,000 ohm, ½ w. res.
R_8—82 ohm, ½ w. res.
R_9, R_{10}, R_{11}, R_{20}—100,000 ohm, ½ w. res.
R_{13}, R_{15}—2.2 megohm, ½ w. res.
R_{14}—27,000 ohm, ½ w. res.
R_{16}—150,000 ohm, ½ w. res.
R_{17}—1 megohm pot. (volume control)
R_{18}—1000 ohm, 1 w. res.
R_{19}—1 megohm pot. (suppressor control)
R_{21}—2200 ohm, ½ w. res.
R_{22}, R_{39}, R_{32}—470,000 ohm, ½ w. res.
R_{23}—1 megohm, ½ w. res.
R_{24}—22,000 ohm, ½ w. res.
R_{26}—820 ohm, ½ w. res.
R_{27}—25,000 ohm, 1 w. res.
R_{28}—15,000 ohm, ½ w. res.
R_{31}, R_{36}—47,000 ohm, 1 w. res.
R_{33}—3300 ohm, 1 w. res.
R_{34}, R_{35}—Tone control (Thordarson R1068X)
R_{37}, R_{38}—1500 ohm, 10 w. wirewound res.
R_{28}—500 ohm, 10 w. wirewound adj. res.
R_{40}—10 ohm, 10 w. wirewound res.
C_1—.02 μfd., 400 v. cond.
C_2, C_5, C_{14}, C_{20}, C_{24}—.1 μfd.,400 v. cond.
C_3, C_7—.01 μfd., 400 v. cond.
C_4, C_{19}, C_{25}, C_{28}—10 μfd., 50 v. elec. cond.
C_6-C_{23}, C_{10}-C_{11}, C_{21}-C_{22}—Dual 20/20 μfd. @ 450 v. elec. cond. (Can type)
C_8—680 μμfd. mica cond.
C_9—.25 μfd. 400 v. cond.
C_{12}—.05 μfd. 400 v. cond.
C_{13}—150 μμfd. mica cond.
C_{15}, C_{16}—15 μμfd. mica cond.
C_{17}—500 μμfd. mica cond.
C_{26}—.1 μfd. @ 400 v. cond. (See text)
C_{29}—.03 μfd. 400 v. cond.
C_{30}, C_{31}—.5 μfd. 400 v. (Bathtub type)
S_1—40 μfd. @ 150 v. elec. cond.
T_1—S.p.d.t. sw. on R_{19}
T_2—Input trans. (UTC-HA104) (See text)
CH_1—Output trans. (5000 ohms push-pull to v.c.) (UTC-LS57) (See text)
J_1, J_2—Tone control choke (Thordarson T20C74)
J_3—Jack
V_1—Closed circuit jack
V_2—12SC7 tube
V_3—12AH7 tube
V_4—6J5 tube
V_5—76 tube
V_6—6AS7 tube
V_7—12SG7 tube
V_8—6SL7 tube





Tone control characteristics with controls full on, one at a time.

to a few cycles, and where the combined bass boost of the tone control and the equalizer stages are included, the sensitivity at the phono input terminals will run as high as a few microvolts at a.c. line frequency. Care must be exercised to avoid hum pickup. The high gain at low frequencies will also easily lead to motorboating. In this amplifier, large decoupling condensers with decoupling resistors are used in each plate supply lead. In the low level stages, miniature components are used together with as short exposed leads as possible to reduce electrostatic surface to minimum. Excessive shielding must be avoided to prevent attenuation of the higher frequencies. Chassis ground is made at one point only. Decoupling condenser cans should be insulated from the chassis, though they are at ground potential, to avoid ground loops. A separate chassis for the power supply simplifies hum reduction.

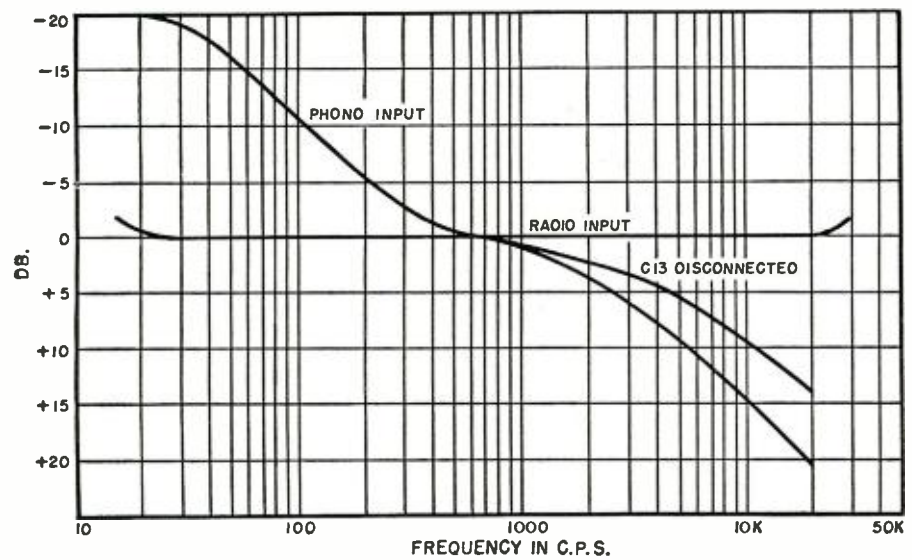
As the photographs will show, the tube sockets were mounted primarily for the shortest possible leads, which also resulted in a relatively neat layout. Beginning from the left front row is the 12SC7 equalizer followed by the 12AH7GT; next is the 6J5 tone control stage feeding the 76 voltage amplifier to the input transformer and to the 6AS7G output tube. In the second row on the left is the 12SG7 reactance tube followed by the 6SL7GT side amplifier. Tube sockets were positioned to favor short leads for the grid and plate. The 12SC7 input tube is mounted on a 2 by 3 inch plate, together with all the associated components. This plate in turn is mounted to the chassis spaced by rubber grommets, effectively protected from mechanical shocks or vibration. The controls are as follows: Beginning from the left is the phono volume control followed by the bass and treble tone controls; the last control is for suppression, controlling d.c. voltage only. The actual wiring of the various controls is not critical. Position leads for best appearance.

Grid and plate coupling condensers were mounted by wrapping them with a thin aluminum sheet, forming brackets. Placement of the tone control choke was not critical due to the fact that the power transformer was separated from the chassis. The leads were, however, shielded. All a.c. filament leads are also shielded. The output transformer provides for two impedances (3000 and 5000 ohm) with a variety of low impedance voice coil outputs. The 5000 to 10 ohm connections were utilized. With an 8 ohm voice coil connected to the 10 ohm tap, the reflected impedance is reduced to 4000 ohms which is about the recommended value as published by the tube manufacturers for this particular set of plate and bias voltages.

The amplifier is mounted vertically in the cabinet. Input and output connections are on the side. Short leads dictate the position of the input jacks. The metal plate visible in the photograph between the output tube and the input transformer is added for heat baffling when the amplifier is mounted in a vertical position to avoid heating the input transformer.

The power supply needs little comment. The four 8 μfd., 600 volt oil-filled condenser blocks were available from surplus. Any combination resulting in equal capacity and voltage rating will do. The voltage for the heaters is adequately filtered by returning all of the filter condensers to the center tap of the transformer. Bypassing on the other side of the heater string is effected by the six 20 μfd. decoupling condensers of the amplifier. Voltage is taken from the first choke and dropped through the resistor to the proper value for the output tube. This is sufficient filtering for the output tube and avoids the necessity of a second high-current choke. Power-switching arrangement is not shown on the diagram as this will depend on the builder's choice. For this unit, two sockets were mounted on the power supply: one feeds power and allows for the "On-Off" switch on the turn-table proper; the other goes to the FM tuner, the volume control being mounted on the tuner.

Response curve with tone control in mid-position and suppressor off.



Tests and Results

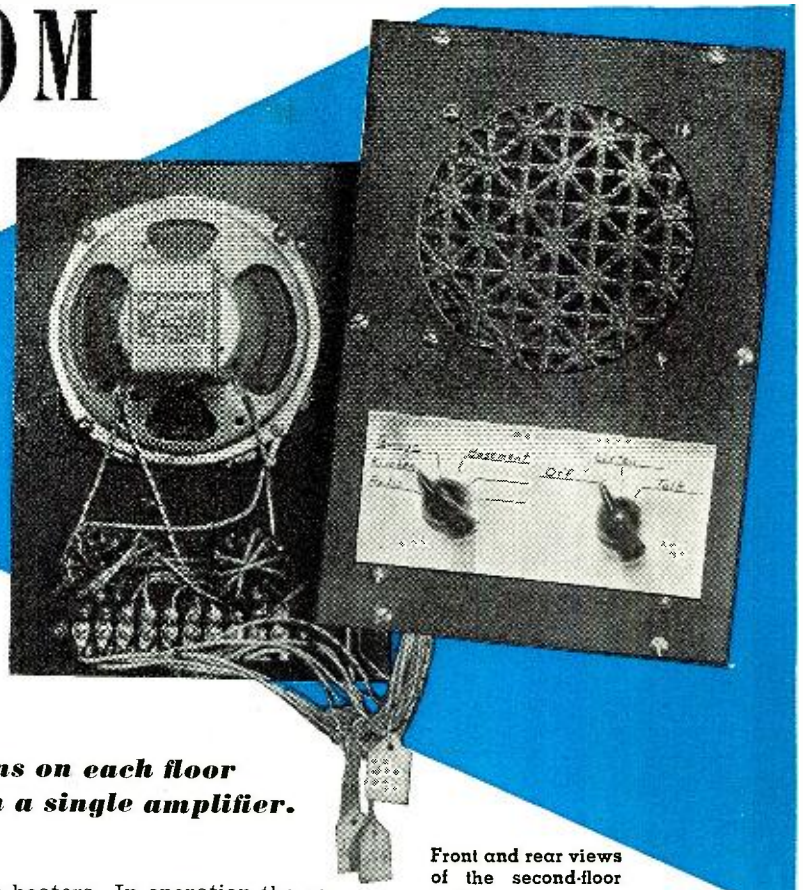
The final value for plate voltage using the particular components for the power supply is 360 volts for the voltage amplifier. This same voltage feeds all the other tubes except the 6AS7G output. This is a bit higher than standard but does not exceed any of the tube ratings. The voltage to ground at the center tap of the output transformer is 310 volts; on each cathode of the 6AS7G it is 100 volts. With these voltage combinations, the total current drain is very close to the 150 milliamperes required for the series heaters. Actual measured drop was 35 volts. If any slight variation does occur, a bleeder can be added

(*Continued on page* 131)

An INTERCOM For The Home

By
R. G. FINKBEINER,*
W8AQK
Engineer, WHRV

This system provides master stations on each floor and any number of substations with a single amplifier.



Front and rear views of the second-floor hall master station.

INTERCOMMUNICATION systems have long proven their value in industry and business. Why haven't their time and labor saving merits been extended to home use? First, the cost of a flexible commercial installation would be excessively high owing to the use of separate amplifiers at each master station. Second, the value of a system in the home has not yet been realized because intercoms intended for such use, with reasonable flexibility, are not available. A flexible, low-cost intercommunication system for the home was the objective in mind when this unit was designed.

The installation to be described has three master stations, two substations, and one amplifier, arranged as shown in the block diagram. The amplifier input and output leads are run to each of the master stations, and, with proper switching, a flexible system is possible at low cost. Two-way conversations can be originated from any master station to any master or sub-station. Provisions are also included for listening to radio programs, picked up by the family receiver, on the master stations.

The amplifier is a three-stage, high-gain unit constructed on a 12"x7"x3" chassis. It has a maximum output of about three watts, which is more than adequate. The input and output impedances are both four ohms, the former being provided by a voice coil to grid transformer. A quick-heating circuit puts the amplifier into operation in about three seconds. During standby the control relay, RL_1, is open, and three volts are applied to the tube heaters. In operation the relay is closed and the normal six volts are applied.

In an experimental version of this amplifier, two relays were used which gave a heating cycle of three volts standby, eight volts accelerated heating for about ten seconds, and six volts operating. The accelerated heating feature made no appreciable reduction in heating time and, therefore, was not included in the final version.

The relay used is a sealed plug-in unit with a coil resistance of 1800 ohms. Any s.p.d.t. plate circuit relay with a coil resistance of from 1500 to 2500 ohms can be used. D.c. is used on the relay to keep hum down and allows use of the ground leads from the master stations as relay returns, thus saving one cable conductor.

Of the several relay supplies tried, the selenium rectifier circuit shown is the most dependable. It provides an average relay current with the R_{10}, R_{11} voltage divider shown. The a.c. circuit to the selenium rectifier is completed through the actual ground lead; therefore, the line plug must be inserted correctly for the relay supply to function.

Selenium rectifiers are not used in the amplifier power supply because the d.c. voltage across the filter condensers would rise to a very high value during standby, thus shortening their life. With a tube rectifier, about 70 volts appears across the condensers during standby, and rises to the normal 250 volts during operation.

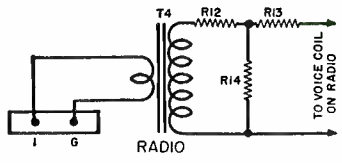
Inverse feedback has been added to reduce distortion and improve frequency response. The signal appearing across the output transformer secondary is fed back to the 6SF5 cathode through R_6. The cathode resistor, R_5, must not be by-passed. It may be necessary to reverse the leads to the output transformer secondary for proper phasing of the feedback signal, which is indicated by a drop in amplification.

A piece of 2" pipe, flattened slightly by a few sledge hammer blows, is used to shield T_1, the voice coil to grid transformer. Two 6-32x1" screws, with the heads sawed off, are soldered to the pipe and used to secure it to the chassis. The transformer is soldered inside the shield by its mounting feet. Its position on the chassis is determined by listening for minimum hum while rotating the transformer in its shield.

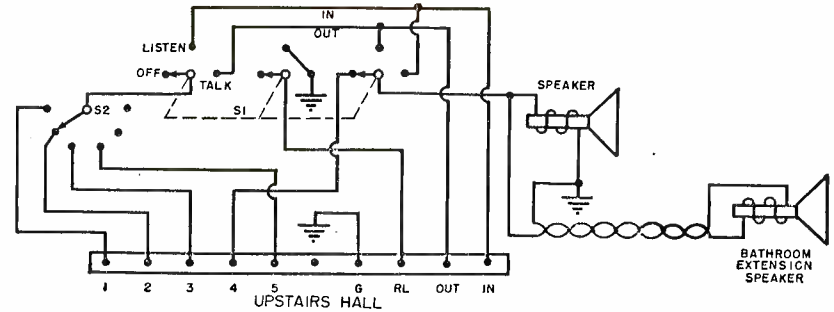
To prevent hum from eddy currents induced in the chassis by the power transformer and choke, an insulated lead should be used to connect all of the ground points together. The lead is then connected to the chassis at only one point, the No. 1 pin on the octal inter-connecting socket. Note that the primary of the input transformer is left floating at the amplifier, but that one side is grounded at the kitchen box. This provides separate ground returns for the amplifier input and output circuits and prevents oscillation.

(*Continued on page* 51)

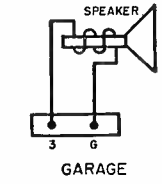
* Home address: 215 Crest Ave., Ann Arbor, Michigan.



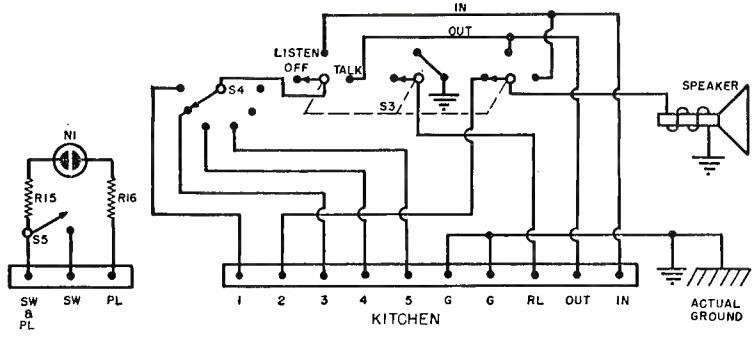
R_{12}, R_{13}—5000 ohm, ½ w. res.
R_{14}—400 ohm, ½ w. res. (see text)
T_4—Universal output trans. (5000 ohm to v.c.)



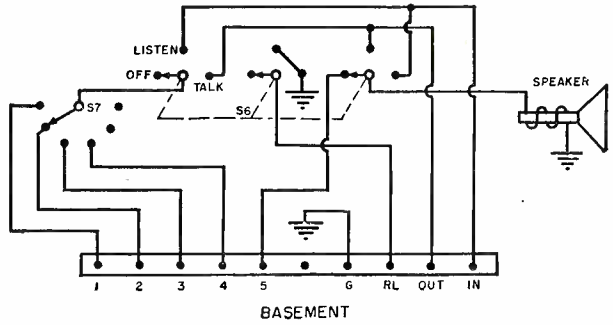
S_1—3 p., 3 pos. rot. sw.
S_2—S.p., 6 pos. rot. sw.
2—5" permanent magnet speakers



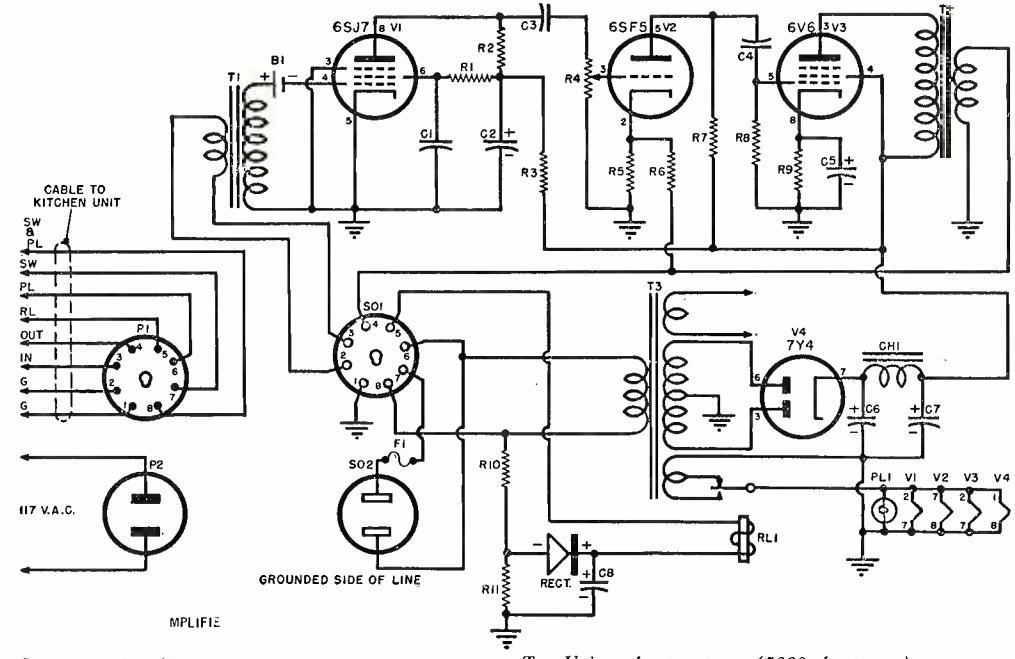
1—5" permanent magnet speaker



R_{15}, R_{16}—50,000 ohm, ½ w. res.
N_1—NE-51 neon pilot lamp
S_3—3 p., 3 pos. rot. sw.
S_4—S.p., 6 pos. rot. sw.
S_5—S.p.s.t. toggle sw.
1—5" permanent magnet speaker



S_6—3 p., 3 pos. rot. sw.
S_7—S.p., 6 pos. rot. sw.
1—5" permanent magnet speaker



R_1—1 megohm, ½ w. res.
R_2, R_8—250,000 ohm, ½ w. res.
R_3—50,000 ohm, ½ w. res.
R_4—1 megohm pot.
R_5—2000 ohm, ½ w. res.
R_6—5000 ohm, ½ w. res.
R_7—100,000 ohm, ½ w. res.
R_9—300 ohm, 10 w. wirewound res.
R_{10}—5000 ohm, 10 w. wirewound res.
R_{11}—2000 ohm, 1. w. res.
C_1—.1 µfd., 600 v. cond.
C_2, C_6, C_7—10 µfd., 450 v. elec. cond.
C_3, C_4—.01 µfd., 600 v. cond.
C_5—10 µfd., 25 v. elec. cond.
C_8—20 µfd., 150 v. elec. cond.
T_1—Voice coil to grid trans.
T_2—Universal output trans. (5000 ohm to v.c.)
T_3—Power trans., 300-0-300 v. @ 70 ma., 5 v. @ 2 amp. (Not used), 6.3 v. c.t. @ 3 amp.
CH_1—10 hy., 70 ma. filter choke
PL_1—Pilot lamp, 6.3 v.
RL_1—S.p.d.t. relay with 2000 ohm coil (See text)
Rect.—50 ma. selenium rect.
F_1—1 amp. fuse
B_1—1¼ v. bias cell
P_1—Octal plug (Amphenol #86-PM8)
P_2—117 v. connector (Amphenol #61F11)
SO_1—Octal tube socket
SO_2—117 v. connector (Amphenol #61M1)
V_1—6SJ7 tube
V_2—6SF5 tube
V_3—6V6 tube
V_4—7Y4 tube

Wiring diagrams of the various individual units that make up the intercom system.

For convenience in servicing, connectors are used to plug the speaker system and a.c. line into the amplifier. Also, the volume control is recessed and screwdriver adjusted to prevent tampering. When finished, the amplifier is fitted with a dust cover and mounted on a shelf in the cellarway near the kitchen master.

The kitchen master station is the junction box for the leads from the amplifier and remaining stations, as is shown in the block diagram. *The ground leads, "G," from all stations and the amplifier must connect at the common ground point in the kitchen unit.* Otherwise the amplifier input and output ground returns will appear on a single conductor causing oscillation. The remaining leads may be run in any convenient manner, which in most cases will be to the kitchen master, as shown.

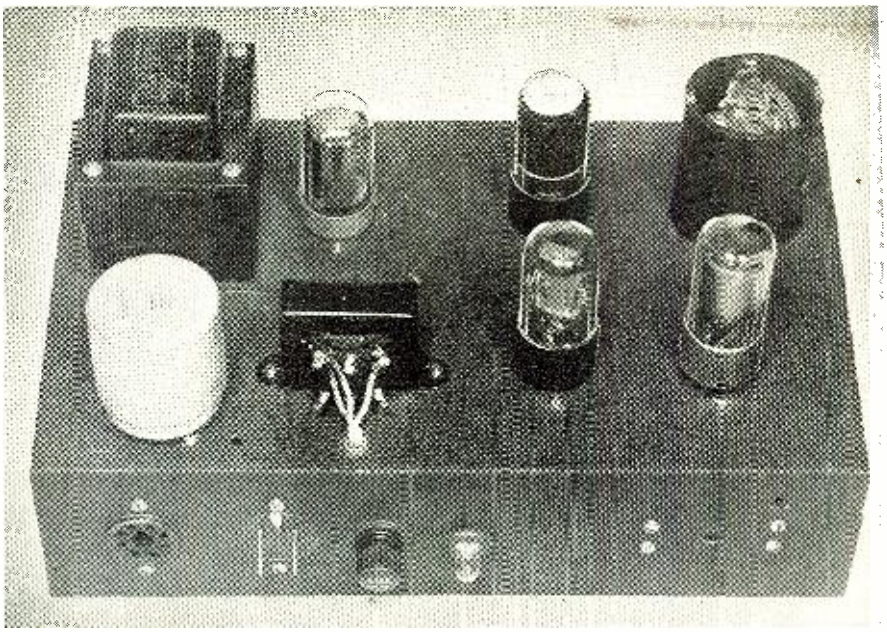
The master stations are built around 6"x9"x5" metal boxes. A box with removable sides is preferred for the kitchen master because of the large number of connections that must be made to the terminal strips in this box. The speaker, switches, and pilot light are mounted on the front, and the 10-lug terminal strip is on the inside bottom of the box. The 3-lug strip, used for line switch and pilot light connections, is placed on the back panel. Boxes with removable fronts are used for the upstairs and basement stations, and all parts are on these front panels. The dial plates are made from white cardboard stock and are protected with celluloid. The plates are lettered with india ink.

The selector switch (S_2, S_4, or S_7) connects the speaker of the station to be called to the common connection on the left-hand section of the "Talk-Listen" switch, S_1, S_3, or S_6. This left-hand section then connects the selected station speaker to the amplifier input when listening, and to the output when talking. The right-hand section simultaneously connects the speaker of the station originating the call to the amplifier output when listening, and to the input when talking. The center section completes the relay circuit and puts the amplifier into operation.

The garage sub-station is a speaker mounted in a *Crisco* can, which makes a very efficient baffle. It is mounted inside the garage and covers the clothesline area back of the garage.

Radio programs may be heard over the master stations when the radio sub-station is connected to the voice-coil terminals of a radio. A bridging pad, consisting of R_{12}, R_{13}, and R_{14}, reduces the voice coil signal level of the radio to that of the amplifier input. Transformer T_4 is used for isolation of ground returns and impedance matching.

After the amplifier gain has been set, the radio is set at normal listening level, and then R_{14} is adjusted for the desired volume on the master stations. The 400 ohm value shown gives



Top view showing relative placement of above-chassis components.

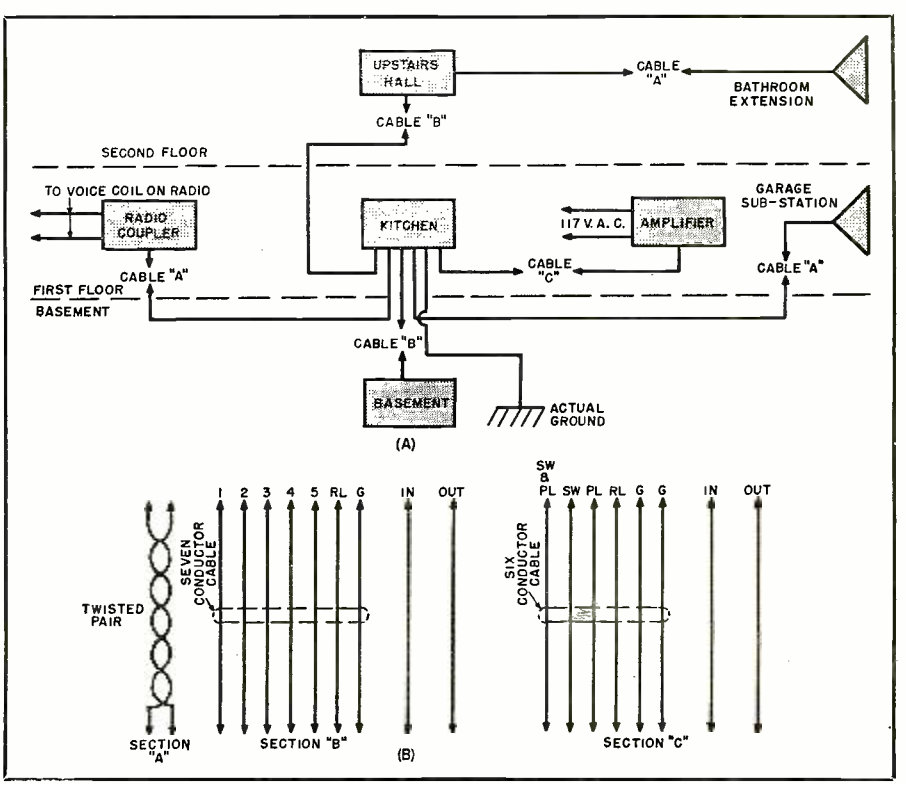
normal volume with a radio which has a voice coil impedance of eight ohms. Slight deviations from this value may be necessary in some cases. The pad does not affect the normal performance of the radio. To prevent hum pickup, the matching transformer should be mounted away from any transformer fields. It may be placed anywhere between the radio and kitchen box, preferably near the radio.

A second radio sub-station may be added, if desired, but only one radio can be heard at a time. It's strictly a one-channel affair. If a station listening to the radio is called, the call will come in with the program, but the answer will not be heard by the calling station. The called station must be turned "Off" first.

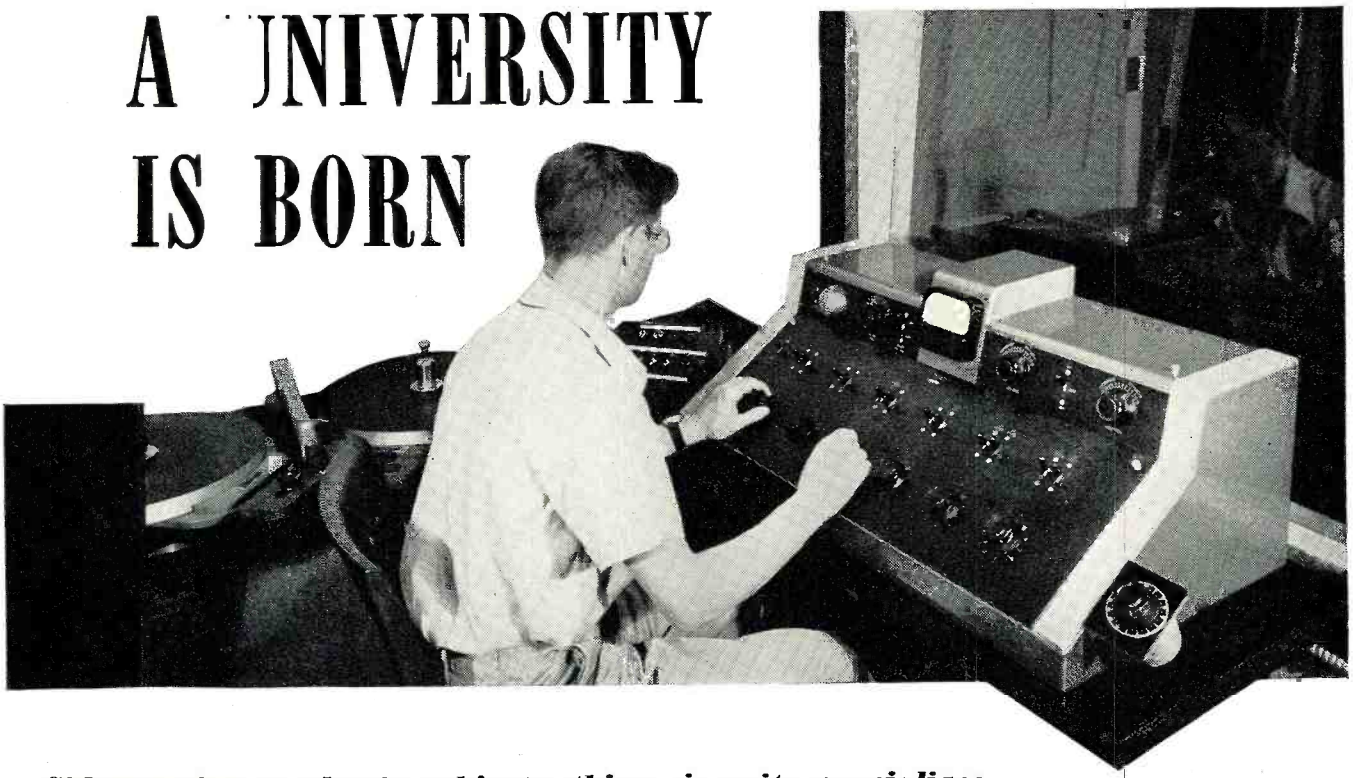
In installing the cable, the leads marked "In" and "Out" must be separated from each other and from the remaining leads, which may be cabled together, as shown on the cable diagram. Oscillation will take place if excessive capacitance exists between the input and output circuits of the amplifier. Physical separation of about an inch between cables running

(*Continued on page* 128)

Block diagram shows cable connections between the various units.



A UNIVERSITY IS BORN



Sidestepping academic subjects, this university specializes in a sound and audio course, leading to a bachelor's degree.

Audio engineering student mixing a studio program at one of the modern instruments in the control room.

ONE of the most unique and unusual educational institutions of our time, the University of Hollywood was built around the theme of "sound and audio engineering." It is located in Hollywood, California, heart of the sound and audio industries, and surrounded by great motion picture studios, radio broadcasting stations and television telecasting stations.

Students receive their training in modern, well-equipped studios and laboratories. They work with the same types of equipment they will find on the job in motion picture, television, broadcasting, and recording studios.

In the recording studios of the school, which are as nearly acoustically perfect as a studio can be, the student spends many hours monitoring and mixing programs, and working with the live talent engaged in recording transcribed shows that will subsequently be broadcast over local AM and FM broadcasting stations.

Training is given in a completely-equipped audio transmission laboratory, where the student learns the purpose, use, and operation of such equipment as the gain set, the wave analyzer, the intermodulation analyzer, the distortion set, the square wave generator, and the oscilloscope, to name only a few of the instruments, as well as all of the techniques required of the audio engineer in lining up recording channels, making gain runs, and allied transmission measurements.

In the shop, he learns not only how to make a properly soldered connection, but also the correct method of laying out an installation job and the techniques which go to make up a workmanlike job of constructing and installing various pieces of equipment, from a jack strip to a complete mixer console.

The radio and television laboratories of the university provide him with a basic theoretical and practical knowledge of radio and TV circuits so that he can handle any and all types of work in these allied fields of audio engineering.

The film laboratory provides training in the methods of recording sound on film or on magnetic tape; the operation, care, adjustment, and repair of magnetic recorders and optical systems; the use and operation of film dummies used for re-recording and dubbing of film; the prin-

Student performers and technicians study recording techniques in one of the university's several acoustically-treated studios.

In this completely equipped sound laboratory, students learn the professional techniques in studying disc recording mechanisms.

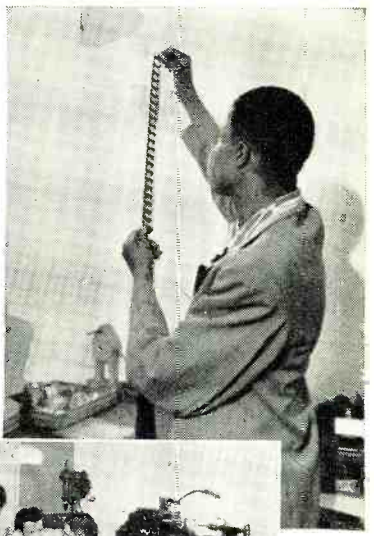
ciples of operation, care and, adjustment of film recorders; and the correct techniques of operation of various types of projection equipment, such as the student may be called upon to use until in a motion picture or television studio.

Future plans for the university call for designing and building one of the most modern sound stages in the world, where every type of recording project, large or small—from one-hundred-piece symphony orchestras to soloists and small dramatic groups—may be handled. These plans also call for the installation of a 12-position mixer panel, one of the largest types in existence, for which a minimum of three operators is required. This is similar to the type of mixing equipment which was specially designed and built for the recording of Walt Disney's "Fantasia," a production in which Dr. Tremaine (one of the co-founders), played a very important role as sound engineer in the design and installation of both the recording and reproducing equipment.

In conjunction with the radio broadcasting course, the university is planning to operate its own broadcasting station which will be staffed by advanced and graduate students of the broadcasting course. A television department with cameras and property and set construction classes is also to be added. This will provide training, in conjunction with the writing and drama departments, in all phases of telecasting productions, ranging from two-minute commercials to full major productions.

Dr. Klekner and Dr. Tremaine have appointed Dr. George K. Teffeau as Dean of the University of Hollywood. He comes well qualified for the past many years of experience in the educational and commercial world.

→ Optical (film) and magnetic recording classes are given thorough training. Student is shown checking the density of the audio portion on a 35mm film recording.



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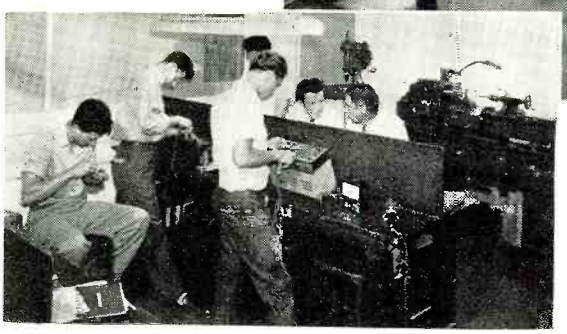
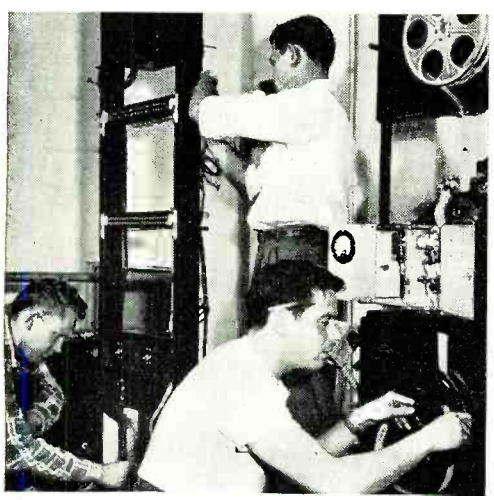
↓ Showing part of a maintenance lab where modern shop practices are taught all of the students.



↓ No "mockups" are used at this new Hollywood University. All students are taught on the finest projectors and audio units available, learning how they are inter-connected to make up a complete sound studio.



↑ Television sets are studied and analyzed by all engineering students.

↓ Fine points are not forgotten; observing ratio of land-to-groove on records. Disc recording is a major part of curriculum.

↑ Students learn magnetic tape recordings on professional gear like this PT6 Magnecord. All forms of recorders, i.e., wire, tape, film, and disc types, are studied by all of the students.

Dr. Teffeau holds degrees in law, business administration, the arts, and literature, and for the past 17 years he has been actively engaged in the educational field as an instructor in both universities and trade schools. In addition to announcing many radio programs which have been released over the major stations and networks, Dr. Teffeau has also had a hand in production and writing.

The idea of the University of Hollywood did not grow overnight. It involved years of searching and endless experimentation. It took the courage and the pioneer spirit of trail blazers for Drs. Klekner and Tremaine to formulate their plans and then see them through to fruition. Because of the strength of their convictions both of these men jointly endowed the university with a sum in excess of $50,000.00.

All academic and non-technical subjects which do not contribute and are not applicable to the chosen engineering or professional career are being omitted. Because of the omission of these non-essential, time-wasting subjects, the University of Hollywood's streamlined education requires only eighteen months of training to qualify for a degree, a B.S.,—Bachelor of Science in Audio Engineering.

—30—

A HORN-TYPE TRANSDUCER of Minimum Dimensions

By R. DOBY and G. AUGSPURGER, JR.
Audio Research Labs.*

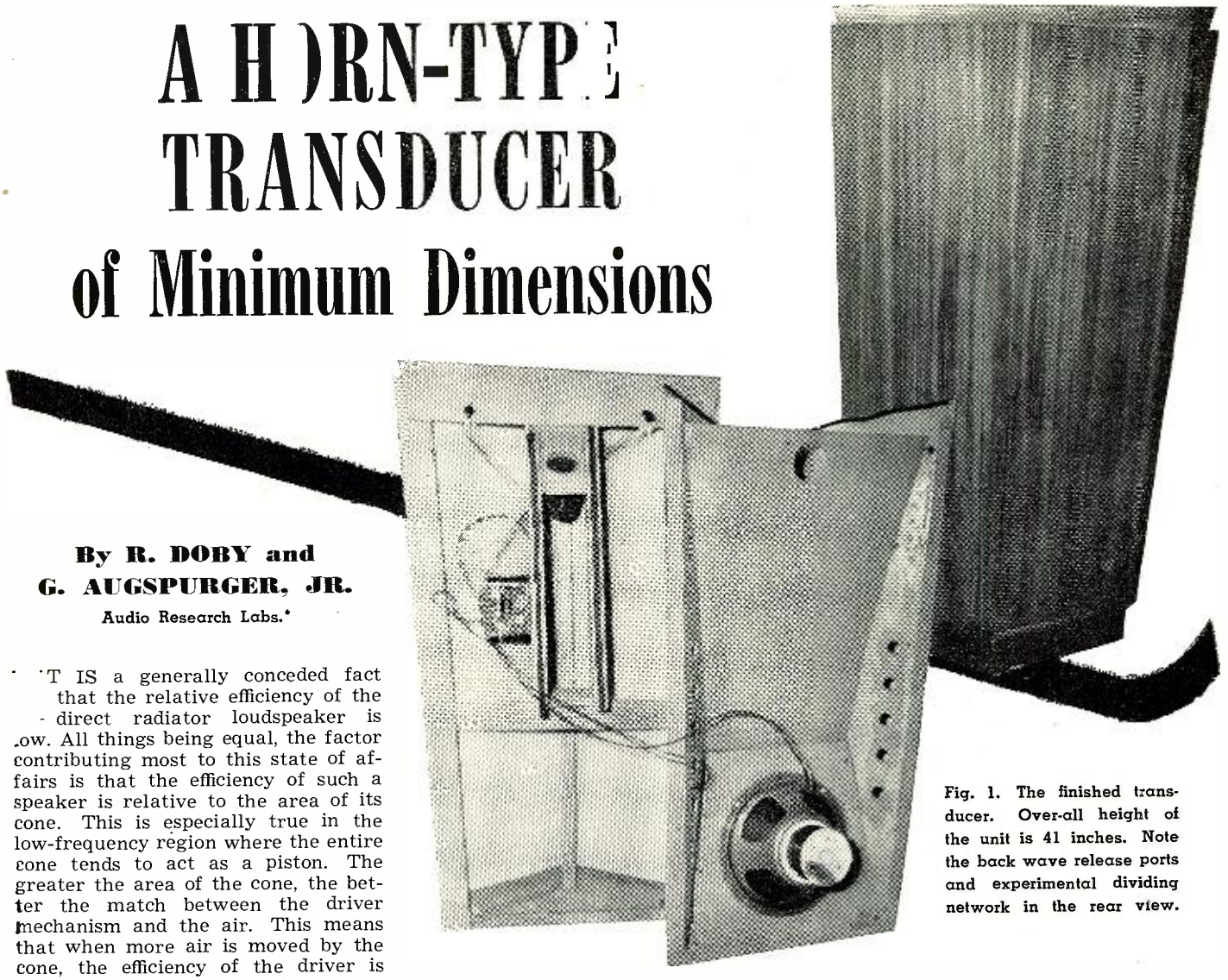


Fig. 1. The finished transducer. Over-all height of the unit is 41 inches. Note the back wave release ports and experimental dividing network in the rear view.

Constructional details for an integral space transducer for home or studio sound installation.

IT IS a generally conceded fact that the relative efficiency of the direct radiator loudspeaker is low. All things being equal, the factor contributing most to this state of affairs is that the efficiency of such a speaker is relative to the area of its cone. This is especially true in the low-frequency region where the entire cone tends to act as a piston. The greater the area of the cone, the better the match between the driver mechanism and the air. This means that when more air is moved by the cone, the efficiency of the driver is greater, hence the emphasis on cone size.

For technical and practical reasons, direct radiator speakers are limited from attaining the ideal, i.e., from being able to move an air mass equal in square inches to one-quarter the wavelength of the lowest frequency to be reproduced.

A direct radiator loudspeaker, in order to reach optimum efficiency when reproducing a thirty-two c.p.s. signal, would require a cone diameter of approximately eight feet. It is obvious that the mass of such a cone precludes any practicality in its design. However, when the diaphragm of a driver unit is attached to an exponential horn, this ideal is easily met. For the horn is a mechanical-acoustical coupling device which transforms a low-velocity, high-pressure, acoustic energy at the entrance of the horn's narrow throat to a low-pressure, high-velocity energy at the termination of the horn's mouth, which is proportionately large in relation to the throat.[1]

There is available a considerable amount of literature regarding the theory of exponential horns, and it would serve no purpose to discuss further the technical nature of the subject here, except to say that by such a device air mass is substituted for cone mass. Since air is fluid and light, the great mouth areas of exponential horns offer no problem of mass, as would be the case in proportionately large cones.

Yet exponential horns have their disadvantages. In the first place, if they are to go down to the region of really low frequency response, they reach alarming dimensions, and their elephantine size limits their use to conditions where space is of little or no concern.

Secondly, they are somewhat directional in the middle frequencies and extremely so in the higher range. Lastly, they must be carefully designed in order that they will not have a discriminating effect against the frequency response in certain given regions. This last problem is seldom met in horns of straight design, but it becomes of real consequence in folded or re-entrant type horns.

We have seen, therefore, that the horn-type speaker possesses many inherent advantages lacking in the direct radiator. Our problem then resolves itself around the development of a small portable speaker, using the principle of the exponential horn. At first this would seem to be virtually impossible, since (as we have seen) the horn depends for its effectiveness upon its cumbersome length and large mouth area. Shortening the horn will ordinarily generate standing waves and cancel out some of the very frequencies we are called upon to reproduce, giving rise to a most unsatisfactory over-all response.

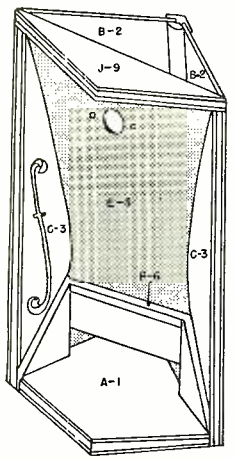
Nevertheless, we will take an aver-

(*Continued on page* 56)

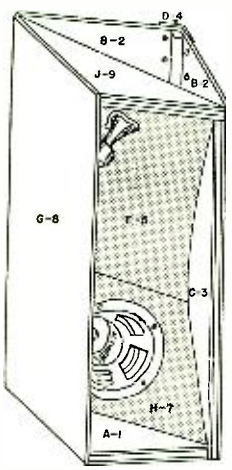
* Audio Research Laboratories, 1315 Tower Ave., Superior, Wisconsin.

1 "Loudspeaker and Transformer Principles," Utah Radio Products Pamphlet—Page 5.

DIRECTIONS FOR BUILDING AN INTEGRAL SPACE TRANSDUCER



(Plate 1)



THESE instructions are for a simplified horn having straight sides, but retaining all the characteristics of the tapered model shown in the accompanying photographs. The reasons for simplification are obvious when one considers that the tapered model has in its construction no piece which is not in some way beveled or biased to fit its adjoining member. The difficulty in constructing the tapered model without complete workshop equipment would be a formidable and time-consuming task. The straightsided model will not tax the skill of the hobbyist nor the equipment of the home workshop, and the results will warrant the effort as well spent.

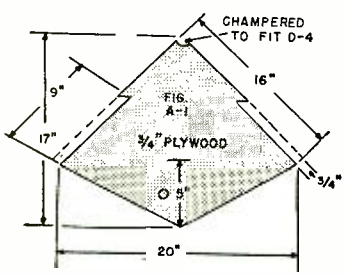
1—On a suitable piece of ¾" plywood stock, lay out the dimension given in Fig. A-1. This is basically a 45 degree isosceles triangle with 16" sides and another isosceles triangle of 30 degrees with the base of 23½ inches. The measurements shown in Fig. A-1 have been computed after cutouts for the side stretch Fig. C-3 have been made.

2—On ¾" plywood, lay out the dimensions given for Fig. C-3, the over-all width being 9" and the height 37". On the short base of this rectangle measure 8" from the long side left and drive a nail. Now find the midway point of the long side marked *M* in Fig. C-3. This is 18½"up from the short base. At this point measure from the long-side 7¼" and drive a second nail. At the very edge of the long-side left, adjoining the short-side top, drive a third nail with a spline, i.e., a thin, elastic strip of wood or metal, 40 inches or more in length; place this behind the first nail in front of the second nail, and behind the third nail there is now produced a curve. Mark this curve with a pencil and withdraw the nail. This will be the inside of the curve for Fig. C-3. The curve should be sawed at a 45 degree angle, found by drawing a line from the bottom of this curve line to a point 9 inches on the bottom side, short base, far edge. The straight side of Fig. C-3 should have an included angle of 30 degrees to match the front side of Fig. A-1.

3—At a point ¾" up from the short base of Fig. C-3 draw a diagonal line 16" long, intersecting with the curved edge; along this, line cut of a ¼" slot ¼" deep, using a sharp small chisel or, if available, a circle saw equipped with ¼" dado head. When this piece, Fig. C-3, is finished, reverse all the angles and make another piece. This will give you the required two opposite struts.

4—On ¼" presdwood lay out the dimensions in Fig. B-2 and saw out, being sure that you keep the smooth side of the work facing you. Next reverse the measurements and lay out a like trapezoid. This will give you the two side pieces, one of which is shown as Fig. B-2. The smooth sides should be faced inward toward each other as they would be subject to view in the completed structure.

5—With the aid of ½" wood screws and a liberal covering of glue attach the pieces C-3 to the smooth side of pieces B-2. The long 37" side of B-2 is the front side, and it is evident that C-3 will be fastened so that its straight edge corresponds to this length. The slot in C-3 will face outward.



6—From your lumber yard secure a 32" piece of inside corner moulding (manufactured by the *American Plywood Company*). This must be able to accommodate ¼" stock. See Fig. D-4. Bore on 4" centers through the flanges on both sides of this moulding 3/16" holes. When this is completed slip the pieces B-2 into the recess channel, mark the holes with a pencil, and bore with a ⅛" drill. When you have finished, extract pieces B-2 and coat the edges which engage the moulding channel with liquid rubber. Reinsert the pieces B-2 into the channels and secure with ⅛" flat-head stove bolts, placing the head on the outside of the channel. Cut off excess thread with a good wire clip.

7—With 1" wood screws and a liberal application of glue, attach the assembly of the two pieces C-3, the two pieces B-2, and piece D-4 to the base **A-1**. This should fit accurately and should be fastened as firmly as possible.

8—On ⅛" presdwood stock lay out the dimensions for Fig E-5. The height, width of the base, and width of top are given. For the center measurement midway between base and top, measure at a like point the diagonal across the assembly as it stands in Step seven. This distance should be 14¾". Again drive nails, place the spline, draw the curve, and complete by sawing out. The circular hole located 4" on center from the top and mid center with the top of Fig. E-5 is for the *University* tweeter, mounting holes measured from the tweeter.

9—Take a piece of ¾" stock lumber 11½" long and 2" wide. Plane a beveled edge on the ¾" side to an angle of 40 degrees, and fasten with wood screws to Fig. E-5, 9½" above the mid base. This is shown in Fig. F-6. The flat 2" side to face inward against Fig. E-5 and the 40 degree bevel to face upward and away from the base.

10—Place Fig. E-5 and Fig. F-6 assembly into the triangular structure obtained at the completion of step seven. Fasten E-5 to the curved beveled edges of the side struts C-3 with ½" wood screws, after having first coated the beveled edges of the side struts C-3 with liquid rubber.

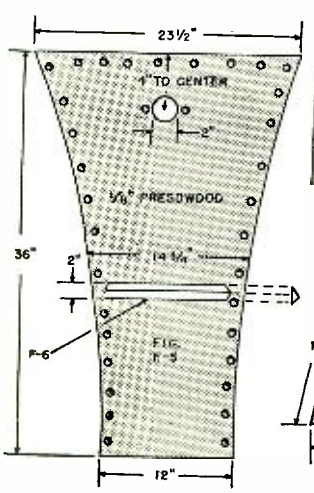
11—On ¾" plywood stock lay out the dimensions given for the top, Fig. J-9. Fit the long side of the triangle of J-9 to the face of E-5, using glue and 1" wood screws. Assembly as it has thus far been completed should resemble the drawing in Plate Number 1, on which the figure numbers have been listed for each component, enabling the reader to better visualize the placement of the various parts.

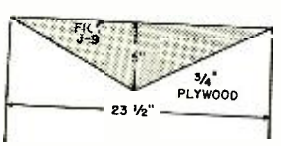
12—On ¼" presdwood stock lay out the dimensions for Fig. H-7, and saw out. The speaker cut-out will depend on the size of the speaker being used, 9" being arbitrary: all speaker mounting holes are to be taken from the speaker itself. Place on the base A-1 a piece of wrinkled aluminum foil cut to fit. This should be glued to a felt base of the same dimensions, and in its turn glued to the base A-1. (Object: to break up reflected sound in the throat of the horn). Next slip speaker mounting baffle into the slot in side strut C-3. With ½" wood screws fasten the 14" top of H-7 to the beveled edge of Fig. F-6.

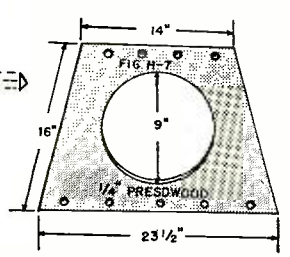
13—Mount speaker, the large cone bass driver on H-7, and the tweeter in front of the 2" hole in Fig. E-5. Assemble the high-pass filter as supplied by the manufacturer of the tweeter and bring the speaker feed cable through a hole in the base **A-1** located under the bass speaker close to the front, the exact location being arbitrary.

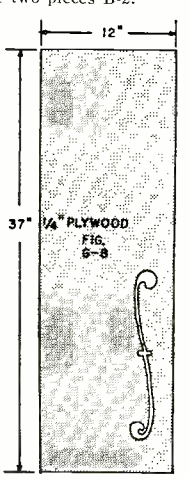
14—On ¼" plywood with a mahogany or other suitable veneer on the finished side lay out the dimensions as shown for Fig. G-8. Cut two pieces to these specifications and angle the long sides that butt together in order to make a close-fitting joint. Fasten with oval-headed screws and finishing washers to the base **A-1** and top J-9. Struts to reinforce the front panels G-8 are not shown, but it is evident what can be done to reinforce these pieces. F slots are also shown in Fig. G-8 to relieve back pressure for the bass speaker, but any configuration can be employed here as long as the area of the opening is equivalent to 8/10ths of the number of square inches in the speaker opening of Fig. H-7.

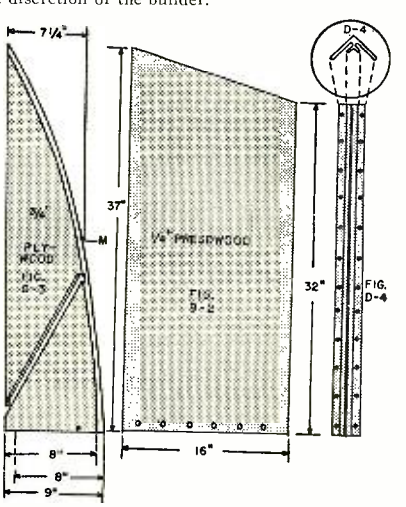
In conclusion, let us remind the prospective builder that the dimensions contained herein limit this corner baffle to a maximum speaker diameter of 12". Success depends upon careful workmanship, attention to details, and good shop practice. When completed in ship-shape fashion this horn baffle, using an *RCA* 10" accordion edge bass speaker and a *University* single tweeter, will open the way for high-quality sound at moderate cost. Thus far, we have not mentioned the dampening for the recess formed in the completed structure between E-5 and the front pieces G-8. For this purpose before the pieces G-8 are set in place, glue to the faces of E-5 and C-3 at least two thicknesses of *Ozite* floor matting, cut to fit. On the pieces G-8, glue one thickness of the same material, making sure you do not cover up the release ports for the back pressure set up by the bass speaker. The finish is left to the discretion of the builder.











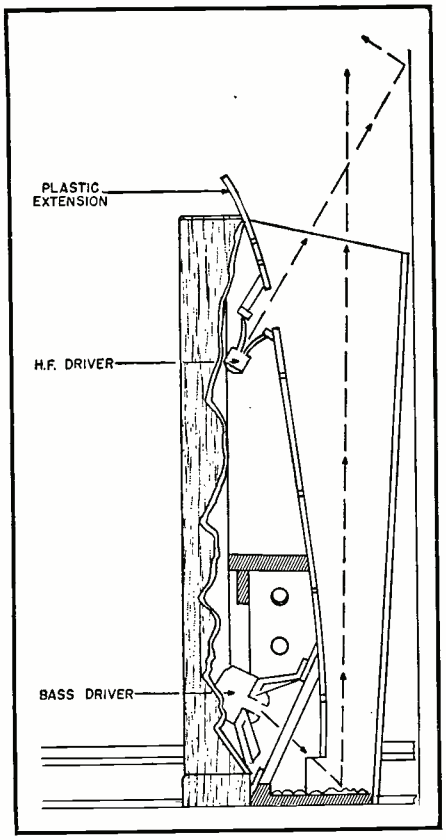


Fig. 2. Side view showing basic horn design.

age room and see what can be done to improvise a horn-type speaker that will not be of prohibitive size. Assuming that we want the best possible dispersion of sound and wish to take advantage of the greatest natural efficiency common to enclosed chambers, the best location for the transducer is unquestionably in the corner of our given room.

Let us then wall off a portion of this corner and bend the wall so that the enclosed space takes on the characteristic of an exponential expansion. If our horn is to have a low-frequency cut-off of about 48 cycles, the triangular area should double itself in cross section every 18 inches. So far so good, but how are we to introduce the mouth of the horn into the room? The best solution would be to design a coupling so that the air column would emerge tangent to the ceiling and to both walls. If we sketch this idea (Fig. 3) it becomes readily apparent that we have brought the whole room into play as a part of the loudspeaker system. In other words, we have produced an integral space coupling of the speaker to the given room. Experimental models have confirmed the assumed improvement in reproduction. If a properly designed coupling chamber is used between the speaker driver and the throat of the horn, the characteristics of this unit are positively amazing!

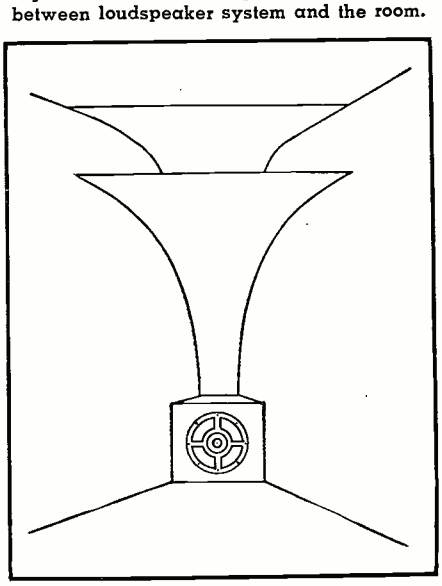
As good as this design is, it still leaves much to be desired, for it is far too unwieldly to be considered a practical piece of furniture in the average living room. Is there any way that we can retain the integral space coupling and still reduce the over-all size of the unit? Attacking the problem from a different angle, we know that the main energy of a horn is expended along its axis.

In the case of the vertical corner horn, this effect is further heightened by the solid angle formed by the intersection of the two walls. Consequently, it should be possible to reduce the height of the horn considerably and still utilize the entire room as an extension of the horn.

The horn we have designed and which we call the "integral space transducer" is essentially a horn of the straight type. Its size is no larger than the conventional box-type baffles now available. Despite this reduction in size, we were able to retain the essential efficiency of a full-size exponential horn. The intersection of the walls acts as an extension of the horn length, and the exponent is governed by a basic three-foot, 48-cycle curve which imparts the initial directivity to the sound. As the wavefront advances and meets the ceiling, it is further allowed to expand horizontally along the walls of the room in the confined area made naturally by the intersection of walls and ceiling. The ultilization of a vertical directivity of sound in the basic horn, combined with the horizontal direction imparted by adjoining walls and ceiling, give this unit a characteristic closely approaching that of an infinite horn.

Its small size was made possible by careful attention to the degree of effectiveness with which a basic length of horn can govern the expanding wavefront when the exponential restriction is no longer wholly present. For a detailed discussion of this point, see Paul W. Klipsch's article in the journal of the "Acoustical Society of America" for October, 1941. In our research it was found that a basic length of slightly over three feet would suffice to give adequate results for the integral space transducer. Another factor which contributed to the small size was a device known as the "sound diffusion reflex coupling chamber." This unique coupling method utilizes a reflective panel made of aluminum, finished in a specially-designed irregular surface which distributes the audio energy equally throughout the throat area. This eliminates the need for complex phase correction plugs. While this method would not be especially desirable for treble frequencies, it is nevertheless remarkably adaptable to the bass range because of its simplicity and rigidity (see Fig. 2).

Fig. 3. Fundamental integral space coupling between loudspeaker system and the room.



The basic horn reproduces only the frequencies below 4000 c.p.s. or thereabouts. For the higher frequencies, there is a separate compression-type tweeter with its own integral horn mounted near the mouth of the basic horn (see Fig. 2).

The angle of this tweeter is so arranged that the axial flow of sound will reflect from the corner at a point substantially below the intersection of walls and ceiling. This gives dispersion to the high notes and integrates them into the general sound pattern far more effectively than if the tweeter were allowed to radiate directly into the open room.

The tweeter and bass driver are controlled by a two-channel dividing network having its crossover at 3500 cycles and an outside bandpass with an attenuation of ten to twelve db. per octave.[2] It would have been entirely possible to lower this crossover frequency, but the basic horn would then have been lost on the lower mid-frequency band and would negate the advantages which are so apparent when these frequencies are allowed to emanate from the basic horn.

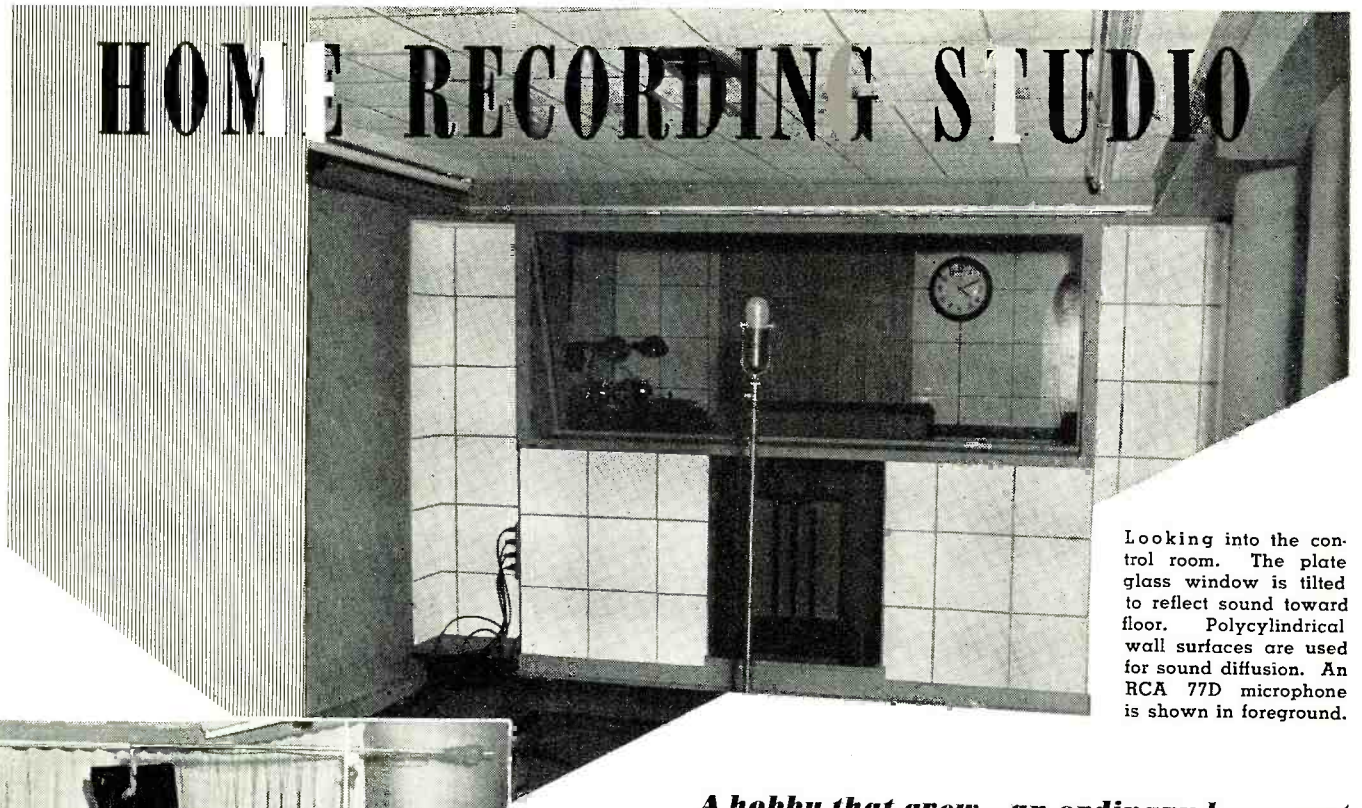
The actual construction of the integral space transducer lends itself admirably to materials that are easily obtainable. As is evidenced by the illustrations, this unit is of triangular structure which allows for a unique type of fabrication giving license to the use of light, durable materials. The base of the unit is a simple right-triangle of ¾ inch plywood, faced with the metal foil necessary for the sound diffusion reflex coupling chamber.

To this triangle are affixed the two side panels made from 3/16 inch tempered Masonite. These two pieces are so tapered as to allow adequate clearance for existing baseboards and mouldings. Upon each of these panels is mounted a curved strut which forms the foundation for the exponential flare, which is a piece of ⅛ inch Masonite laid out as a pie-shaped exponential curve. This is fitted to the curved struts, and the resulting enclosure is the basic triangular horn. The two short members are fastened to the curved struts to form a foundation for the trapezoidal speaker mounting board. The ensuing closed

[2] Jensen, Model A40-1.

(*Continued on page* 130)

HOME RECORDING STUDIO



Looking into the control room. The plate glass window is tilted to reflect sound toward floor. Polycylindrical wall surfaces are used for sound diffusion. An RCA 77D microphone is shown in foreground.

A hobby that grew—an ordinary basement room houses this unique recording studio.

Rear section of studio with arrangement of sliding drapes for acoustical control in case damping is necessary. An Electro-Voice 635 dynamic mike is used.

Inside the control room. Two Presto 6N recorders with automatic equalizers. The recording amplifier is on a shelf under the table. Playback unit is on left.

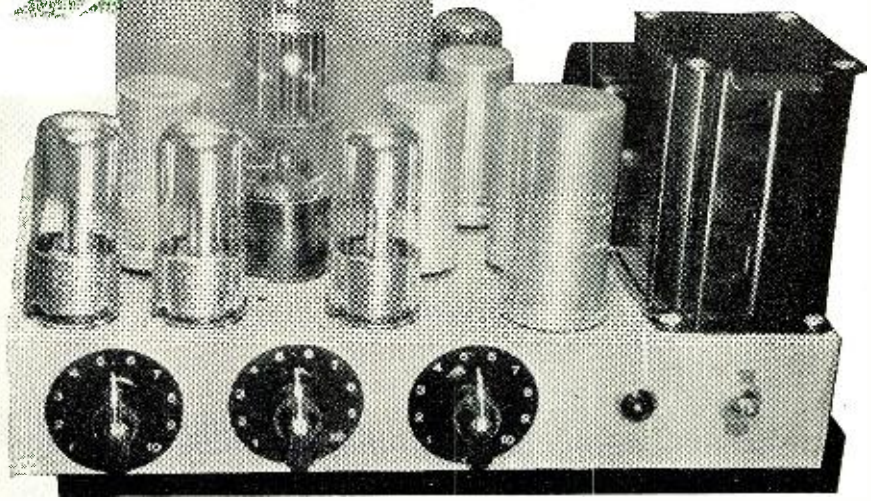
WHAT started out as an ordinary hobby has grown into a well-paying, part-time adventure. The JSK recording studio, owned and operated by Julian Krupa, an artist by profession, is located in a basement room of his home at 6024 S. 74th Avenue, Argo, Illinois.

Like all radio hobbyists, Krupa started in a small way by building amplifiers, gadgets, etc. His interests expanded and now he has a studio that is as modern in design and as well-equipped as many of the professionally operated facilities.

Although comparatively small, a 12-piece orchestra has been accommodated with good results in reproduction. Recent additions to the studio were a tape recorder and a specially-designed reverberation chamber. This just shows you what you can do at home in your spare time, if you can afford it. —30—

← Amplifier rack containing AM-FM tuner, power supplies, and equalizer circuits. Amplifiers also feed a reverberation chamber located in room outside of the studio.

Control console made by Raytheon. The desk with sliding shelf was home-built and mounts the sound effects, turntables, mixers, and four special mixing preamplifiers.



Home-built audio amplifier showing placement of controls and above-chassis components.

HIGH-QUALITY AUDIO at Reasonable Cost

By
JOHN V. URBAN
Staff Eng., WPIX, New York

Construction details for an audio amplifier designed primarily for use with FM-AM tuners, TV, and record players.

TELEVISION is providing an ever increasing number of enjoyable - - looking and listening hours to a rapidly growing number of people. The author has spent many pleasant hours viewing the antics of a favorite comedian or some other type of preferred program. This apparent realization of the listener's dream come true prompted us to dispose of all of our high-quality audio equipment some months ago.

Much to our sorrow, however, one of the greatest deterrents to the realization of perfection in home entertainment has been the apparent disregard for the audio portion of the program, largely at the receiving end. This, of course, has come about due to the demand by the public for lower priced television receivers to which the manufacturers have responded by incorporating audio systems roughly equivalent in response to that of the cheaper a.c.-d.c. midget radio variety.

Transmission of the audio portion of the televised program is accomplished through a frequency modulated signal and generally adheres to high standards. The only exception to this rule is the case where the advantageous studio acoustics of the larger network radio stations are not adaptable for use on television programs and remote sports and television broadcasts. Of course, the latter generally do not include any wide frequency range transmission, but are generally limited to the voice frequency range of the announcer or master of ceremonies.

The amplifier described herein was constructed in order to enjoy the full audio range of some of the telecasts. It was connected to the audio input stage of a table model television receiver. The results were so gratifying that we are now using the same audio system with an FM tuner, an AM tuner, and a record changer, using a variable reluctance pickup cartridge.

The input of the amplifier requires 1 volt for an output of 8 watts and is wired to a shielded junction box containing a four-position rotary switch for selection of the audio driving source. At an output of 2 watts, which is sufficient for most home installations, the output contains less than 1% total harmonic distortion for any frequency from 100 to 5000 cycles. This is the highest frequency at which measurements were taken, since the fourth and higher order harmonics of this frequency fall outside the useful audio range. The frequency response curves shown in Fig. 1 were made with the aid of a *Hewlett-Packard* audio frequency generator, model 205 AG, and a *Hewlett-Packard* harmonic wave analyzer, Model 300A. The characteristic curves and distortion measurements were taken on the amplifier which was constructed with "run of the mill" unselected components. The statistics could be greatly improved by more careful balancing in the driver stage and selection of tubes and components, but it was felt that the average constructor would not have the equipment available to do this and would, therefore, be more interested in the results tabulated on a unit made with parts that did not require pretesting and selection.

The relatively good performance characteristics of the amplifier are due in part to the use of a good output transformer. The constructed unit utilized one of the linear standard series, which is highly recommended. The cheaper series equivalent may be used, though with some sacrifice in performance, noticeable especially in distortion at the higher output levels and frequency response at both the low and high end of the range. Since the speaker voice coil was directly driven, and no other use for the amplifier was contemplated, a 500-ohm output winding on the transformer was not deemed necessary, resulting in a substantial saving in the cost of the transformer.

The output stage of the amplifier utilizes the low mu twin triode, 6AS7G. This tube is of the heater cathode type primarily designed for voltage regulator service. It will conduct a relatively high plate current due to its low plate resistance, and this is a dis-

tinct advantage, since in audio service it serves to dampen the loudspeaker very effectively. Damping is achieved by the use of inverse feedback when tubes having high plate resistances, such as pentodes or beam tetrodes, are used as output amplifiers. In many cases, however, feedback loops introduce regeneration and phase distortion at certain frequencies. This is especially true when the feedback loop includes resistance-capacitance networks to boost or attenuate a particular range of frequencies. It is also true that feedback lowers the gain of an amplifier, so that the advantage of the sensitivity of the multi-grid output tube is somewhat offset by its need for feedback.

Each section of the 6AS7G receives its bias through a separate resistor. This provides a self regulatory action, since if one section is inclined to draw more plate current it will increase its bias and hence tend to maintain a balance with the other section. A total of four tubes was tried, and each operated within acceptable limits. If the unbalance between sections should exceed 5 ma., the cathode bias resistors should be decreased to 2000 ohms each, and a 1000 ohm balancing potentiometer (wirewound 4 watt rating) inserted in series with the end of each cathode resistor and the arm of the potentiometer grounded. (See schematic diagram Fig. 2.)

The use of the 6AS7G as an audio amplifier output stage has been hampered by its relatively low amplification factor of approximately 2. It is easily driven to the better than 8 watts output by the use of a push-pull 6SN7GT driver stage. Distortion in the driver is minimized by the push-pull circuit and the use of unbypassed cathode resistors which provide degeneration. A driver transformer was not used since a good one is an expensive item and would raise the over-all cost considerably.

The driver stage is preceded by half of a 6SN7GT, which functions as the familiar split load type phase inverter, chosen for its simplicity and balance, and which will supply output voltages of opposite phase sufficiently equal without the need for careful balancing. Since the driver stage is not followed by high amplification, the danger of hum disturbances due to heater cathode leakage is minimized. This

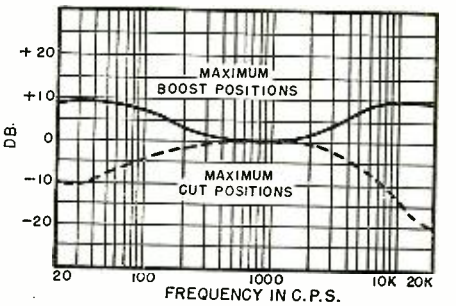


Fig. 1. Over-all frequency response curves of the home-built audio amplifier.

type of hum sometimes prohibits the use of this means of phase inversion when it is followed by high amplification.

The other half of the 6SN7GT is used as a voltage amplifier. With the possible exception of the large bypassing and coupling condensers, this stage is conventional in every respect. These are essential for minimum hum as they bypass hum voltage originating between the heater and the cathode, and are also necessary for good low-frequency response. The audio frequency voltage developed across the

R_1, R_4—2 megohm audio taper pot.
R_2—2.2 megohm, ½ w. res.
R_3—250,000 ohm audio taper pot.
R_4, R_5—1200 ohm, ½ w. res.
R_6—51,000 ohm, ½ w. res.
R_7—510,000 ohm, ½ w. res.
R_8, R_{18}, R_{20}, R_{27}, R_{28}—47,000 ohm, 1 w. res.
R_{11}—15,000 ohm, ½ w. res.
R_{12}—10,000 ohm, ½ w. res.
R_{13}, R_{17}, R_{21}, R_{26}, R_{29}, R_{30}—470,000 ohm, ½ w. res.
R_{14}—1500 ohm, ½ w. res.
R_{15}—4700 ohm, ½ w. res.
R_{16}—47,000 ohm, ½ w. res.
R_{19}—22,000 ohm, ½ w. res.
R_{22}, R_{23}, R_{24}, R_{25}—2700 ohm, ½ w. res.
R_{31}, R_{32}—2500 ohm, 10 w. wirewound res.
C_1, C_7, C_{13}, C_{14}, C_{15}, C_{16}, C_{19}, C_{20}—.1 μfd., 400 v. cond.
C_2—50 μμfd. mica cond.
C_3—500 μμfd. mica cond.
C_4—.03 μfd., 400 v. cond.
C_5—.001 μfd., 400 v. cond.
C_6—.01 μfd., 400 v. cond.
C_8, C_9, C_{11}, C_{21}—10 μfd., 450 v. elec. cond.
C_{10}—50 μfd., 50 v. elec. cond.
C_{12}—.25 μfd., 400 v. cond.
C_{17}, C_{18}—40 μfd., 150 v. elec. cond.
C_{22}—80 μfd., 450 v. elec. cond.
T_1—5000 ohm plate-to-plate to load output trans. (UTC LS57, CG16 or Chicago Transformer PC080)
T_2—Power trans. 375-0-375 v. @ 150 ma., 6.3 v. @ 5 amps., 5 v. @ 2 amps. (Thordarson T22R33, or Stancor P6014)
S_1—S.p.s.t. toggle sw.
CH_1—10 hy., 150 ma. filter choke (UTC S29)
F_1—2 amp. fuse
PL_1—6.3 v. pilot lamp
V_1, V_2, V_3—6SN7 tube
V_4—6AS7 tube
V_5—5Y3 tube

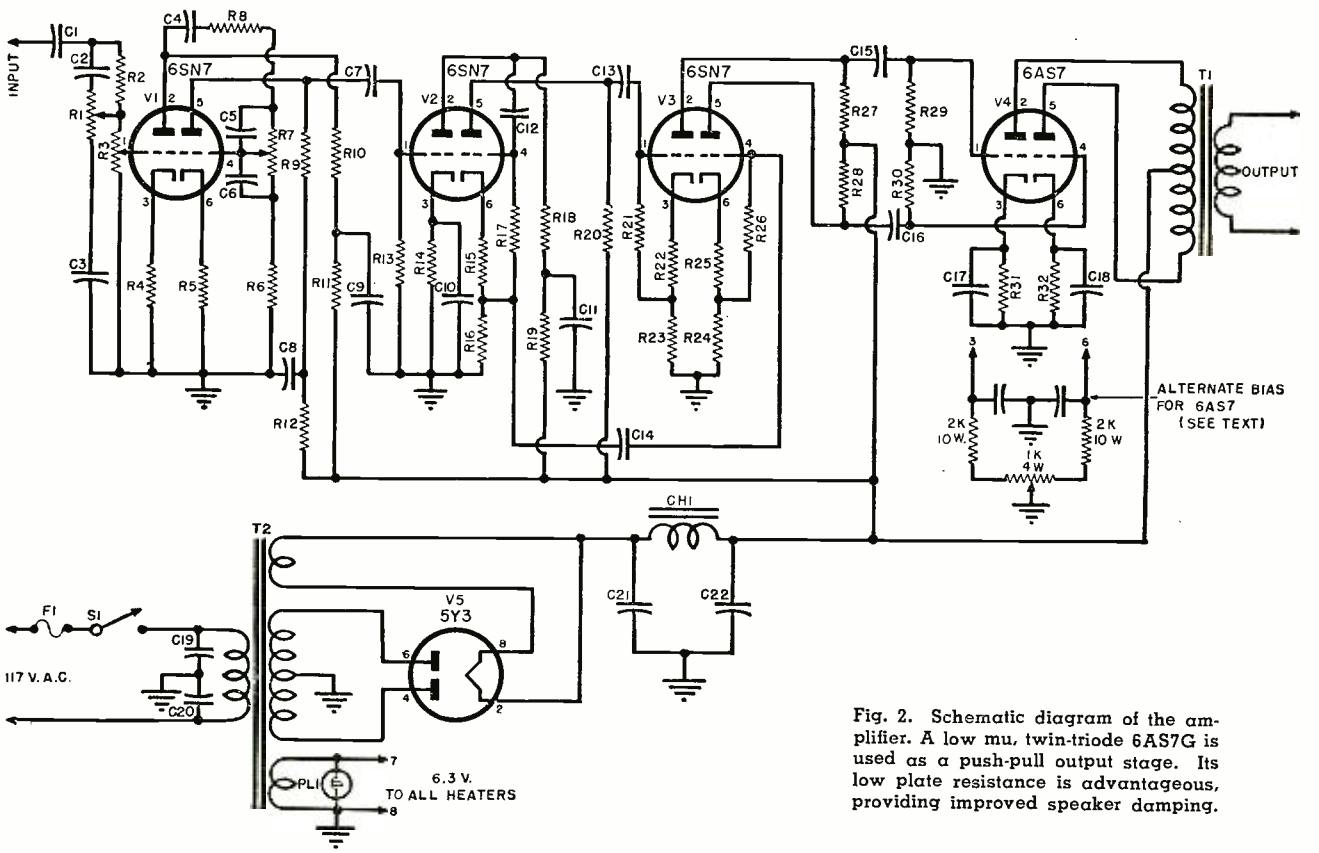
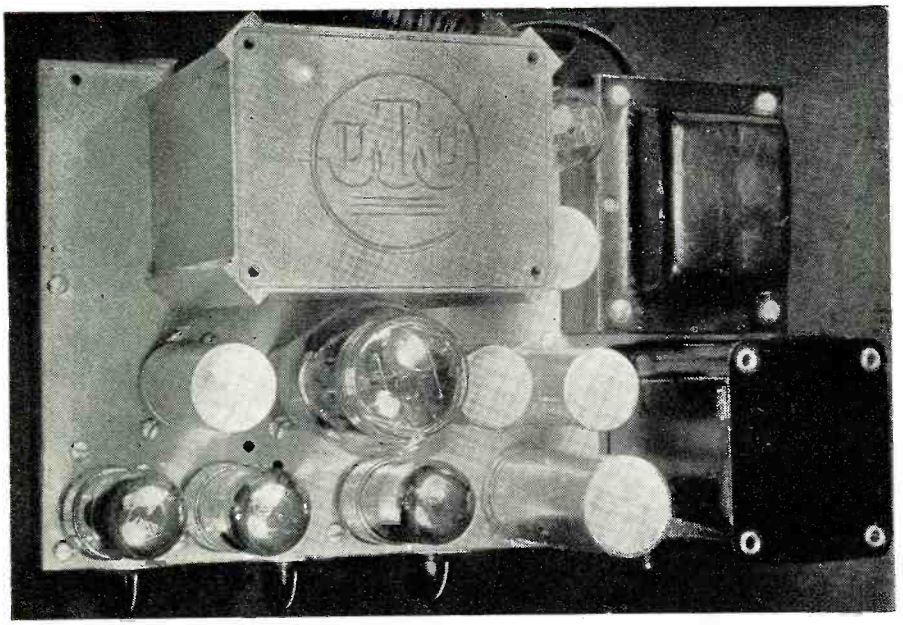


Fig. 2. Schematic diagram of the amplifier. A low mu, twin-triode 6AS7G is used as a push-pull output stage. Its low plate resistance is advantageous, providing improved speaker damping.



Top view of the audio amplifier, showing relative placement of components.

cathode circuit impedance is equal to the total voltage developed in the plate circuit, multiplied by the ratio of cathode circuit impedance to the plate circuit impedance. This voltage across the cathode impedance will act in a degenerative manner reducing the low-frequency response if the bypassing condenser is not sufficiently large.

The tube complement of the amplifier is completed with the use of a third 6SN7GT, which functions as a separate high and low frequency amplifier control stage. There is no interaction between the stages or controls. The circuit values are chosen so that there is the least effect upon the frequencies from approximately 600 to 800 cycles. The low frequency control will boost 9 db. at 40 cycles and attenuate 10 db. at 40 cycles when set in extreme positions. The boost is gradual to about 150 cycles, and it then rises sharply to a peak at 40 cycles. This is a desirable characteristic inasmuch as it tends to decrease the annoying bass boominess of a human voice when excessive boost is present at 200 to 300 cycles, and it also provides the boost necessary below 100 cycles to bring out to advantage the lows of the drum and bass string instruments.

The high frequency control will boost the response 10 db. at 20,000 cycles and attenuate it 20 db. at the same frequency. Both of the tone control potentiometers are of the audio taper type (in which the 10 per-cent resistance point occurs at 50 per-cent rotation), and these will provide substantially linear response when set at 50 per-cent rotation. With the amount of control available, one naturally feels there must be some disadvantage, and this is revealed as an insertion loss of 20 db. at 800 cycles. On the other hand, if the selective feedback method of tone control had been used, it would have necessitated a corresponding loss in gain and might have resulted in some regeneration and transient distortion.

Except for the relatively high capacitance output filter condenser and large bypass and decoupling networks, the power supply is entirely conventional in every respect. It was found necessary to use at least an 80 μfd. output filter condenser to prevent low frequency motorboating and instability due to the low frequency boost stage.

A very desirable feature in most equipment is reasonable compactness, and this entire amplifier and power supply were assembled on a 7″x9″x2″ chassis. Good construction practice will call for a good grounding technique for the tone control stages. No separate ground bus was found necessary after the unit was completed. Grounding for the tone control stages should be made to one point on the chassis. One side of the heaters is grounded, but in no case should this point be used for grounding any other circuit components. The heaters are wired in parallel and grounded at the transformer negative return point. The heater of the 6AS7G is rated at 6.3 volts a.c. 2.5 amperes, and at least #20 wire should be used for this wiring, especially if a larger chassis is used and a longer filament run is necessitated.

The input of the amplifier was wired to the shielded junction box, using low capacity, low loss shielded wire, but a single contact microphone connector and chassis receptacle may be substituted if desired. Output of the unit is wired to an octal socket on the rear apron of the chassis and is used with an octal male connector and twisted pair speaker cable.

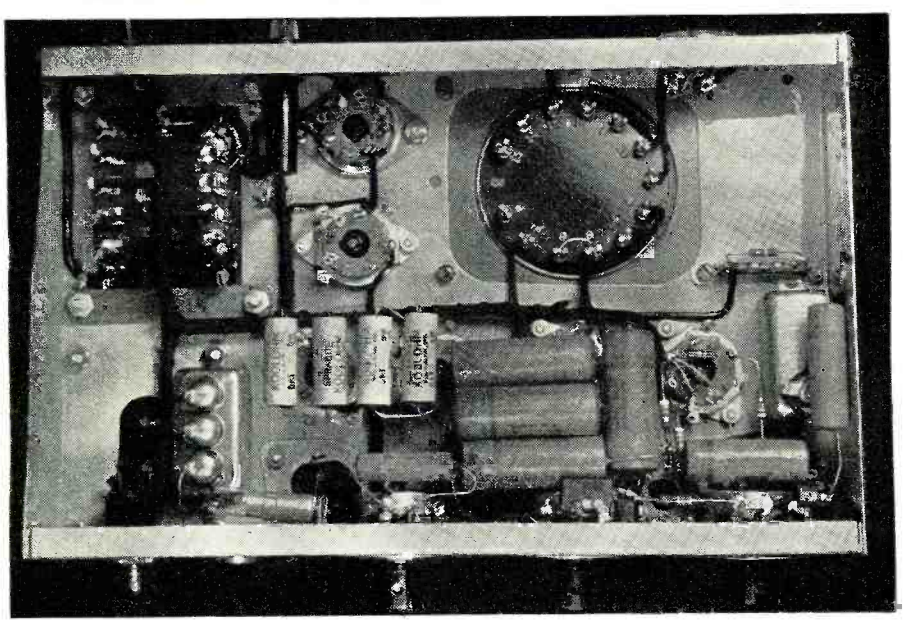
Many excellent preamplifiers giving the proper compensation have been described in this and other magazines.

The type of equalizer and amplifier which allows the characteristics to be varied to suit various pickups will probably be the most satisfactory for the majority of users.

For full realization of the capabilities of the amplifier, the input source must be a good one. Live music broadcast over the local frequency modulation stations has proved excellent. If one of the variable reluctance pickup cartridges is used for phonograph reproduction, the tone control stages do not obviate the need for a properly equalized input preamplifier.

The speaker system includes the speaker and its proper baffle. A separate low and high-frequency, or coaxial type, reproducer is recommended. During the amplifier tests, a 10-watt rated speaker made by a reputable manufacturer was destructively damaged by the output of the amplifier at the lower frequencies. With this in mind, it is recommended that a speaker system capable of handling 20 watts be used with this unit. —30—

Under-chassis view. Note, particularly, neatness of wiring and parts assembly.



WMOR'S SUPERSONIC TONE Selects Receivers

By DAVID B. PIVAN
Chief Engineer, WMOR

Special shopping tips to customers in Chicago's many National and Jewel stores bring added revenue to station.

R. J. Wood, Jr., manager of station WMOR, points out first Jewel Food Store loudspeaker installation to Roy Martin (left), store manager, and a representative of Consumers Aid, Inc. (right).

LARGEST independent FM broadcaster in the Midwest, Station WMOR is located in the heart of Chicago, its antenna mounted atop one of the tall "Loop" skyscrapers. An effective radiated power of 40,000 watts provides it with a service area comprising a radius of 75 miles. Any receiver using a good FM antenna will consistently pick up the programs at distances of more than a hundred miles. This coverage does not vary from day to night, nor is it disturbed by heterodynes or static noise, and it possesses a measure of fidelity that amazes "dyed in the wool" AM listeners.

Staff members of WMOR believe they have found the key to successful FM broadcasting by airing shows that cannot be obtained to any extent on AM or other FM stations, i.e., programming special events and featuring personalities. During the daytime hours, instrumental music is transmitted and may be heard in the nearly two hundred supermarkets of Chicago's two major food chains. Shoppers in these stores are diverted by pleasant background music, plus an occasional shopping tip.

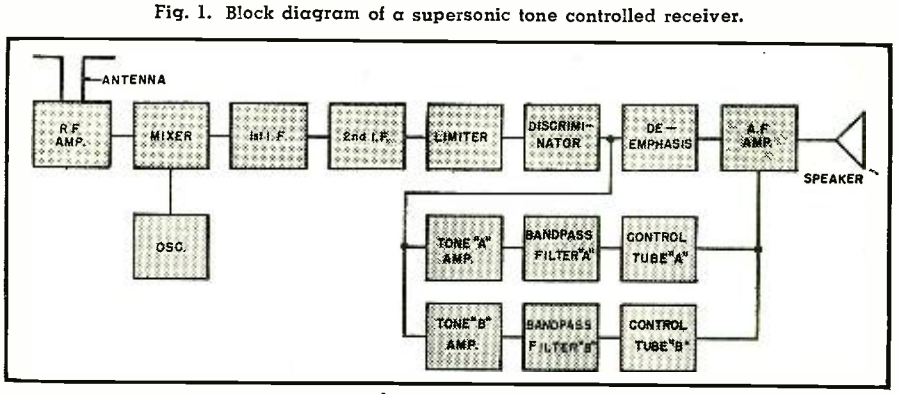
Receivers in the stores are equipped with selective filters actuated by a supersonic tone that is superimposed upon the commercial announcement. The output of the filters can be used to silence the announcement or to boost it, whichever is desired. The manner in which it is accomplished is shown in the block diagram. Although only two selective filters are indicated, additional ones may be added to perform such functions as automatically turning the remote receivers on and off.

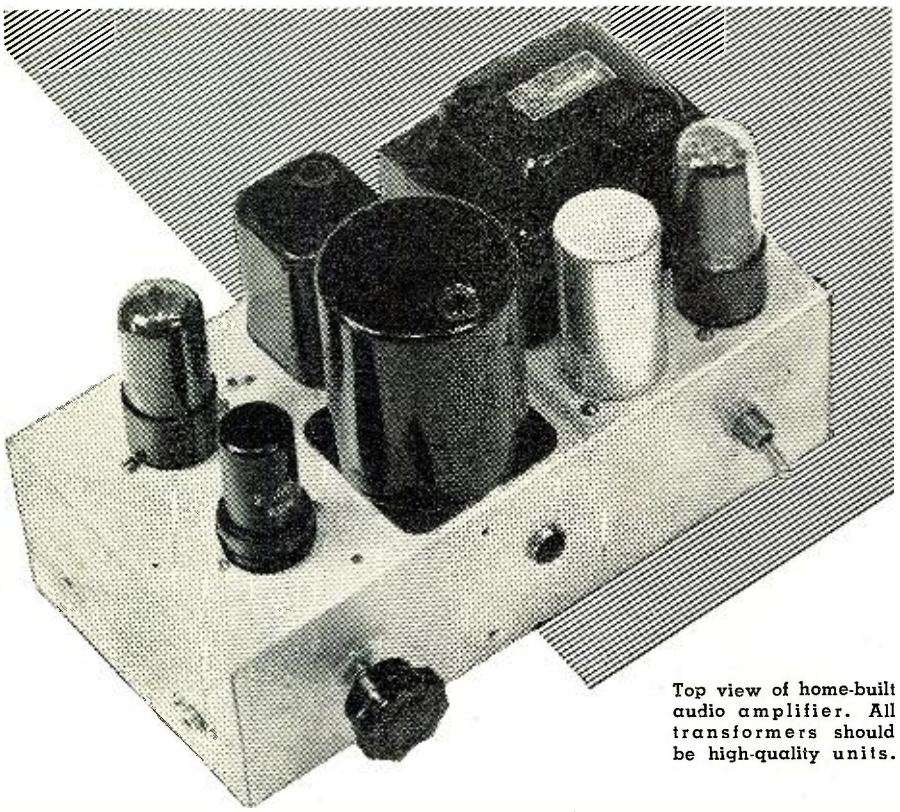
Two main studios are provided at WMOR for the origin of live shows, both of which are treated acoustically to give a somewhat longer reverberation time than is commonly attained. The resulting programs have a "liveness" that further increases the realism of the high-fidelity broadcast. High fidelity has come to mean many different things in the past few years, but at WMOR it refers to "true fidelity." Whether or not the public as a group actually desires true fidelity is not certain. One-time listener tests have not indicated conclusively that there is a preference one way or the other, but tests conducted over a period of time show a decided trend toward as exact a reproduction of the original sound as is possible. All of the audio equipment in the studios is designed with that purpose in mind and has a flat response from 20 to 20,000 cycles within 1½ db.

Two transcription libraries are maintained at WMOR, *Capitol* and *World*, the latter being a vertical service. Transcriptions with low surface noise are played "wide open," that is, equalized to correspond to the recording characteristic. These transcriptions have a high-frequency response to 10,000 c.p.s., with some going considerably higher. Shellac pressings, with the exception of a few foreign labels, seldom have high-frequency response above 7000 c.p.s. Consequently, when these records are played it is necessary to employ a high-frequency roll-off to improve the signal-to-noise ra-

(*Continued on page* 116)

Fig. 1. Block diagram of a supersonic tone controlled receiver.





Top view of home-built audio amplifier. All transformers should be high-quality units.

A Direct-Coupled AMPLIFIER With Cathode Follower

By
RAYMOND H. BATES

Two novel circuits in a single audio amplifier provide wide frequency response with a minimum of distortion.

THE construction of the amplifier to be described in this article was actually initiated a little over two years ago, at which time I became an enthusiastic audio ham. During the recent war I was associated with radar in a practical way and so became acquainted with the cathode-follower which was used extensively in radar as an inexpensive medium for matching a high impedance to a low impedance in voltage amplifier stages. At that time, it appeared to me that the cathode-follower might be ideally suited for audio output stages where the problem of getting a good impedance match is generally difficult and usually expensive. With this in the back of my mind, I began experimenting with all types of audio amplifiers, searching for a circuit that would provide a lot of performance for a minimum of parts. Previous issues of RADIO & TELEVISION NEWS, I discovered, had described both cathode-follower and direct-coupled amplifiers as separate circuits. I could not find any articles that described an audio amplifier with both direct coupling between stages and cathode-follower output. So, using old issues of RADIO & TELEVISION NEWS as source material, I proceeded to construct this amplifier.

As can be seen in the schematic diagram, the circuitry is extremely simple.

There are two features that give this amplifier its superior performance. One is direct coupling between the plate of the 6SJ7 and the grid of the 6V6. The other is the cathode-follower output from the 6V6.

In addition to its simplicity, direct coupling eliminates the undesirable characteristics that are inherent in ordinary resistance-capacitance coupling, such as short circuiting of weak signals and grid blocking of strong signals.

The cathode-follower output, in addition to its simplicity, provides both improved high and low frequency response, damping out of all the peaks in both the output transformer and speaker, less distortion, and 100 percent degenerative feedback.

In order to determine the circuit values in the schematic, free use was made of the tube manuals and Kirchoff's and Ohm's laws. Commencing with the output stage in the conventional manner, the tube manuals indicate that for a single-stage output, a 6L6, 6V6, 6F6, or 6K6 are likely output tubes. The 6V6 was selected because of its ready availability and relatively lower percentage harmonic distortion rating. The 6SJ7 was chosen mainly because of its high gain and low percent distortion.

In order to keep power requirements down, I chose a 350 v., center-tapped, 120 ma. (53 ma. only required) power transformer which is readily available at moderate cost. Allowing for a 15 volt drop in the filter choke and a 250 volt drop from the plate to the cathode of the 6V6, 85 volts is available at the cathode of the 6V6. Since in a direct coupled circuit the grid bias, 12.5 volts in this case, is obtained by the voltage differential between the cathode and grid, approximately 73 volts is required at the grid of the 6V6 (and at the plate of the 6SJ7, inasmuch as these two tube elements are connected directly together). With 73 volts at the plate and 55 volts at the screen of the 6SJ7, a voltage amplification of 115 can be obtained at only .8 per-cent distortion. This means that a .1 volt signal at the grid of the 6SJ7 will provide a 11.5 volt signal at the grid of the 6V6 which is considered adequate.

In accordance with Kirchoff's law, the voltage and current distribution around the circuit is indicated in the schematic. Note that there is a 12.5 volt drop through the d.c. resistance of the primary of the output transformer which was measured to be approximately 250 ohms. The cathode-follower output is obtained simply by connecting the transformer to the cathode of the 6V6 and tying the plate and screen of the 6V6 together to the "B plus" supply, as shown.

The output of the amplifier is approximately 4.5 watts. While this figure may seem low to those accustomed to dealing with amplifiers having an output of 20 or more watts, it is entirely adequate for home use when an efficient speaker system is used.

Tests made by various organizations have shown that for listening in the average home living room, an output

of less than one watt is generally used. The only reason for providing more power than this is to allow for the peak passages that occur in some classical compositions.

The input sensitivity is such that even the high-quality, low-output crystal pickups will provide sufficient drive.

No provision has been made for the use of variable reluctance pickups, although there is no reason why such units could not be used if a preamplifier stage were added. There have been many satisfactory preamplifiers described in various issues of this magazine.

In the event a preamplifier is used for the magnetic pickups, great care should be exercised in the shielding and placement of parts to avoid hum pickup. The careful selection of the tube used in the preamplifier will aid materially in the reduction of hum.

There is sufficient reserve capacity in the power supply to take care of almost any type of preamplifier without any trouble.

No provision for tone controls has been made, although they could be added with little difficulty. There is a great deal of controversy as to the best type of tone control, and it was felt that they could be added at a later date when the most satisfactory type had been determined by experiment.

It is essential that the primary of the output transformer, T_1, have a resistance of approximately 250 ohms, as the resistance of this winding determines the grid bias for the 6V6. A check of the various types of transformers on the dealers' shelves by means of an ohmmeter will be sufficient. The primary impedance of this transformer should be from 5000 to 6000 ohms, with the higher value giving slightly less distortion.

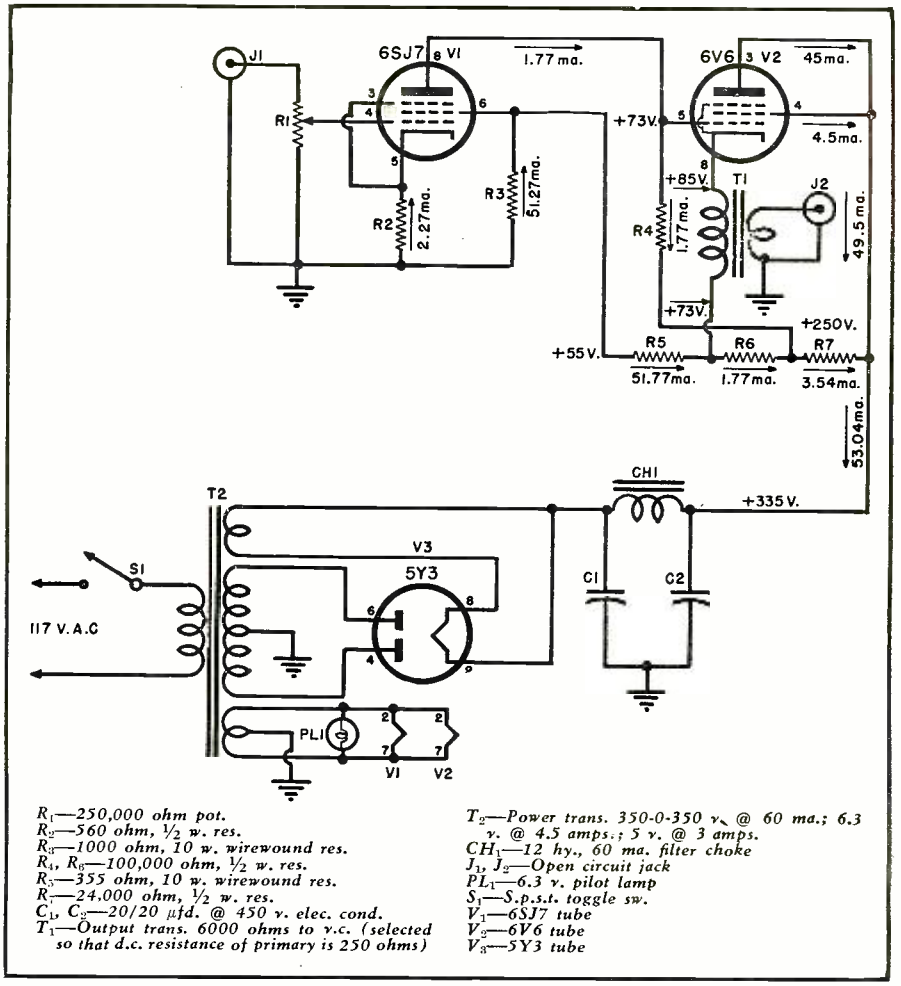
The voice coil winding should be selected to match the speaker in use. Most of the better speakers have an impedance in the vicinity of 8 ohms, and for that reason this value is specified.

It is not essential that this transformer be of the sealed type, but it should be of good quality so that the full benefit of the amplifier may be realized. Poor transformers are usually deficient in frequency response at the upper and lower frequencies.

The power supply, being conventional, needs no explanation.

As can be seen in the photographs, the construction of the amplifier is simple and straightforward, with point to point wiring being used throughout. All the parts used are of good quality, all chokes and transformers being shielded and/or hermetically sealed. The total cost is slightly less than ten dollars. By observing the usual precautions, twisting filament leads, etc., hum is inaudible at full gain.

When used with a good-quality tuner or record reproducer and a well baffled extended range speaker, the performance of this amplifier is superior for average living-room listening. The author used a *Pilotuner* for FM pro-



R_1—250,000 ohm pot.
R_2—560 ohm, ½ w. res.
R_3—1000 ohm, 10 w. wirewound res.
R_4, R_6—100,000 ohm, ½ w. res.
R_5—355 ohm, 10 w. wirewound res.
R_7—24,000 ohm, ½ w. res.
C_1, C_2—20/20 μfd. @ 450 v. elec. cond.
T_1—Output trans. 6000 ohms to v.c. (selected so that d.c. resistance of primary is 250 ohms)
T_2—Power trans. 350-0-350 v. @ 60 ma.; 6.3 v. @ 4.5 amps.; 5 v. @ 3 amps.
CH_1—12 hy., 60 ma. filter choke
J_1, J_2—Open circuit jack
PL_1—6.3 v. pilot lamp
S_1—S.p.s.t. toggle sw.
V_1—6SJ7 tube
V_2—6V6 tube
V_3—5Y3 tube

Complete schematic diagram of direct-coupled cathode-follower amplifier.

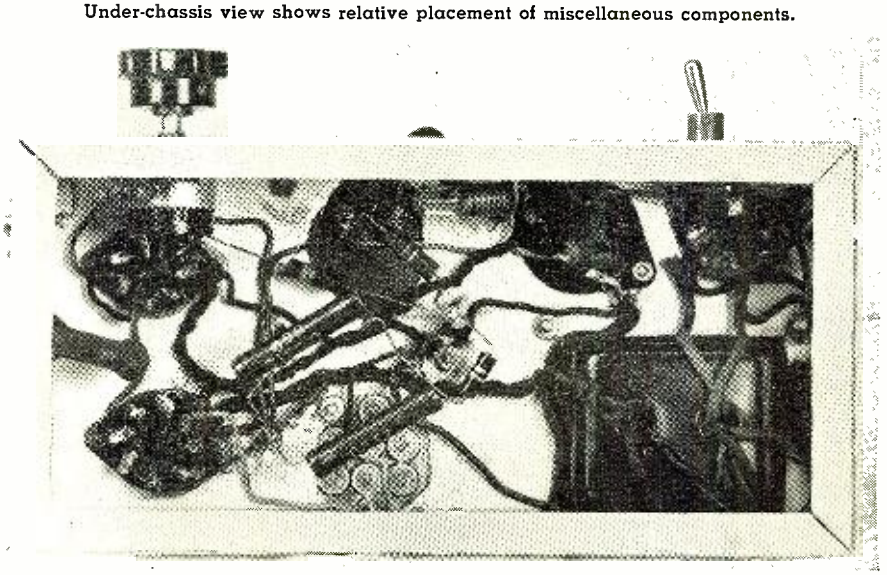
grams, a *Webster* dual speed record player for reproducing the conventional 78 r.p.m. and *Columbia* 33⅓ r.p.m. records, an *RCA* player for the new 45 r.p.m. records, and a *Jensen* bass reflex reproducer.

Lacking laboratory test equipment, the author could not conduct the usual harmonic and intermodulation distortion tests on this amplifier. However, judging from extensive living-room listening tests, using recordings ranging from the *RCA Victor* Red Seal version of "Night on Bald Mountain" to the *Capital* Stan Kenton rendition of "Peanut Vendor," this amplifier leaves little to be desired.

If you've never listened to a direct-coupled cathode-follower amplifier, then you have a pleasure to look forward to while constructing this one.

—30—

Under-chassis view shows relative placement of miscellaneous components.



Equalizing CRYSTAL PHONOGRAPH PICKUPS

By
CHARLES P. BOEGLI
Cincinnati Research Co.*

New equalizers provide crystal pickup performance comparable to that of high-quality magnetic units.

THE RELATIVELY recent development of a series of magnetic pickups typified by the *Clarkstan* RV, *General Electric* variable reluctance, *Pickering,* and a number of others, has set new standards of phonograph record reproduction. These units operate well with low stylus pressures, and the playback is characterized by remarkable "cleanness" and freedom from needle talk and record scratch. Not to be outdone, manufacturers of crystal pickups have concentrated on evolving improved units, and some recent products track satisfactorily with even lower stylus pressures than the magnetic pickups.

Crystal pickups capable of providing wide-range response are not new; until recently, however, their cost has been high. It is customary to feed the signal from these pickups directly into a high-impedance grid circuit, often employing a series equalizer, and under these conditions, as contrasted with late magnetic units, the crystal pickups generally have the advantages of higher voltage output and a lack of susceptibility to hum pickup. On the other hand, for a given frequency range, the reproduction with crystal pickups has the disadvantage of greater record scratch.

This is not primarily attributable, as has popularly been supposed, to the greater relative response of the crystal pickups to vertical stylus movement (the common belief being that "The noise is on the bottom of the record groove while the music is on the sides"), but rather to the superior inherent damping of the magnetic cartridge arising both from its low internal impedance and the low loading resistance that is as a result permitted without detrimental effect on the frequency response[1, 2]. The low impedance circuit effectively prevents resonant oscillations of the stylus when a particle of grit or dust is encountered and in this manner reduces the scratch level. Thus, the scratch level is somewhat akin to the "hangover" effect encountered in power output stages when pentodes are used without feedback. The same factors, of course, influence the "cleanness" of reproduction. Consequently, it may be assumed that when all other factors (like mechanical stylus damping) are equal, the lower-impedance pickup circuit will result in less noise and cleaner reproduction.

It has been found that with proper equalization, the impedance of the crystal pickup input circuit can be greatly reduced, and results attained comparable to those to be had with magnetic pickups. The manner in which this is accomplished is the subject of this paper.

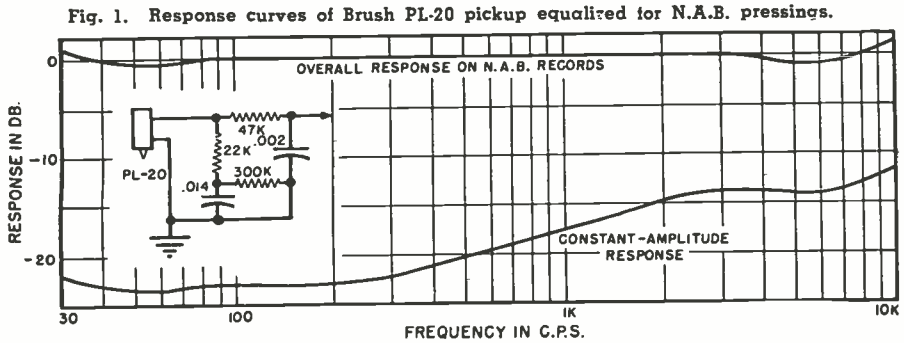
The internal impedance of a crystal pickup is almost purely capacitive. If such a pickup is loaded in the customary manner with a resistance, the constant-amplitude bass response will drop off 6 db. per octave below the frequency at which the internal impedance of the pickup equals the load resistance. To extend the response down to a reasonably low frequency requires an extremely large load resistance; for example, a pickup having .001 μfd. internal capacitance requires a load resistance of 5.3 megohms for flat response to 30 c.p.s., assuming no low-frequency peak arising from arm resonance. With some pickups a low-frequency peak exists and this reduces the required load resistance by a small amount. Under any circumstances, this is practically equivalent to open-circuit conditions, and scratch occurring at higher frequencies is quite pronounced. The general practice with crystal pickups is to use a load resistance of the order of .5 megohm and accept the resulting low-frequency loss.

As the load resistance is decreased, the frequency at which bass attenuation begins becomes higher, but the damping of the circuit becomes better. If the load resistance is made equal to the internal impedance of the crystal at, say, 15 kc., the constant-amplitude response will drop 6 db. per octave below 15 kc. over the entire audible range. This means that the pickup is now velocity-responsive over the audible range and is, in respect to response, behaving like a magnetic pickup. In addition, under these circumstances, the low value of load resistance provides very good damping, reducing the needle scratch and markedly improving cleanness of reproduction. The output voltage of the pickup is considerably reduced at low frequencies and is of the order of some of the high-output magnetic devices.

A brief calculation will show that with these conditions the impedance of the entire input circut at high frequencies is of the same magnitude as that attained with customarily loaded magnetic cartridges. The "hangover" effect is most objectionable at these frequencies, and here the crystal cartridge gives performance comparable to the magnetic unit. At low frequencies, however, the crystal cartridge circuit impedance is high, and much more "hangover" occurs than in the case of the magnetic unit. Although not very objectionable, the resonance is noticeable, and it consti-

* 6431 Montgomery Ave., Cincinnati 13, Ohio.

Fig. 1. Response curves of Brush PL-20 pickup equalized for N.A.B. pressings.



tutes the principal remaining disadvantage of the crystal unit.

Most commercial crystal pickups display a high-frequency peak due to needle resonance, and the optimum value of load resistance is equal to the crystal impedance at the frequency where open-circuit, high-frequency response is up 3 db. because of needle resonance. Under these circumstances, the resonant peak is minimized and high-frequency response drops off sharply above the peak.

With such a circuit, the low-frequency turnover of commercial pressings is easily compensated for by inserting, in series with the load resistor, a condenser whose reactance equals the load resistance at the turnover frequency. The load circuit and the capacitance of the pickup then form a capacity voltage divider below the turnover frequency, and the system is amplitude-responsive in this range. Furthermore, the parallel impedance of the pickup and equalizer is very low, so that even with a .5 megohm shunt, as is encountered in the input of a great many amplifiers, the bass response extends to very low frequencies indeed, of the order of 10 to 20 c.p.s.

Almost all modern commercial pressings have some form of high-frequency pre-emphasis, for which it is also desirable to equalize. This can easily be done by means of a simple losser circuit inserted after the low-frequency equalizer. This additional section must have a sufficiently high impedance not to affect the performance of the first network but not so high as to be affected by the input shunt resistor or stray capacities.

The primary requirement for successful equalization in this manner is that the response of the crystal cartridge be substantially uniform over the desired range. A peak at high frequencies due to needle resonance is permissible, but it must be remembered that high-frequency response will not extend above this peak. The same situation exists with respect to the low frequencies; a peak does no damage but response cannot be expected to extend below the peak.

Furthermore, if the peaks are inordinately high (evidence of poor design) they will not be completely removed by the equalizer.

Examples of Equalizer Design

For standard records the *Brush* PL-20 crystal pickup, for example, has all of the many desired characteristics. The open-circuit response for the PL-20 cartridge, as published by the *Brush Development Company,* is shown in Fig. 3. It will be noted that the response is up 3 db. at about 7300 c.p.s., and since the internal capacitance is .001 μfd.,[3] the proper load resistor is 22,000 ohms. The response of the cartridge loaded with this resistance is shown in Fig. 1. The low-frequency peak causes a rise of 3 db. at 36 c.p.s.

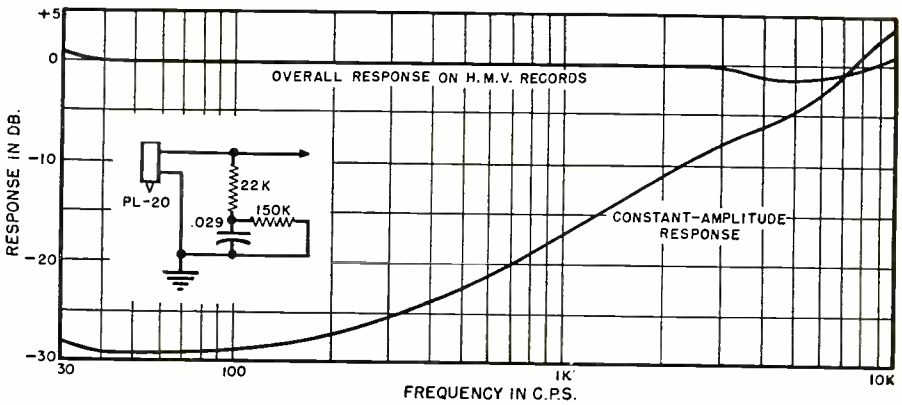


Fig. 2. Response curves of Brush PL-20 pickup equalized for H.M.V. pressings.

British H.M.V. and some other foreign records follow a very simple characteristic, with a turnover at 250 c.p.s. and no treble emphasis.[4] Compensation for this turnover frequency is easily made by inserting, in series with the load resistor, a condenser whose impedance equals the load resistance at 250 c.p.s.; that is, a .029 μfd. condenser. The last step is to remove the low-frequency peak by shunting this condenser with another resistor equal in size to the impedance of the condenser at 36 c.p.s.; this turns out to be 150,000 ohms. The completed equalizer and the calculated frequency response are shown in Fig. 2.

The N.A.B. recording characteristic (used in *Artist, Capitol, M.G.M.,* and other pressings) requires a second equalizer section to compensate for the treble pre-emphasis. The first section is computed in a manner similar to that just described and found to consist of a 22,000 ohm resistor in series with a .014 μfd. condenser, which is, in turn, shunted by a 300,000 ohm resistor. The second section can consist of a 47,000 ohm series resistor and a .002 μfd. shunt condenser; the complete equalizer and the calculated response are shown in Fig. 1.

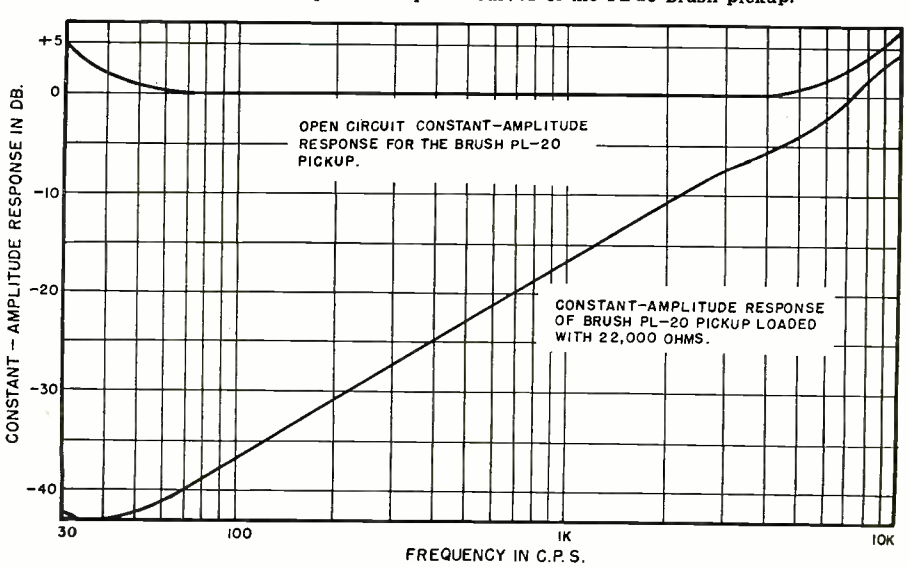
It is of interest to note that this particular recording characteristic could also have been compensated by loading the cartridge with a 100,000 ohm resistor in series with a .0032 μfd. condenser. In this case, the change of crystal capacitance with temperature will upset the high-frequency equalization. In the previous case the load resistor was selected with no other purpose than the elimination of the high-frequency peak and a change in crystal capacitance is not likely to have any noticeable effect.

The same procedure can be carried out with long-playing records for any pickup displaying the previously described characteristics. *Columbia* Microgroove records follow the N.A.B. characteristic except for additional bass boost amounting to 3 db. at 100 c.p.s. Correction for this boost can be made in the same manner as was shown for a bass rise due to the pickup arm, but it is evident that any residual rise because of arm resonance then remains uncompensated. If desired, this resonant rise can be removed by an additional equalizer section, but this expedient is likely to be difficult, and the best procedure is probably to leave the arm resonance uncompensated.

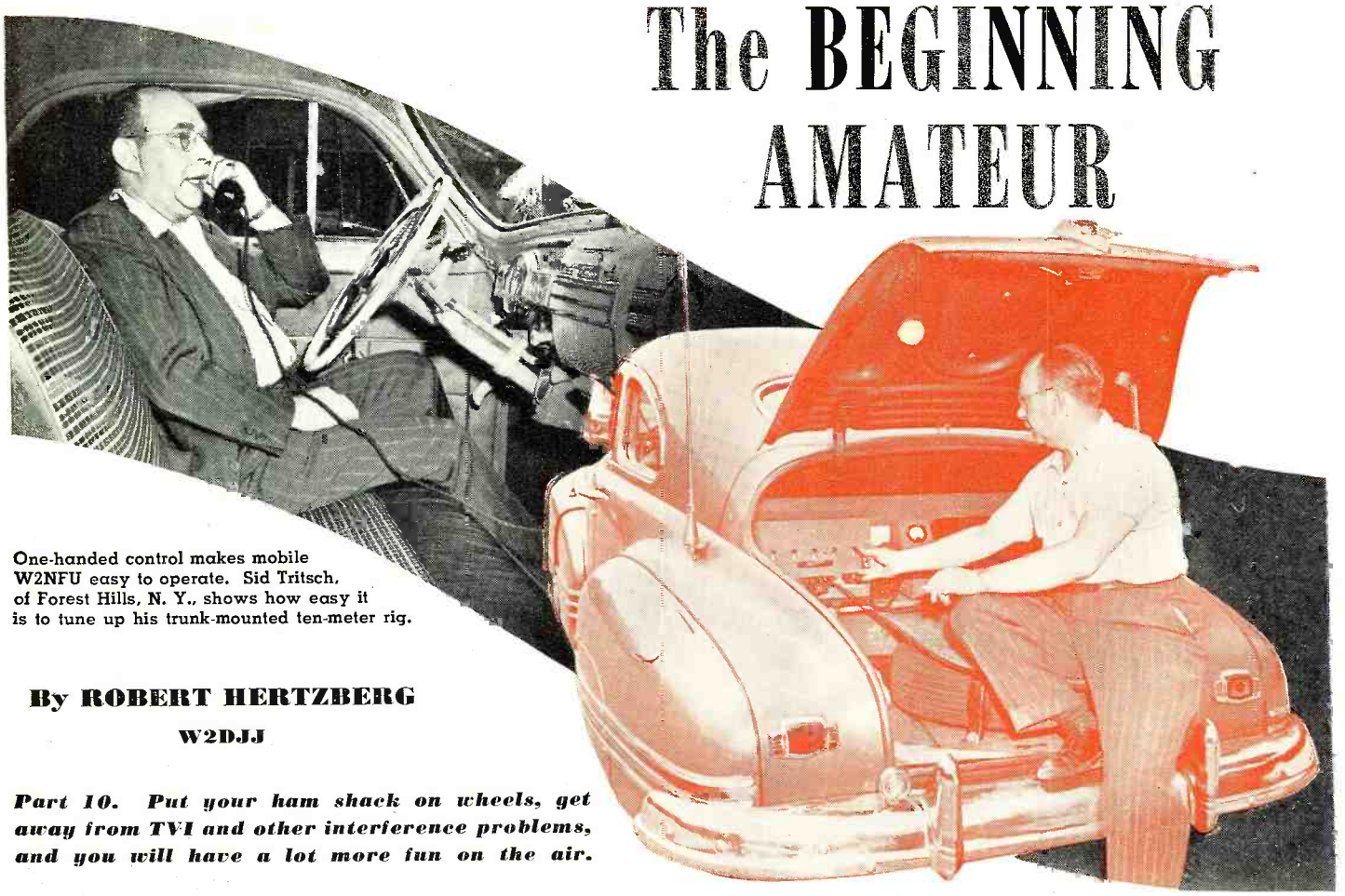
In conformity with the above prin-

(*Continued on page* 152)

Fig. 3. Constant amplitude response curves of the PL-20 Brush pickup.



The BEGINNING AMATEUR



One-handed control makes mobile W2NFU easy to operate. Sid Tritsch, of Forest Hills, N. Y., shows how easy it is to tune up his trunk-mounted ten-meter rig.

By ROBERT HERTZBERG
W2DJJ

Part 10. Put your ham shack on wheels, get away from TVI and other interference problems, and you will have a lot more fun on the air.

"THERE'S nothing like it!" That's the enthusiastic comment you get from any ham who has put a rig in his car, and for good reason, too. Mobile operation is in a large way the answer to TVI and many other problems that beset ordinary fixed stations. With a converter on the dashboard and a transmitter in the trunk compartment, you can pick your own location and enjoy extremely interesting local and DX contacts. In some parts of the country, particularly the crowded East, mobile has saved ham radio from virtual extinction, and clubs whose members work mobile only are springing up overnight. Putting your radio "shack" on wheels gets you out into the open air and helps you to reestablish friendly relations with your friends and family.

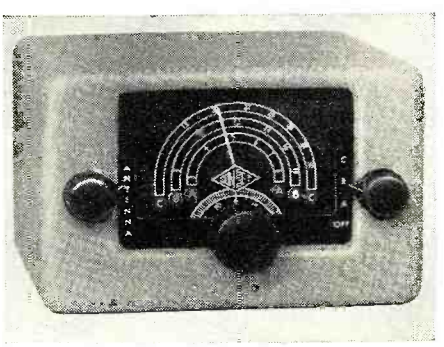
"Mobile" doesn't mean only "auto"-mobile. You can operate from boats and airplanes and, for that matter, from bicycles and motorcycles, if you have three or four hands!

There is some confusion as to the difference between "mobile" and "portable." The first term applies to operation in a vehicle while the latter is moving or stationary. The second describes a temporary displacement to a fixed location other than that indicated on the station license; for example: You move from your regular house to a summer camp, cottage, bungalow, etc., where you will remain for a couple of months. If you want to set up a small station there, you have only to write a brief letter informing the office of the FCC having jurisdiction over that particular area. You will use your regular call letters, followed by the number of the call district. On phone, you sign off by saying, "This is W2XYX portable two," if you're still in the second district; or "This is W2XYZ portable one," if you happen to be somewhere along the Connecticut shore, in the first district. The FCC must be notified every month; you're allowed three renewals, or a total of four months of "portable" status. Beyond that, you have, in effect, moved to a permanent location, and you must apply for a modification of your ticket.

For mobile operation, you should notify the FCC only if you expect to be gone from your home-base more than 48 hours; you don't have to bother with paper work if you're out for a short week-end drive. For more than two days of mobile service, you are required to write to the FCC and to renotify them monthly. There is no time limit, as with portable operation. If you decide to make a grand tour of the United States, you can work mobile all along the way if you remember only to send the FCC a notice every thirty days.

A husky, 5-tube job, rated at about 28 watts, is the Stancor Model ST-203-A. This is intended for trunk compartment mounting, and has a frequency coverage of 27 to 32 mc.

The Gonset three-band converter, giving continuous coverage from 3 to 30 megacycles over three bands. It uses four tubes and the dimensions are 5¼ by 3½ by 5½ in.



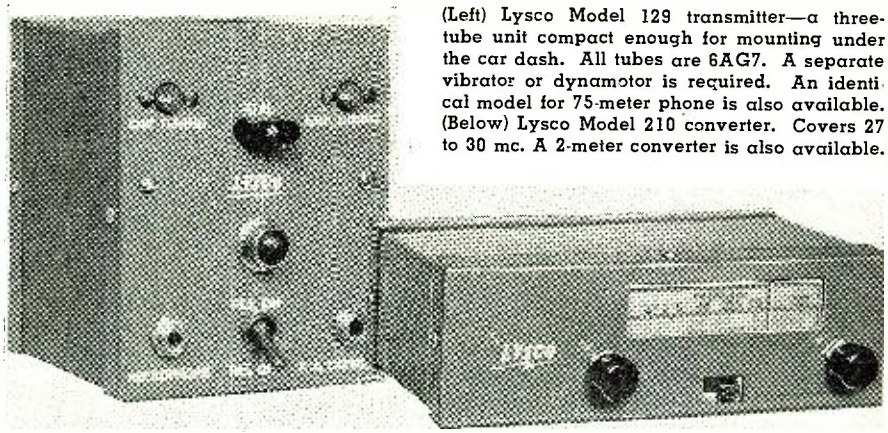
Although mobile operation is now permitted on any or all of the ham frequencies, from the practical standpoint only the frequencies above 27 megacycles are worth considering. The problem is the antenna, and it is a mechanical rather than an electrical one. On 20 meters, for instance, a quarter-wave "whip" antenna has to be about 16 feet long. Such a rod, sticking up from a fender or bumper, would last about five miles before it became entangled with low-hanging trees, trolley wires, lamp posts, etc. For 10 meters, however, an 8-foot whip is just right; in fact, an ordinary car-radio antenna serves the purpose quite well. The 10 meter is normally a daylight band anyway, and as most driving is done at this time, about 95% of current mobile hamming is on that band. The higher frequency bands permit the use of smaller antennas, some in the form of high efficiency beams, and a lot of interesting experiments can be made with them.

Some extraordinary DX can be achieved with mobile rigs feeding inconspicuous whips. Sid Tritsch, W2NFU, whose "shack on wheels" is shown in the accompanying pictures, once worked another mobile station in California while he was driving through a forest of apartment houses in New York City. He has also worked a D4 in Germany. Although he has thirty states to his credit, he doesn't think his success is anything unusual.

From the technical standpoint, mobile is a challenging game because you are more or less limited to low transmitting power. This restriction can be traced back to the storage battery of the car, which does not have the inexhaustible source of power of your 110-volt a.c. outlet at home. The heaters of the tubes draw a few amperes, and the plate voltage unit (dynamotor or vibrator) draws more; the total load of even a modest rig can readily run to 30 or so amperes. This means that the car engine must be running at a pretty good rate, not just idling, when the station is in use.

Many hams install larger-than-usual batteries and adjust the third brush on the charging generator for maximum output, so that they can operate for short periods at least with the engine turned off. Every now and then an operator will get so engrossed in a particularly good QSO from some hilltop that he will find himself with a dead battery, and a stalled car, after an hour or so of working his rig. To call this annoying is putting it mildly!

It is highly advantageous to park in high, clear spots, but at the same time it is not advisable to race the engine of a stationary car. Many hams for this reason are buying separate gasoline-engine driven d.c. charging generators, which can be carried in the trunk compartment, hauled out and set up at the chosen location, and connected either to the car battery or an extra one. The battery more or less "floats" across the generator and remains up to snuff. A typical 40-ampere generator can run most of an afternoon on a gallon of fuel, saving a lot of wear and tear on the car engine. Such a machine will pay for itself over a period of a year or so of active hamming.



(Left) Lysco Model 129 transmitter—a three-tube unit compact enough for mounting under the car dash. All tubes are 6AG7. A separate vibrator or dynamotor is required. An identical model for 75-meter phone is also available. (Below) Lysco Model 210 converter. Covers 27 to 30 mc. A 2-meter converter is also available.

For mobile reception, it is almost universal practice to use a converter working into the regular broadcast receiver already in the car. This draws heater current from the car's battery and plate voltage from the existing vibrator "B" supply. The unit is very small and is easily mounted on the steering column or under the dashboard, within easy reach of the driver. Of course, there is nothing to prevent you from making and installing a separate high-gain receiver, but this will certainly require more space than the converter, and you'll have trouble finding a place for it. Don't make the mistake of crowding a lot of equipment under the dashboard.

Space requirements of even small transmitters makes their placement in the trunk compartment almost mandatory. In some cars, the shelf behind the rear seat is a good spot, although the equipment then becomes rather conspicuous. Some hams manage to squeeze transmitters into the glove compartment in the front, but they still have to find power supply space.

For temporary operation of a mobile rig at a fixed location, the Onan 40-amp., 6 v. charging generator shown here in trunk compartment of a station wagon offers reliability with economy. It weighs 77 pounds and is easily handled by two men. Tub-like container on the left is gasoline can. Radio equipment on back shelf is a Motorola police job which is adapted for ten meters.

Advantages of mounting the unit in the front of the car include shortness of leads, especially the battery wires, and convenience in tuning. Disadvantages are the limited space and inaccessibility of interior parts. The large, wide-open trunk compartment offers enough space for experimental breadboard layouts, test equipment, etc.,

(*Continued on page* 122)

There's no mistaking this "ham shack on wheels." Sid Tritsch, of Forest Hills, N. Y., carries his call letters above his license plate. The latter, incidentally, contains his initials as well as his street number. The antenna is an 8-foot whip.

Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

A Service Sideline

'T WAS a sleepy day. A slow November drizzle had been falling since early morning, and there was something about the warm and cosy interior of Mac's Radio Service Shop that made a fellow's eyelids heavy; still, when Barney caught his boss nodding, this unusual sight shocked him wide awake. Snapping his fingers loudly he exclaimed:

"Hey, Mac, no sleeping on the job—as you tell me! What's the matter? Out kicking the gong around last night?"

"Not exactly," Mac said as he rubbed both hands across his sleepy eyes. "I was out on an amplifier job until one this morning, and those hours are kind of hard on a decrepit old man like me. Now, of course, if I were good-looking, red-headed, and only starting my twenties—"

"Never mind the heavy sarcasm," Barney interrupted. "You know that I'm never out late unless I'm sitting up with a slick friend; but how about this amplifier business sideline? You never told me anything about that. How did you get started in it? Does it pay well? Do you think it is a good deal for a service technician?"

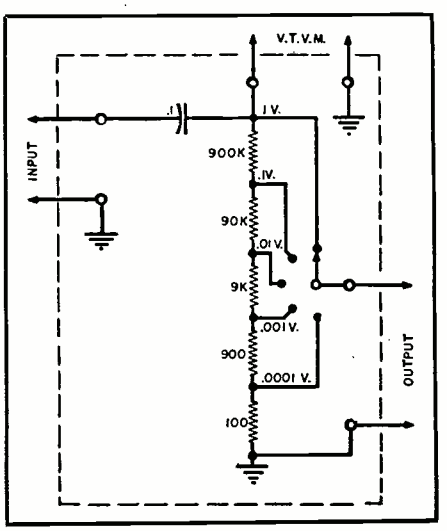
Mac walked over to the lavatory and sloshed some cold water on his face before answering.

"You might say," he finally replied, "that I got into the business through the back door. Customers kept bringing me amplifiers to service, and I decided that I could do a better job of servicing if I had a little experience in the use of the equipment. On top of that, unless I could provide a 'loaner,' I had to work on an amplifier immediately; so I bought a couple units just to keep the customers from standing over me and breathing on the back of my neck while I worked on their equipment. It was an easy and natural step from that to renting out amplifiers and to selling them."

"How about the filthy old folding stuff?" Barney wanted to know. "Does the sideline bring in enough money to make it worth while?"

"If it didn't, I'd have dropped it long ago," Mac said dryly. "You are the only liability that is permitted to keep on hanging around here. Seriously, both the renting of the equipment and the sale of new amplifiers and accessories have paid off surprisingly well. What is more, the advertising that I get out of these amplifier jobs is a very real asset to my service business. You will notice that every bit of my amplifier equipment carries the shop name on it in not-too-modest-sized letters."

Fig. 1.



"Doesn't this interfere with your service work?'

"No, simply because I do not let it. I never forget that service is my main business, and I only sit in on the amplifier game in a small way. I do not go out after big jobs, for they take special equipment and organization that a small service shop does not have. You have to be careful in handling this sideline, or the first thing you know the tail will be wagging the dog. In my case, I try to get those jobs that I can handle in my off hours. This means jobs that I can do in the evenings or on Sundays. A surprising demand for p.a. equipment, however, does come at these times."

"Do you always set up the equipment and operate it?"

"I *always* install the equipment, and I usually furnish an operator except in the most simple and low-powered setups. An operator who does not know what he is doing can ruin some pretty expensive equipment for you in a hurry; but what is still more important, he can make your installation sound very, very sad if he does not know how to control the gain, handle the mike, arrange the speakers, etc. Allowing some dub to run the amplifier is a good way to get the kind of advertising you *do not* want."

"How much equipment do you need to be in the amplifier business in 'a small way'?'

"That will depend largely on the kind of jobs you handle. In my case, I have an eight-watt job that can be used either as a low-power indoor amplifier, or a pre-amplifier to drive a high-power booster. Then I have two complete twenty-watt amplifiers. All three are equipped with pickups and turntables built right on top of them. Finally, I have a fifty-watt booster that I can use for a pretty husky installation.

"In addition, of course, I have several crystal microphones of various types, out-door, trumpet-type speakers, and reflex consoles—"

"Just a minute," Barney interrupted; "why do you use only crystal mikes?"

"Because it has been my experience that they are the best all-around mikes for this kind of work. They are very rugged, comparatively inexpensive, and use a simple single-conductor cable. Their output is high, and their fidelity is more than adequate for p.a. installations.

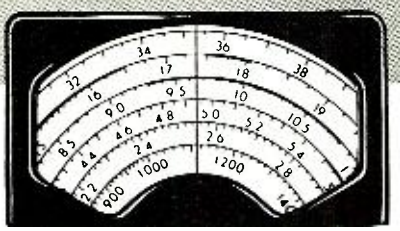
"But as I was saying," Mac went on, "all of my equipment is arranged for maximum versatility. Every bit of auxiliary equipment is arranged so that it can be instantly used with any of the amplifiers."

"How do you get jobs? Just wait until people call you?"

"That is a good way to be independent—and starve to death," Mac said reprovingly. "I get jobs by going after them. Every time I read in the

(*Continued on page* 157)

International SHORT-WAVE



***Compiled by* KENNETH R. BOORD**

IT IS a pleasure this month to dedicate the *ISW Department* to *Radio Tahiti* (FZP8) in Papeete, Tahiti. I have just received an airmail letter-verification from G. Carisey, Le Chef du Service de l'Information, Papeete, Tahiti, in French, giving details on this *new* s.w. broadcaster. McPheeters, New York, received a similar letter on the same date and below I am reproducing a "composite" free translation of the two letters. Said Mr. Carisey:

"I have the honor of acknowledging receipt of your letter and am pleased to confirm that it was indeed *Radio Tahiti* that you heard.

"We began our transmissions on the 4th of July of this year with a daily transmission at 0415-0500 GMT on 12.080. This transmission, directed primarily to French Oceania, includes chiefly: 15 minutes of news in French; 15 to 20 minutes of recorded music, generally local music; and 10 to 15 minutes of news in Tahitian.

"For the time being, it is only a period of tests which we have undertaken while transforming the telegraph transmitters which we have at our disposal in Papeete. At present, important work is in progress, and we hope to have at the beginning of next year a powerful radio station which will allow us longer and more frequent transmissions on various wavelengths. These same installations will permit radiotelephony from Papeete to France, the United States, New Zealand, and Australia.

"I am particularly satisfied to know that you receive our transmissions correctly, and I would be happy if you would send me eventually your opinion of our programs and your suggestions for improving the quality of your reception.

"You may, of course, select information from this letter for use in your radio magazine.

"At this time I do not have a photograph of our installations, which are still crude, but I think I can send you in the next mail some views of the buildings under construction on the grounds of our future radio station.

"It is useless to send me an IRC and I am returning the one which you attached to your letter and which I cannot use.

"I beg you to accept, sir, with my thanks, the expression of my distinguished consideration."

A penciled note enclosed (written in *English*) listed this data: *Call Signal*—*Radio Tahiti* (F.Z.P.8). *Location*—Papeete, Tahiti. *Frequency*—12.080. *Power Output*—600 watts. *Antenna*—Rhombic (finding direction, Paris). *Schedule*—On the air *daily* 0415-0500 GMT (2315-2400 EST).

From reports received by this department, *Radio Tahiti* continues to be heard fair to excellent *daily* throughout the United States. The station comes on the air with Hawaiian-type music. Plays various kinds of recordings—including some in *English*, such as cowboy ballads and some American dance tunes.

(An official of *Radio Tahiti* informed Fellers, Japan, that F08AA, *"Radio Club de Tahiti,"* 6.980, was a privately-owned station which ceased operation at the end of June. I understand (via Dilg, Calif.) that, at least "back in the old days," F08AA was battery-operated and was officially listed with 200 watts. Formerly was on the air *only* on Tuesdays and Fridays around 2300-2345 and has not been reported lately as heard.)

Our congratulations go to *Radio Tahiti* and its staff, looking forward to expansion of its services.

* * *

Raso

From Oliver P. Ferrell, project Supervisor, Radio Amateur Scientific Observations, 121 South Broad Street, Philadelphia 7, Pennsylvania, comes this data:

"The work now being undertaken by this office is supported in part by Contract No. AP19 (122)—72 of the U. S. Air Force, through the sponsorship of the Geophysical Research Directorate, Air Material Command. We are currently collecting observations in the frequency band 50-54 mc. By observation we mean an instance of reception of a signal beyond the range of 400 miles. Since most of the DX heard beyond this range is due to sporadic-E, we are calling this program a sporadic-E observing project.

"Quite a few SWL's after reading about this project in *CQ*, volunteered their services in recording DX in this band. It struck me at that time that there must be many more SWL's who might be interested in working on this project. We are now drawing plans wherein the SWL's would be constituted as a separate section of this program."

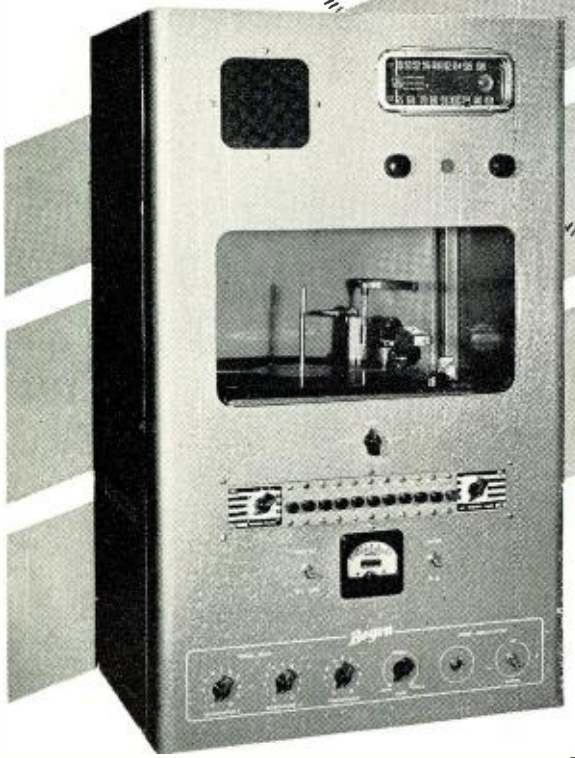
Mr. Ferrell is interested in contact-

(*Continued on page* 142)

Valuable contributor to the ISW Department is Grady C. Ferguson, Charlotte, N. C., shown at the listening post he has operated for 17 years. He has veries from 100 countries.

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.)

Servicing Public Address Systems



This Bogen SB-50 sound broadcaster has a peak output of 90 watts. It is designed for use as a centralized sound system in hospitals, factories, schools, industrial plants, resorts, large stores, etc.

By JOHN B. LEDBETTER
Engineer, WKRC-TV

A review of the many preliminary tests which can be made to save both time and money for you and your customer.

MANY service technicians have not investigated the possibilities offered by p.a. servicing, either because they feel insufficiently trained for this work, or because they are unable to afford a costly outlay of shop equipment. In reality, p.a. servicing requires no extensive research or specialized study; neither does it call for elaborate, expensive test instruments. The service technician who has already established himself adequately in radio receiver repair has the necessary technical knowledge, at least fundamentally, and all or most of the test equipment required to service the majority of public address systems. A few minutes spent each day in studying circuit diagrams, service manuals, and trade magazines will do much to familiarize him with the more complex circuit arrangements.

Test Instruments Required

Test equipment should include at least a tubetester, volt-ohm-milliammeter, output meter, and audio oscillator. (Many volt-ohm-milliammeters include an output meter range as well as a db. scale).

An oscilloscope, signal tracer, and vacuum-tube voltmeter are invaluable for tracing hum, distortion, leakage, and intermittent troubles, as well as critical voltages in a.v.c., compressor, expander, limiter, and inverter circuits. These instruments are available in the low and medium-price ranges and should be added to the shop equipment as soon as possible.

A condenser checker and vibrator tester also are handy to have around the shop.

Preliminary Testing

Much time and trouble can be saved by adopting these rules: (1) Take nothing for granted, and (2) look for the simple things first. Although both rules should be obvious, it is surprising how often they are overlooked. Many hours have been spent checking tubes, condensers, and voltages when the trouble lay in a rosin joint or faulty connection. Not to be overlooked are those "self-serviced" amplifiers which come into the shop with connections changed, wrong replacement parts used, and tubes changed around.

Rule 1 applies equally as well to tube testing. Certain multi-element tubes, especially pentagrid converters, duo-diode triodes, and beam power output tubes are notorious for giving a satisfactory reading (particularly on emission-type testers), only to be inefficient or become totally inoperative when the normal load is applied. Trouble of this sort can show up in almost any type of tube, so play safe —double-check a suspected tube with one known to be good.

Before actual testing is begun, the *apparent* source of trouble should be determined as closely as possible. Once the trouble is localized or confined to a particular stage, much of the usual routine work can be eliminated.

First, inspect the line cord briefly but carefully for breaks, worn spots, poor insulation, loose connections, and for shorted strands or corroded contacts at the plug. Inspect the fuse holder for corrosion or loose blades. If the fuse is blown, check it for proper current-carrying capacity and check the transformer for evidence of overheating. A blown fuse (if its rating was correct) should not be replaced until the line cord and power transformer have been checked for internal and external shorts and grounds. If these appear to be in good condition, the amplifier should then be turned on, making sure the speaker or normal load is connected.

Next, inspect the rectifier tube for open or burned-out filament, and for red-hot plates which indicates a shorted *input* filter condenser. A shorted *output* filter is often indicated by a purple glow on the *inside* of each plate, surrounding the filament. Hot rectifier plates, accompanied by an overheated filter choke, could point to a shorted *output* filter condenser, a possible short to ground at the output side of the choke, or a shorted bypass condenser at this point. In either case, turn the amplifier off immediately to prevent further damage.

While the rest of the tubes are heating, inspect the microphone cable for apparent breaks or frayed shield and the plug for loose or defective connections. The microphone itself can be checked later. When the tubes have reached normal operating temperature, check for burned-out heaters or filaments by touching metal tubes *gently,* or by observing heater glow in

glass tubes. A cold tube is an almost certain indication of a burned-out filament. It is not absoute in every case, however, since loose tube prongs, a rosin joint, or broken filament supply lead at the tube socket could be responsible.

During these tests, set the gain controls approximately half-open and connect the microphone. If the amplifier is in operating condition, feedback should be experienced. The microphone cable can be checked for intermittent breaks and faulty connections by twisting and moving the cable. Broken leads usually will be found within six inches of either end, since most of the bending and strain during use takes place within this distance. If no output can be obtained from the amplifier, but normal hiss or tube noise can be heard, check the condition of the microphone and cable by substitution. If no substitutes are immediately available, a quick check can be made by inserting an open-circuit plug into the microphone input. A loud hum or pop indicates that the system from that point to the speaker is at least operative.

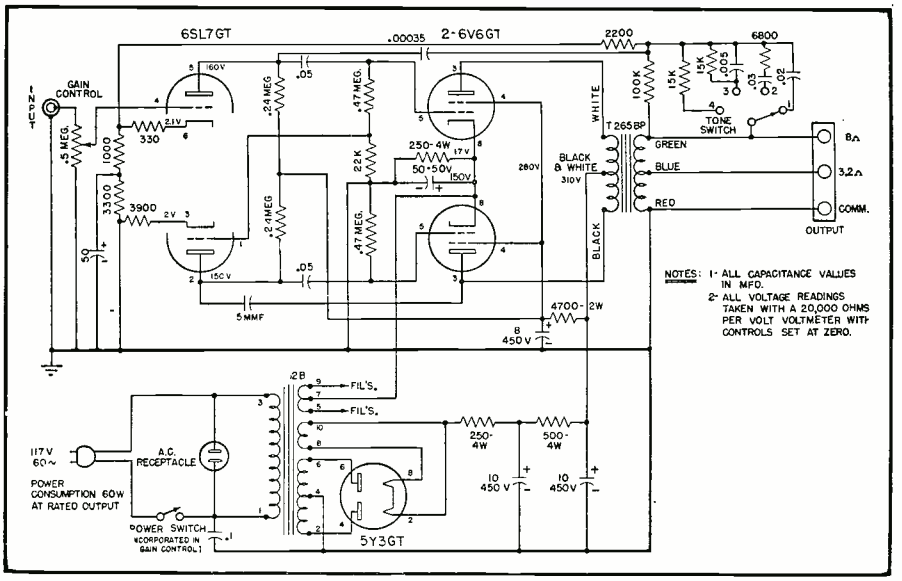
Assuming the amplifier to be inoperative at this point, proceed as follows: Start at the speaker and work back, stage by stage, toward the microphone. First, listen for hum in the speaker. A normal amount proves the field coil to be in good condition. Absence of hum could mean an open or shorted field coil or filter choke, or a shorted filter condenser. It could also be due to a lack of "B" voltage which, in turn, could be caused by a defective rectifier tube, faulty socket contacts, or an open circuit in the high-voltage secondary winding of the power transformer. Excessive hum usually means one or more open filter condensers or a shorted bias choke or resistor.

Double-check the field coil by holding a screwdriver in front of the core and noting the "pull." Use care to avoid damaging the speaker cone.

The output stage is next in line. Remove the output tubes, one by one, from their sockets. Absence of an accompanying pop denotes an open output transformer or voice coil, a shorted bypass condenser, or no "B" voltage. *One* of the tubes in a push-pull stage should not be removed for any length of time unless the other is also removed. The remaining tube is forced to carry twice its normal load and may become soft or gassy.

The tube in the preceding stage (usually the driver or inverter) is next removed and replaced. Absence of noise indicates no plate voltage due to an open dropping resistor or shorted bypass condenser, open or shorted coupling condensers, excessive cathode bias in the output stage (biasing these tubes past cut-off), or defective output tubes.

Each preceding stage is checked in the same manner, with a lack of noise accompanying tube removal or replacement indicating trouble in the



Service, sales, and rentals of small systems makes up a large part of the service technician's income. This is a schematic of the Bogen PH-10 (10 watts output).

plate circuit of that immediate stage, or in the grid circuit (or tube) of the following stage. A simple approximation of the loss or gain of each stage can be obtained in these tests by noting the increase in circuit "pop" as each tube is removed and re-inserted. Tubes with control grid caps can be given the same test by touching the caps with the finger or with a screwdriver.

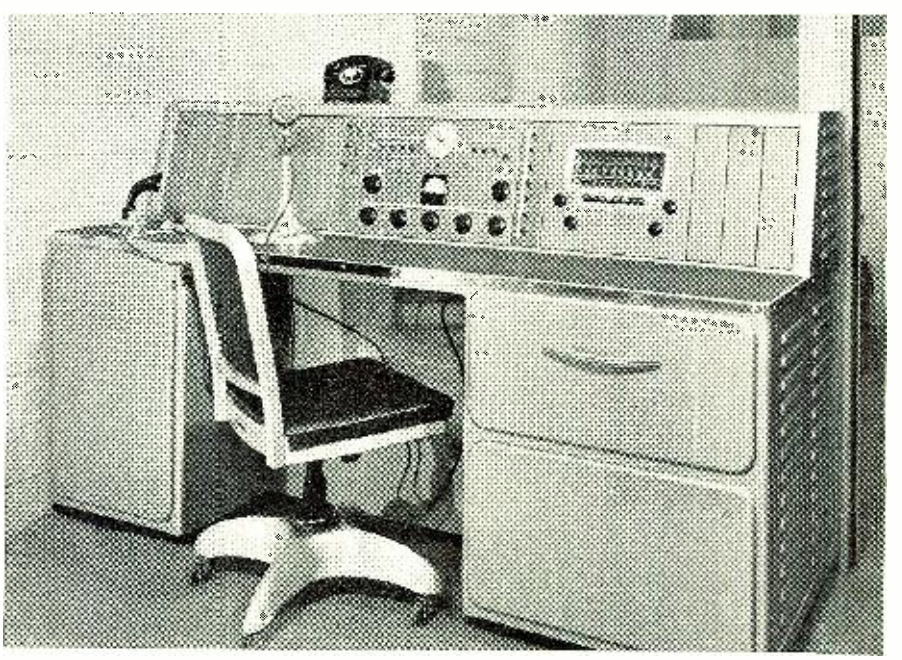
If the trouble has been located during this preliminary checking (which usually takes less than two minutes), much time is saved in subsequent routine testing. If the trouble has *not* been found, the tests have by no means been wasted. The regular routine tests are simply taken up at this point.

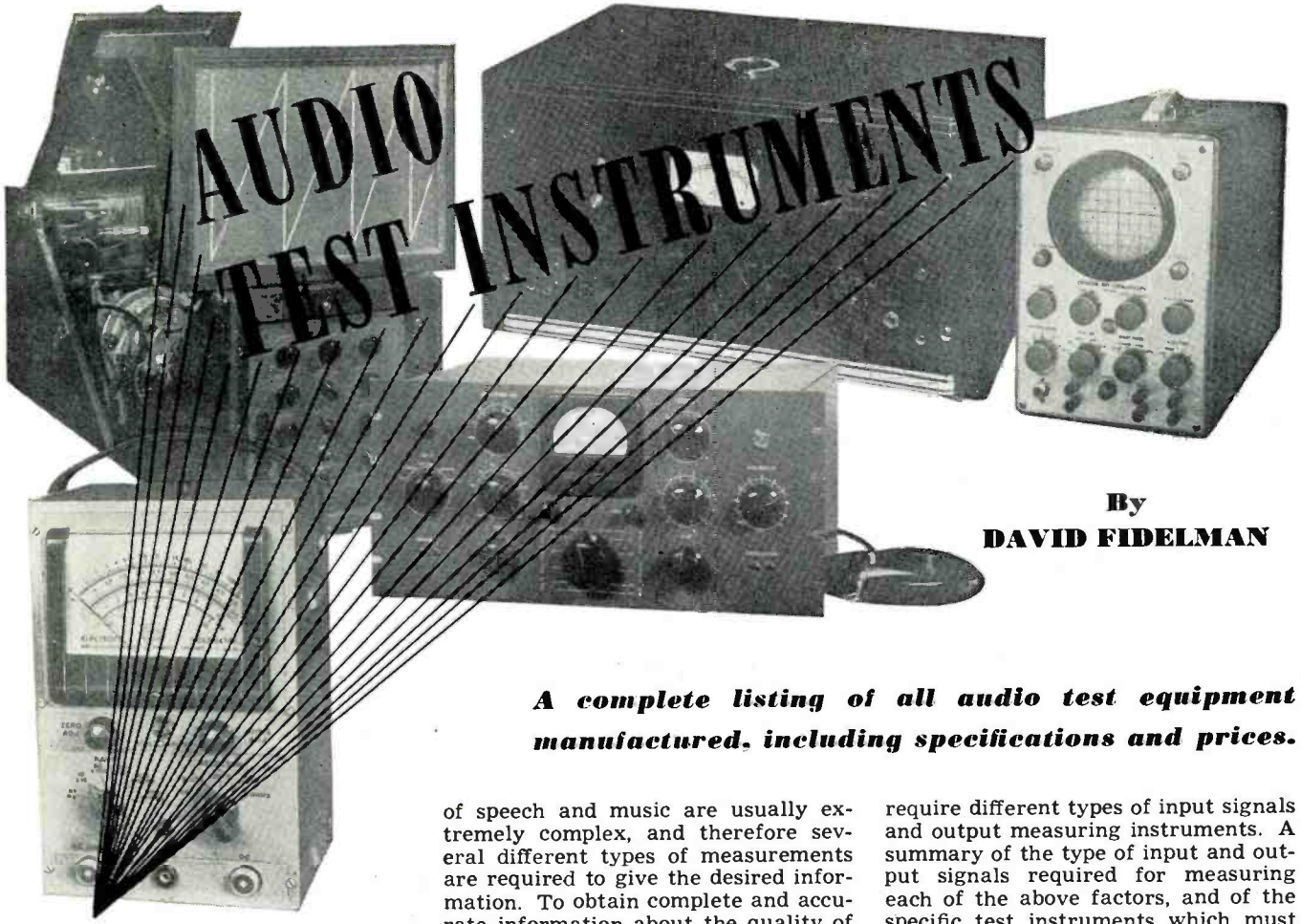
Tubes should be tested first. In these tests the amplifier should be left on so that the tubes will remain at normal operating temperatures. In this way leakages, intermittent shorts, and noise are more readily indicated. Both output tubes are removed and tested first; the other tubes are tested in any order, the rectifier being last. A two-fold purpose is served by this method: removing the output tubes *first* eliminates unnecessary noise, and the surge in "B" supply voltage as each tube is removed often will reveal leaky or intermittently-shorting condensers. The amount of overload, unless abnormal conditions exist, will not be sufficient to damage condensers in good condition.

Individual tests should be made for low emission, noise, shorts, leakage, and intermittents. Tubes testing ten

(*Continued on page* 188)

Deluxe control position at the camera works of the Eastman Kodak Co.





AUDIO TEST INSTRUMENTS

By
DAVID FIDELMAN

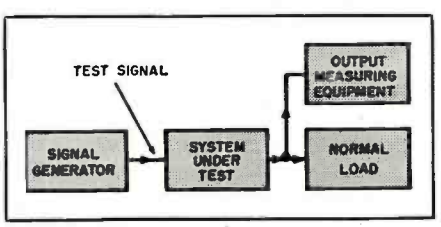
A complete listing of all audio test equipment manufactured, including specifications and prices.

ONE of the most important factors to be considered in any type of audio engineering, construction, or operation is the selection of proper instruments and equipment to test the operation and quality of the system. With good test instruments, properly used, it is possible to obtain a reliable and accurate measurement of all the factors which are important in obtaining good reproduction of sound. The purpose of this article is to present as complete a listing as possible of all the audio test equipment available in the country—together with characteristics, specifications, prices, and information on where they can be obtained—in order to aid the audio engineer and technician in the intelligent selection of the instruments best suited to his needs.

Any type of measurement consists essentially of causing the system under test to perform its function under controlled conditions, and to measure the success with which it performs this function. The accuracy of the measurement is determined by the degree to which the input test signal represents or simulates the true operating condition, and by the accuracy with which the operation of the system and the relevant factors can be measured. Sound and audio signals of speech and music are usually extremely complex, and therefore several different types of measurements are required to give the desired information. To obtain complete and accurate information about the quality of reproduction which can be expected from any given system, the following factors should be measured: (a) Frequency response, (b) noise level, (c) maximum output (voltage, current or power), (d) harmonic distortion at different output levels, (e) intermodulation distortion at different output levels, (f) transient response, (g) phase response, and (h) wow and flutter (in disc, film, or magnetic reproduction). All of the commercial equipment currently available for the measurement of these various factors are listed in this article.

A basic setup for any type of measurement is shown in Fig. 1. A known input signal of the proper form is applied through a signal generator of the desired impedance to the input of the system, and the resulting output is measured across the desired load impedance. Of course, measurements of the different factors listed above will require different types of input signals and output measuring instruments. A summary of the type of input and output signals required for measuring each of the above factors, and of the specific test instruments which must be used for the measurement, is given on page 73. (The accepted limits for good reproduction are also included in this table for convenient reference when performing these measurements.) The information represents a complete summary of all the measurements of audio reproduction and the various factors which determine the quality of reproduction. The specific commercial units which may be used in these measurements are also listed in the tables.

Fig. 1. Basic setup for any type of measurement consists of applying a standard test signal to the input of the system under test and measuring the resulting response on a normal operating load.



Referring to Fig. 1, it may be seen that all audio test instruments fall into certain logical categories as follows:

I Signal generating instruments
(a) Sine-wave oscillators and signal generators
(b) Square-wave generators
(c) Sine/square-wave generators
(d) Fixed single-frequency generators
(e) Sweep-frequency generators
(f) Generators of complex signals

II Instruments for measurement and observation of electrical signals
(a) Vacuum-tube voltmeters
1. For low-level signals
2. For intermediate and high-level signals
3. V.t.v.m.'s included in multimeters
(b) Oscilloscopes
(c) Signal tracers and test speakers

III Instruments for measurement of sound

(*Continued on page* 110)

AUDIO TEST EQUIPMENT MANUFACTURERS LISTED IN FOLLOWING TABLES

Alfred W. Barber Laboratories
34-04 Francis Lewis Blvd.
Flushing, N. Y.

Allen B. Du Mont Laboratories, Inc.
Clifton, New Jersey

Altec-Lansing Corp.
1161 North Vine St.
Hollywood 38, Calif.

Amplifier Corp. of America
396 Broodway
New York 13, N. Y.

Audio Instrument Co.
1947 Broadway
New York 23, N. Y.

Ballantine Laboratories, Inc.
Boonton, New Jersey

Barker & Williamson, Inc.
235 Fairfield Ave.
Upper Darby, Pa.

Beta Electronics Co.
1762 Third Ave.
New York 29, N. Y.

Boonton Radio Corp.
Boonton, New Jersey

Brown Electro-Measurement Corp.
4635 S. E. Hawthorne Blvd.
Portland 15, Oregon

Brush Development Co.
3405 Perkins Ave.
Cleveland 14, Ohio

Central Scientific Co. (Cenco)
1700 Irving Park Road
Chicago 13, Ill.

Cinema Engineering Co.
1510 W. Verdugo Ave.
Burbank, Calif.

Clarkstan Corp.
11927 W. Pico Blvd.
Los Angeles 34, Calif.

Clippard Instrument Laboratory
1125 Bank St.
Cincinnati 14, Ohio

Clough Brengle Co.
6014 Broadway
Chicago, Ill.

Coastwise Electronics Co. (Ferret)
130 N. Beaudry Ave.
Los Angeles 12, Calif.

Daven Company
191 Central Ave.
Newark 4, New Jersey

Doolittle Radio, Inc.
7421 S. Loomis Blvd.
Chicago 36, Ill.

Electrodyne Co.
899 Boylston St.
Boston 15, Mass.

Electronic Designs, Inc.
Irvington, N. Y.

Electronic Instrument Co. Inc.
276 Newport St.
Brooklyn 12, N. Y.

Electronic Tube Corp.
1200 E. Mermaid Lane
Philadelphio 18, Pa.

Feiler Engineering Co.
945 W. George St.
Chicago 14, Ill.

Ferret (See Coastwise Electronics)

Furst Electronics
12 S. Jefferson St.
Chicago 6, Ill.

Furzehill Laboratories Ltd.
Boreham Wood, Herts
England

General Electric Co. (G-E)
Electronics Dept.
Thompson Road, Syracuse, N. Y.

General Radio Co.
Cambridge, Mass.

Heath Company
Benton Harbor, Mich.

Hewlett-Packard Co.
395 Page Mill Road
Palo Alto, Calif.

Hickok Electrical Instrument Co.
10514 Dupont Ave.
Cleveland 8, Ohio

Instrument Electronics
45-17 Glenwood St.
Little Neck, N. Y.

Jackson Electrical Instrument Co.
18 S. Patterson Blvd.
Dayton 1, Ohio

James Millen Mfg. Co.
150 Exchange St.
Malden 48, Mass.

John Fluke Engineering Co.
Box 755Y
Springdale, Conn.

Kalbfell Laboratories, Inc. (Kay-Lab)
1076 Morena Blvd.
San Diego 10, Calif.

Kay Electric Co.
14 Maple Ave.
Pine Brook, New Jersey

Keithley Instruments
1507 Warrensville Center Road
Cleveland 21, Ohio

Lavoie Laboratories
Matawan-Freehold Road
Morganville, New Jersey

McMurdo Silver Co., Inc.
1240 Main St.
Hartford 3, Conn.

Measurements Corp.
Boonton, New Jersey

Panoramic Radio Products, Inc.
10 S. Second Ave.
Mount Vernon, N. Y.

Pickering & Co., Inc.
309 Woods Ave.
Oceanside, N. Y.

Precision Apparatus Co.
92-27 Horace Harding Blvd.
Elmhurst, N. Y.

Progressive Electronics Co.
497 Union Ave.
Brooklyn 11, N. Y.

Radio City Products Co.
152 W. 25th St.
New York 1, N. Y.

Radio Corp. of America (RCA)
RCA Victor Division
Harrison, New Jersey

Radio Supply & Engineering Co.
89 Selden Ave.
Detroit 1, Mich.

Reiner Electronics Co.
152 W. 25th St.
New York 1, N. Y.

Scott, Inc.
385 Putnam Ave.
Cambridge 39, Mass.

Shallcross Mfg. Co.
Collingdale, Pa.

Simpson Electric Co.
5200 W. Kinzie St.
Chicago 44, Ill.

Southwestern Industrial Electronic Co.
P. O. Box 13058
Houston 19, Texas

Superior Instruments Co.
277 Fulton St.
New York 7, N. Y.

Supreme, Incorporated
Greenwood, Miss.

Sylvania Electric Products, Inc.
Emporium, Pa.

Technology Instrument Corp.
1058 Main St.
Waltham, Mass.

Times Facsimile Corp.
229 W. 43rd St.
New York 18, N. Y.

Tektronix, Inc.
712 S.E. Hawthorne Blvd.
Portland 14, Oregon

Triplett Electrical Instrument Co.
Bluffton, Ohio

Waterman Products Co.
2445 Emerald St.
Philadelphia 25, Pa.

Weinschel Engineering Co.
123 William St.
New York 7, N. Y.

Western Electric Co.
195 Broadway
New York 7, N. Y.

SUMMARY OF METHODS AND EQUIPMENT USED IN MEASURING THE VARIOUS FACTORS WHICH DETERMINE THE QUALITY OF AUDIO REPRODUCTION

Response or distortion being measured	Input signal		Output signal		Acceptable limits	
	Type of signal	Type of signal generator	Type of signal	Type of measuring equipment	Good reproduction	Acceptable reproduction
Frequency response	Sine wave	Sine wave generator	Sine wave	V.T.V.M. or oscilloscope	20-14,000 c.p.s.	40-10,000 c.p.s.
Maximum output	Sine wave	Sine wave generator	Sine wave	V.T.V.M.	Depends upon size of listening room	
Noise level	Zero	—	Random noise & hum	V.T.V.M.	—60 db. (below full output)	—50 db. (below full output)
Harmonic distortion	Sine wave	Sine wave generator	Fundamental plus harmonics	Distortion analyzer	2% total harmonics	2-5% total harmonics
Intermodulation distortion	Sum of high frequency and low frequency sine waves	Intermodulation composite signal generator	Amplitude modulated sine wave	Intermodulation analyzer	5%	10%
Transient response	Square wave	Square wave generator	Square wave	Oscilloscope	No set standards	
Phase response	Sine wave	Oscilloscope (Horizontal amplifier)	Sine wave	Oscilloscope (Vertical amplifier)	No set standards	
Wow & flutter	Steady sine wave	Sine wave generator	Frequency-modulated sine wave	Wow & flutter meter	0.1%	1.0%

"WOW" METERS

Manufacturer	Type number	Test frequency	WOW range (full scale defl.)	Response rate	Required input volts	Input impedance	Price
Amplifier Corp.	—	3000 c.p.s.	0.3% to 3%	0-200 c.p.s.	1 mv. 100 v.	500,000 Ω	$660
Brush	BE-904	Any in range 500-1250 c.p.s.	0.1% to 5%	0.5-200 c.p.s.	6 milliwatts	250/750/1500 Ω	$1617.64
Furst	115-R	1000 c.p.s.	0.5% to 2%	0.5-120 c.p.s.	0.1-250 v.	1.0 meg.	$685

INSTRUMENTS FOR MEASUREMENT OF SOUND

Type of unit	Manufacturer	Type number	Characteristics	Price
Condenser microphones (sound standard)	Western Electric	640-AA	Cylindrical shape, 1″ diam. x 1″ long Capacity 50-60 μμfd. Calibrated frequency response curve—smooth; response from 50 to 15,000 c.p.s.	—
	Altec-Lansing	21-B	Cylindrical, 0.6″ diameter Frequency response flat ±1 db. Capacity 20 μμfd.	$190
Sound level meters	General Radio	759-B	Calibrated from 24 db.-140 db. above standard ASA ref. level of 0.0002 dynes/cm^2. Freq. char.—all three standard ASA curves: 40 db., 70 db., and flat Two meter speeds: slow and fast Calibration accuracy ±1 db.	$320
	H. H. Scott	410-A	Calibrated from 34 db.-140 db. above standard 0.0002 dynes/cm^2. Freq. char.—all three standard ASA curves: 40 db., 70 db., and flat Two meter speeds: slow and fast Calibration accuracy ±1 db.	$249
Artificial ear	Ballantine	505	For measuring freq. response and efficiency of telephone receivers. To be used with V.T.V.M.	—

UNIVERSAL IMPEDANCE BRIDGES

Manufacturer	Type Number	Frequency (Internal gen.)	Range of Measurement			Accuracy	Price
			R	L	C		
General Radio	650-A	1000 c.p.s.	0.001 Ω-1 meg.	1 μhy.-100 hy.	1 μμfd.-100 μfd.	1%, 2%	$240
Brown	250-A	1000 c.p.s.	0.001 Ω-1 meg.	1 μhy.-100 hy.	1 μμfd.-100 μfd.	0.5%-2%	$240
	275-B	1000 c.p.s.	0.001 Ω-1 meg.	1 μhy.-100 hy.	1 μμfd.-100 μfd.	0.1%-1%	$495
Construction kit: Heath	—	1000 c.p.s.	0.01 Ω-10 meg.	10 μhy.-100 hy.	10 μμfd.-100 μfd.	—	$69.50

AUDIO SIGNAL TRACERS

Manufacturer	Model Number	Type of Unit	Price
Ferret	721	Test speaker	$29.95
	730	Signal tracer and voltohmmeter	$99.95
McMurdo Silver	910	Test speaker	$22.70
	905-A	Signal tracer and test speaker	$44.50
Philco	7030	Signal tracer	$52.50
Precision Electronics	201	Signal tracer	$34.50
	251	Signal tracer and meter	$49.75
Radio City Prod.	777	Signal tracer and meter	$41.50
Superior	CA-12	Signal tracer and meter	$29.95 Also in kit form: $21.95
Supreme	688	Signal tracer and voltohmmeter	$149.50
Electronic Instr. Co.	113-A	Signal tracer and voltohmmeter	$69.95
CONSTRUCTION KITS: Heath	-	Signal tracer and test speaker	$19.50
Electronic Instr. Co.	145	Signal tracer	$18.95
Feiler	TS-3	Signal tracer	$27.20
	TS-2	Signal tracer	$23.80
	TS-5	Signal tracer	$24.15
	TS-1	Signal tracer	$7.65

SQUARE-WAVE GENERATORS AND ELECTRONIC SWITCHES

Manufacturer	Type Number	Repetition Freq. Range c.p.s.	Signal Amplifier Freq. Range	Input Imp. (electr. sw.)	Output Voltage	Output Impedance	Ampl. Gain (electr. sw.)	Rise Time	Price
Reiner	530(3)	10-100,000	—	—	20 P-P max.	0-2000 Ω	—	0.3 μsec.	$ 90
General Electric (see Note 1)	YGL-1(3)	5-125,000	—	—	75 P-P max.	20 ohms/volt	—	0.3 μsec.	$225
Tektronix	104(3)	Four fixed: 50, 1000, 100,000, 1 mc.	—	—	50 P-P max. 5 P-P max.	0-20,000 Ω 0-93 Ω	—	3 μsec. 0.015 μsec.	$195
Measurements	71(3)	6-100,000	—	—	75 P-P max.	20 ohms/volt	—	0.2 μsec.	$310
Lavoie	LA-583-A(3)	20-100,000	—	—	60 P-P max.	1000 Ω bal.	—	0.3 μsec.	$250
Hewlett-Packard	210-A 2,3)	20-10,000	—	—	50 P-P max.	1000 Ω bal.	—	1 μsec.	$150
DuMont	185-A(4)	10-2000	0-25,000 c.p.s.	100,000 Ω	Sine 75 / Sq. W. 30	50,000 Ω	10 max.	25 μsec.	$105
Cenco	80600(4)	500-3000	—	100,000 Ω	—	22,000 Ω	14	—	$ 85

Notes: (1) Pulse characteristic: rectangular wave 75% positive, 25% negative pulse. (2) Requires 2 volts sine wave input driving signal. (3) Square wave generator. (4) Electronic switch.

SINE-WAVE SIGNAL GENERATORS

Manufacturer	Type No.	Class	Frequency range	Output: Matched load	Output: Open-circuit volts	Output impedance	Distortion	Accuracy of calibration	Frequency drift	Output variation	Hum and noise level	Price
General Radio	913-C	Beat-frequency	20-20,000 c.p.s.	0.3 watt	25	600 Ω bal./unbal.	0.25% 1%	±(1%+0.5 c.p.s.)	7 c.p.s. 1st hour zero later	±0.25 db.	—60 db.	$450
	1301-A(2)	R-C Push-button	20-15,000 (27 fixed freq.)	18 mw. 100 mw.	6.6 30	600 Ω bal./unbal. 5000 Ω unbal.	0.1%	±(1.5%+0.1 c.p.s.)	0.02% per hr.	±1 db.		$395
	1302-A	R-C	10-100,000 c.p.s.	40 mw. 20 mw. 80 mw.	10 5 20	600 Ω bal. 300 Ω unbal. 5000 Ω unbal.	1%	±(1.5%+0.2 c.p.s.)	1% 1st 10 min. 0.2% after	±1 db.	—60 db.(1)	$365
Hewlett-Packard	200-A	R-C	35-35,000 c.p.s.	1 w.	25	500 Ω unbal.	1%	—	Greater of: 2% or 0.2 c.p.s.	±1 db.	—60 db.(1)	$120
	200-B	R-C	20-20,000 c.p.s.	1 w.	25	500 Ω unbal.						
	200-C	R-C	20-200,000 c.p.s.	100 mw.	—	1000 Ω unbal.	1%	—	2% or 0.2 c.p.s.	±1 db.	—60 db.(1)	$150
	200-D	R-C	7-70,000 c.p.s.	100 mw.	—	1000 Ω unbal.	1%	—	2% or 0.2 c.p.s.	±1 db.	—60 db.(1)	$175
	200-I	R-C	6-6000 c.p.s.	100 mw.	—	1000 Ω unbal.	1%	1%	2% or 0.2 c.p.s.	±1 db.	—60 db.(1)	$225
	201-B	R-C	20-20,000 c.p.s.	3 w/1 w.	50	600 Ω	1%/0.5%	—	2%, 1%	±1 db.	—60 db.	$250
	204-A	R-C	2-20,000 c.p.s.	5 v.	—	10,000 Ω	1%	—	—	—	—	$175
	202-D	R-C	2-70,000 c.p.s.	100 mw.	—	1000 Ω unbal.	1%	—	2% or 0.2 c.p.s.	±1 db.	—60 db.(1)	$275
	205-A(3) 205-AG(4)	R-C	20-20,000 c.p.s.	5 w.	—	50 Ω, 200 Ω, 600 Ω, 5000 Ω bal./unbal.	1%	—	2%, 1%	±1 db.	—60 db. to —90 db.	$390 $425
	206-A	R-C	20-20,000 c.p.s.	+15 dbm.	10	50 Ω, 150 Ω, 600 Ω bal./unbal.	0.1%	—	1%	—	—70 db. to —100 db.	$550
RCA	WA-54A	Beat-frequency	20-17,000 c.p.s.	125 mw.	40 2.5	250 Ω, 500 Ω 5000 Ω bal.	5% 3%	—	—	±2 db.	—60 db.(1)	$152.50
	68-B	BFO	20-17,000 c.p.s.	125 mw.	—	250/500/5k Ω bal.	0.3%	±1% or 1 c.p.s.	—	±1 db.	—70 db.(1).	$718.75
Sylvania	145	R-C	20-20,000 c.p.s.	1 w.		8 Ω, 15 Ω, 500 Ω unbal.	2%	±2% or ±1 c.p.s.	—	±2 db.	—60 db(1).	$129.50
Furzehill	2232(3)	Beat-frequency	20-20,000 c.p.s.	10 v.r.m.s.	—	600 Ω unbal.	0.5%	±1% ±2 c.p.s.	5 c.p.s. per day after ½ hr.	±1 db.	— 50 db.(1)	—
Weinschel	150-AO	—	0.3-100,000 c.p.s. decade push-buttons	—	—		0.5%	0.5%+0.2 c.p.s.	0.02% per hr. after ½ hr.			$950
Southwestern Industrial Electronic Co.	M	R-C	1-120,000 c.p.s.	400 mw.	20		0.2%	1.5%+0.1 cp..s.	0.5%	±0.5 db.	—75 db.	$387.50
Barker & Williamson	200	R-C	30-30,000 c.p.s.	250 mw.	12.5	500 Ω	1%	±2.5%	1%	±1 db.		$115
Clough-Brengle	179-A	BFO	25-15,000 c.p.s.	100 mw.	35	600 Ω unbal.	5%	2% or 5 c.p.s.	—	±1 db.	—54 db.	$ 95
	280-A	BFO	25-32,000 c.p.s.	100 mw.		600 Ω bal. 4000 Ω unbal.	0.5%	2% or 5 c.p.s.	—	±1 db.	—60 db.	$275
Jackson	655	R-C	20-200,000 c.p.s.	500 mw.		10 Ω, 250 Ω 500 Ω, 5k Ω	5%	3% or 1 c.p.s	—	±1 db. (30-15k c.p.s.)	—60 db.(1)	$135
Supreme	680	BFO	15-15,000 c.p.s.	500 mw.	65	250/500/5k Ω bal.	5%	—	—	±1 db.	—	$ 82.95

Notes: (1) Below full output. (2) Range can be extended to 2 C.P.S. (3) Contains vacuum-tube voltmeter to read output voltage. (4) Contains two vacuum-tube voltmeters for complete gain measurements.

DECADE AMPLIFIERS AND HIGH INPUT IMPEDANCE TRANSFORMERS

Type of Unit	Manufacturer	Type Number	Input Impedance	Output Impedance	Voltage Gain	Frequency Range	Price
Impedance transformer and decade ampl.	Keithley	102	200 meg., 6.2 μμfd.	300 Ω	1/10/100	5 c.p.s.-150 kc.	$175
Impedance transformer	Audio Instr. Co.	100	100 meg., 6 μμfd.	200 Ω	1	over 10 kc.	$72.50
Decade amplifier	Ballantine	220	1 meg.	1500-3000 Ω	10/100	10 c.p.s.-100 kc.	$90
	Hewlett-Packard	450-A	1 meg., 15 μμfd.	150 Ω	10/100	10 c.p.s.-1 mc.	$140
	Kay-Lab.	102-A	3 meg., 10 μμfd.	10 Ω	100/1k/10k	10 c.p.s.-100 kc.	$175
	Reiner	101	—	—	100	10-5000 c.p.s.	$45

FREQUENCY METERS

Manufacturer	Type number	Principle of operation	Frequency range	Input impedance	Accuracy	Price
Hewlett-Packard	500-A	Electronic measurement	5-50,000 c.p.s.	50,000 Ω	2%	$210
Barker & Williamson	300	Electronic measurement	20-30,000 c.p.s.	—	2%	$105
General Radio	1141-A	Tuned R-C bridge	20-20,000 c.p.s.	3000-10,000 Ω	0.5%	$215
Kay-Lab	601-A	Heterodyne	500 c.p.s.-50 mc.	—	—	$125
Daven	838-A	Electronic measurement	20-100,000 c.p.s.	High	2%	$300

SINE AND SQUARE-WAVE GENERATORS

Manufacturer	Type No.	Class	Frequency Range c.p.s.	Output		Output Impedance	(Sine-wave) Distortion	Accuracy of Calibration	Output Variation	Price
				Open-circuit Volts	Matched Load					
McMurdo Silver	913	R-C	20-25,000	60	1 w.	6/125/500/5kΩ 500 Ω bal.	1%	±1% or ±1 c.p.s.	—	$68.50
Ferret	701	R-C	20-24,000	15	—	—	—	2%	—	$89.95
Radio City Prod.	711	R-C	10-100,000	15	—	—	—	—	—	$87.50
Cenco	80592	R-C	20-20,000	25	60 mw.	500 Ω unbal.	—	±3% or 3 c.p.s.	±2 db.	$100
Construction Kit: Heath		R-C	20-20,000	—	—	—	1%	—	±1 db.	$34.50

CALIBRATED ATTENUATORS

Manufacturer	Type Number	Input Impedance	Load Impedance	Attenuation Range	Minimum Atten. Step	Attenuation Accuracy	Price
General Radio	546-C(1)	600 Ω	100k Ω	0-146 db.	Continuous	± (0.3%+0.5μv.)	$110
	654-A	10k Ω	1 meg.	0.001-1.0	0.001	±0.2%	$100
	1450	600 Ω	600 Ω	0-110 db.	1 db.	±1%	—
Hewlett-Packard	350 A/B	500/600 Ω	500/600 Ω	0-110 db.	1 db.	—	$50
Furzehill	1358	600 Ω	600 Ω	0-110 db.	1 db.	0.1 db.	—
Daven	690 Series	500/600 Ω	500/600 Ω	0-110 db.	1 db.	—	$80 and $100
	692	500 Ω	500 Ω	0-111 db.	0.1 db.	—	$110 and $130
	693	600 Ω	600 Ω				
	694	135 Ω	135 Ω				
Shallcross	355	600 Ω	600 Ω	0-35 db.	5 db.	—	$35
Keithley	101	11k Ω	30k Ω	0.0001-1.0	Decade	2%-4%	$10.50

Note: (1) Contains meter for measuring input voltage.

OSCILLOSCOPES WITH GREATER THAN 1 MC. BANDWIDTH

Size of C-R Tube	Manufacturer	Type Number	Signal Freq. Range	Defl. sens. (R.M.S. v/in.)		Sweep Frequencies	Input Impedance	Price
				Vertical	Horizontal			
5"	DuMont	241	20 c.p.s.- 4 mc.	0.07	0.7	15-30,000 c.p.s.	2 meg., 40 μμfd.	$ 458
		248-A	20 c.p.s.- 5 mc.	0.1	2.75	15-150,000 c.p.s.	1 meg., 40 μμfd.	$1870
	RCA	WO-58A	5 c.p.s.- 2 mc.	0.2	0.7	10-100,000 c.p.s.	1 meg., 25 μμfd.	$ 431.25
		715-B	5 c.p.s.-11 mc.	0.06	0.3	5-100,000 c.p.s.	1 meg., 40 μμfd.	$3000
	Reiner	556	10 c.p.s.- 2 mc.	0.05	0.05	to 1 mc.	10 meg., 25 μμfd.	$ 455
	Supreme	660	5 c.p.s.- 5 mc.	0.1	0.14	7-100,000 c.p.s.	5 meg., 5 μμfd.	$ 276.80
	Tektronix	511-A	5 c.p.s.-10 mc.	0.65	—	—	1 meg., 40 μμfd.	$ 795
		512	d.c.-2 mc.	0.375	—	—	1 meg., 40 μμfd.	$ 950
3"	Lavoie	LA-239A	10 c p.s.- 5 mc.	0.06	—	—	0.3 meg., 30 μμfd.	$1950
	Reiner	524	20 c.p.s.- 2 mc.	0.1	0.7	15-30,000 c.p.s.	2 meg., 30 μμfd.	$ 275
	DuMont	224-A	20 c.p.s.- 2 mc	0.1	0.7	15-30,000 c.p.s.	2 meg., 30 μμfd.	$ 290
	Furzehill	1684 D/2	d.c.-3 mc.	0.015-0.045	0.03-0.09	2-150,000 c.p.s.	1 meg., 60 μμfd.	$ 895
	RCA	WO-79A	10 c.p.s.- 5 mc.	0.17	0.43	20-250,000 c.p.s.	1 meg. 30 μμfd.	$ 687.50

MULTIPLE BEAM OSCILLOSCOPES

Manufacturer	Type Number	Number of Beams	Signal Freq. Range	Defl. sens. (R.M.S. v/in.)		Sweep Frequencies	Input Impedance	Price
				Vertical	Horizontal			
DuMont	279	2	d.c.-200,000 c.p.s.	0.35	0.35	2-30,000 c.p.s.	2 meg., 60 μμfd.	$1300
Electronic Tube Corp.	H-21	2	d.c.-200,000 c.p.s.	0.035	0.26	2-50,000 c.p.s.	—	$1285
	H-43	4	d.c.-200,000 c.p.s.	0.35	—	—	—	$1995

MISCELLANEOUS MEASURING AND ACCESSORY INSTRUMENTS

Type of unit	Manufacturer	Type number	Characteristics	Price
Noise generator	H. H. Scott	810-A	Random noise source—equal power in equal frequency bands 20-20,000 c.p.s. (and to over 200,000 c.p.s.) Output 0-0.2 volts	$42.50 (or $70)
Complex wave generator	Barber	57	Fundamental and harmonics of variable phase Fund: 50-3000 c.p.s. Harmonics: 2nd-5th; 0-100%; 0 to ±180° phase Output: 1 volt fundamental	$495
Linear to logarithmic amplitude char. converter	Kay-Lab	510	Output proportional to logarithm of input voltage from 0.04 v.-15 v. Impedance 10,000 Ω	$49
	Audio Instr. Co.	121	Combines a linear-to-logarithmic converter with a V T V.M Freq. range: 25-20,000 c.p.s. Meter range: 50 db. Input: 100,000 Ω unbalanced 0.1 volts for full-scale defl.	—
Impedance meter	Electrodyne	Impedometer	Used with oscillator and V.T.V.M. to measure impedance on scale of V.T.V.M. Range: 0.1-100,000 ohms	$34.50
Angle meter	Technology Instrument	310-A	Freq. range: 30-20,000 c.p.s. Range: R—0.5 to 100k ohms L—5 μhy. to 500 hy. C—0.0012 to 10,000 μfd. Phase angles: 0° to ±90° Self-contained V.T.V.M.	—
Phase meter		320-A	Freq. range: 20 c.p.s.-100 kc. Voltage range: 1-170 v. peak Phase angle ranges: 0-36°, 90°, 180° 360° Accuracy: larger of 2-3% or 3-5 c.p.s.	$475
Vacuum-tube volts-amperes-watts meter	Fluke Eng. Co.	101 VAW meter	Inserted into output circuit. Freq. range: 20-200,000 c.p.s. Voltage range: 0.1-300 v. Current range: 1.0 ma.-300 amps. Power: reads VA cosφ Accuracy: ±3%	$695

OSCILLOSCOPES UP TO 1 MC. BANDWIDTH (3 DB. AT 1 MC.)

Size of C-R Tube	Manufacturer	Type Number	Signal Freq. Range	Defl. Sens. (R.M.S. v/in)		Sweep Frequencies	Input Impedance	Price
				Vertical	Horizontal			
Projection (12"x16")	Beta Electronics	701	7 c.p.s.-125 kc.	0.06	0.065	7-7000 c.p.s.	1 meg., 25 μμfd.	$645-$695
7"	Sylvania	132	10 c.p.s.- 70 kc.	0.21	0.25	15- 30,000 c.p.s.	0.5 meg., 26 μμfd.	$144.50
5"	DuMont	274(1)	20 c.p.s.- 50 kc.	0.65	0.65	8- 30,000 c.p.s.	1 meg., 40 μμfd.	$136.50
		208-B	2-100,000 c.p.s.	0.01	0.5	2- 50,000 c.p.s.	2 meg., 30 μμfd.	$285
		250	0-200,000 c.p.s.	0.015	0.7	1-150,000 c.p.s.	2 meg., 40 μμfd.	$635
	RCA	WO-60-C(1)	2-100,000 c.p.s.	0.020	0.024	3- 30,000 c.p.s.	1 meg., 22 μμfd.	$431.25
		WO-27-A(1)	0-100,000 c.p.s.	0.03	0.035	0-100,000 c.p.s.	0.5 meg.	$1437.50
	Reiner	550-A	5-500,000 c.p.s.	0.03	—	4- 22,000 c.p.s.	70k Ω, 38 μμfd.	$187.50
		508	2-100,000 c.p.s.	0.01	0.5	2- 50,000 c.p.s.	2 meg., 30 μμfd.	$265
	G-E	ST-2A	0-500,000 c.p.s.	0.015	0.35	10-100,000 c.p.s.	1 meg., 36 μμfd.	$279.50
	Cenco	71552	10-300,000 c.p.s.	1.0	1.0	10- 60,000 c.p.s.	0.5 meg., 20 μμfd.	$135
	Hickok	505-A	30 c.p.s.-1 mc.	0.03	0.2	10- 25,000 c.p.s.	1 meg., 25 μμfd.	$298.33
		195-B	30 c.p.s.-1 mc.	0.03	0.15	—	1 meg., 25 μμfd.	$260
	Millen	90905	15-125,000 c.p.s.	—	—	15- 40,000 c.p.s.	—	—
	Precision	ES-500	10 c.p.s.-1 mc.	0.02	0.5	10- 30,000 c.p.s.	2 meg., 22 μμfd.	$149.50
	Supreme	655	20-100,000 c.p.s.	0.3	0.3	20- 30,000 c.p.s.	—	$126.50
	Triplett	3440	20 c.p.s.-1 mc.	0.02	0.2	10- 60,000 c.p.s.	2 meg., 25 μμfd.	—
3"	DuMont	164-E(1)	5-100,000 c.p.s.	0.8	0.65	15- 30,000 c.p.s.	1 meg., 40 μμfd.	$127.20
	RCA	WO-55-A(1)	7- 70,000 c.p.s.	1.33	1.5	15- 50,000 c.p.s.	0.5 meg., 55 μμfd.	$129.50
	G-E	YNA-4(1)	0- 50,000 c.p.s.	0.18	0.21	10- 20,000 c.p.s.	1 meg., 10 meg., and open grid	$189.50
	Sylvania	131(1)	10-100,000 c.p.s.	0.5	0.5	15- 40,000 c.p.s.	1 meg., 30 μμfd.	$ 89.50
	Cenco	71551	10-300,000 c.p.s.	1.0	1.0	10- 60,000 c.p.s.	0.5 meg., 20 μμfd.	$ 95.75
	Millen	90903	15-125,000 c.p.s.	—	—	15- 40,000 c.p.s.	—	—
	Supreme	650	20-100,000 c.p.s.	0.5	0.5	20- 30,000 c.p.s.	—	$ 99.95
	Radio City Prod.	90	5-200,000 c.p.s.	0.285	0.320	10- 45,000 c.p.s.	1 meg., 20 μμfd.	$127.50
	Radio Supply & Eng.	AR-3	to 1 mc.	—	—	—	—	$ 49.95
	Furzehill	1936-A	1-20,000 c.p.s.	0.02	0.375	5- 10,000 c.p.s.	1 meg., 40 μμfd.	$360
	Waterman	1684-N	0- 50,000 c.p.s.	0.0025	0.1	5- 10,000 c.p.s.	2.2 meg., 25 μμfd.	—
		1684-K(1)	0-300,000 c.p.s.	0.001	0.002	0.3- 60,000 c.p.s.	2 meg.	—
		S-11-A(1)	0-200,000 c.p.s.	0.1	0.1	3- 50,000 c.p.s.	0.5 meg., 35 μμfd.	—
		S-12-A(1)	0-200,000 c.p.s.	0.05	0.05	0.5- 50,000 c.p.s.	0.5 meg., 35 μμfd.	—
2"	Philco	7019	20-100,000 c.p.s.	1.0	1.0	10- 50,000 c.p.s.	0.5 meg., 36 μμfd.	$ 66
	Millen	90952	10 c.p.s.-1 mc.	0.35	—	16- 22,000 c.p.s.	—	—
		90902	15-125,000 c.p.s.	—	—	15- 40,000 c.p.s.	—	—
	Waterman	S-10-A	20-100,000 c.p.s.	1.0	1.0	10- 50,000 c.p.s.	0.5 meg., 36 μμfd.	—
		S-10-B(1)	20-150,000 c.p.s.	1.0	1.0	10- 50,000 c.p.s.	0.5 meg., 36 μμfd.	—
CONSTRUCTION KITS:								
5"	Electronic Instr. Co.	400	50- 50,000 c.p.s.	0.65	0.65	15- 30,000 c.p.s.	—	$ 39.95
	Feiler	TS-7	20-350,000 c.p.s.	0.5	0.5	10- 32,000 c.p.s.	1 meg., 50 μμfd.	$ 75.50
	Heath	—(1)	2 mc.	0.06	0.06	15- 70,000 c.p.s.	1 meg., 50 μμfd.	$ 39.50

Note: (1) Identical vertical and horizontal amplifiers.

FREQUENCY STANDARDS AND TONE GENERATORS

Manufacturer	Type No.	Frequency	Accuracy	Maximum Output	Output Impedance	Price	Class
General Radio	723	3 models: 400, 440, or 1000 c.p.s.	±0.05%	50 mw.	50/500/5k Ω	$115 to $150	Tuning-fork
	813-A	1000 c.p.s.	0.5%	30 mw.	50/500/5k Ω	$70	Tuning-fork
Hewlett-Packard	100-A	100/1000/ 10k/100k c.p.s.	3 c.p.s. per mc. per deg. C.	5 v.	1000 Ω	$450	Crystal osc.
	100-B	100/1000/ 10k/100k c.p.s.	±0.001%	5 v.	1000 Ω	$500	Crystal osc.
Furzehill	1100	10 kc/100 kc/ 1 mc.	±0.005%	—	—	—	Crystal osc.
	1744	1 kc/10 kc/ 100 kc/1 mc.	±0.005%	—	100 Ω	—	Crystal osc.
Times Facsimile	FK-2	1800 c.p.s.	0.001%	0.5 v.	600 Ω	$275	Tuning fork
	FKP, FKC	1800 c.p.s.	0.001%	0.5 v.	600 Ω	$350	Tuning-fork
	FK-4	1800 c.p.s.	0.001%	10 v.	1 meg. Ω	$225	Tuning-fork
General Radio	572-B	1000 c.p.s.	±10%	—	10/300 Ω	$12.50	Tuned reed
Shallcross	691-A	1000 c.p.s.	—	—	600 Ω	$45	Vacuum-tube osc.

MULTIMETERS CONTAINING AUDIO-FREQUENCY VACUUM-TUBE VOLTMETERS

Manufacturer	Model number	Quantities measured	Voltage range (full-scale)	Frequency range	Accuracy	Input impedance	Price
RCA (Volt-Ohmyst)	195-A	V-O	5-1000	30-100,000	—	200k. Ω, 170 μμfd.	$79.50
Hewlett-Packard	410-A	V-O	1-300	20 c.p.s.-700 mc.	3%	10 meg., 1.3 μμfd.	$245
Ferret	730(1)	V-O	1-3000	to 300 mc.	3%	10 meg.	$99.95
Clippard	406	V-O	1-1000	30 c.p.s.-100 mc.	2%-5%	7 meg., 7 μμfd.	$89.50
Jackson	645	V-O-ma.	1-1000	50-200,000	—	4.4 meg.	$69.50
Philco	7001	V-O-ma.	1-100	50 c.p.s.-30 mc.	5%	15 meg. or 2.7 meg., 5.5 μμfd.	$104.50
Precision	EV-10	V-O-ma.	3-6000	AF-RF	—	—	$104.35
Radio City Prod.	669	V-O-ma.	3-1000	AF & Supersonic	—	11 meg.	$59.50
Reiner	456	V-O-ma.-C	3-6000	10 c.p.s.-500 mc.	—	25 μμfd.; 2 μμfd.	$210
	451	V-O-ma.	2.5-1000	AF-700 mc.	—	7 μμfd.	$125
McMurdo Silver	900-A	V-O-ma.	3-1200	20 c.p s.-100 mc.	5%	20 meg., 7 μμfd.	$68.50
Supreme	574	V-O-ma.	1-2500	AF-100 mc.	—	10 meg., 9 μμfd.	$72.50
Sylvania	221	V-O-ma.	3-1000	20 c.p.s.-500 mc.	—	2.7 meg. ∫ 40 μμfd. \ 194 μμfd.	$99.50
Hickok	209-A	V-O-ma.-C	3-1200	to 200 mc.	—	12 meg., 6 μμfd.	$199
	203	V-O-ma.-C	3-1200	to 200 mc.	—	12 meg., 6 μμfd.	$149
Electronic Designs	100	V-O	3-50	60 c.p.s.-100 mc.	±3%	1 meg., 3 μμfd.	$59.50
Simpson	266	V-O-ma.	1-5000	AF-RF	—	10 meg., 4 μμfd.	$114
Electronic Instr. Co.	113-A(1)	V-O	5-1000	to 30,000	—	1.5 meg.	$69.95
	210	V-O	5-1000	50 c.p.s.-200 mc.	2%	1.5 meg.	$69.50
CONSTRUCTION KITS: Heath	V-2	V-O	3-1000	AF-RF	—	11 meg.	$24.50
Electronic Instr. Co.	221	V-O	5-1000	—	2%	—	$23.95

Notes: (1) Contains audio amplifier and loudspeaker for signal tracing. (2) V—volts (a.c.-d.c.); O—ohms; ma.—milliamperes and amperes; C—capacity

(*Continued on page* 106)

FIXED BIAS FOR AUDIO OUTPUT STAGES

An analysis of various circuits used to obtain fixed bias for triode or pentode output stages.

By JOSEPH R. BOOKEE

WHEN an amplifier builder decides that it is time to create a masterpiece, he comes to the necessity for a decision between beam power and triodes. He must choose from available types a tube or set of tubes which will both deliver the amount of output power he needs and satisfy his requirements as to fidelity and economy. The controversy between the proponents of triode output stages and those favoring beam power tetrodes with large amounts of inverse feedback will not affect the point of discussion here one whit. The purpose of this article is to enumerate the engineering and performance characteristics of stages employing fixed bias and show the advantages offered by the use of fixed bias to either of the two types of audio amplifier design.

A good point to begin with, perhaps, is that more power output can be achieved with the same tubes, using fixed bias, than can be obtained using self bias. Furthermore, this will be at no cost of increased harmonic distortion, and the tubes will run at the same or lower zero-signal plate current ("plate dissipation"). This means that greater power efficiency will result. Here are some examples of the improvement, as shown for two popular tube types.

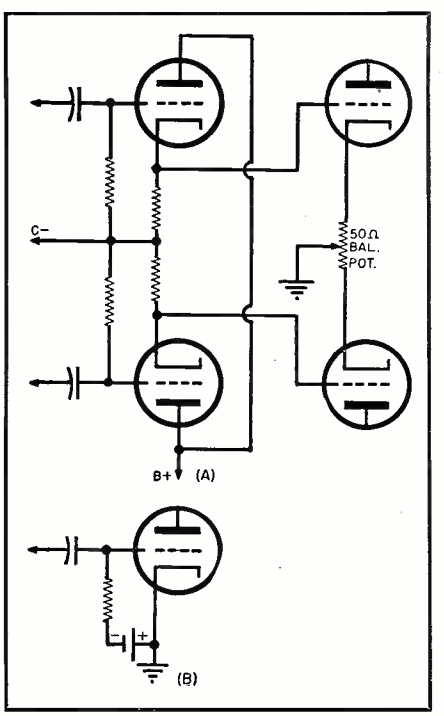
Type 6V6 beam power pentode. Operating conditions as a push-pull "Class AB_1" power output stage are given in Table 1; all values are for two tubes.

It is well to remember certain facts about this fixed bias operation. Although the operating conditions given are nominally for fixed bias in "Class AB_1," the facts that define the operation as "Class AB_1" are that no appreciable grid current flows during any portion of a signal cycle and that plate current flows for more than half of the signal cycle. Since these tubes are being biased not far from cut-off, as far as plate current flow is concerned the operation is more like "Class B" than "Class A." Although the harmonic distortion does not seem to increase, it is entirely possible for intermodulation effects to increase, especially if power supply regulation is not good enough. The customary inverse feedback will remedy this.

Types 2A3, 6A3, 6B4, and 6A5 are low mu triodes in widespread applications. Operating conditions for two tubes in push-pull "Class AB_1" operation are shown in Table 2.

Because of the smaller plate load in fixed bias, the peak plate current is increased greatly. Also, because of the decreased plate load resistance, the power output would tend to be decreased slightly while the harmonic distortion dropped sharply. Due to the increase (25%, or 62 volts) in effective plate-to-cathode voltage, the power output is increased by 50% anyway, while the greatly desirable 50% decrease in harmonic distortion remains.

Fig. 1. (A) Schematic of a cathode follower driver stage. (B) Application of a bias cell.



Now we come to the argument having the most subtle persuasiveness of all. The tube operating under fixed bias will tend to have less transient distortion because of the elimination of a main source of incremental plate resistance. Since there is no cathode resistor, as such, there is no tendency toward inverse feedback of the type termed "current feedback," which tends to raise the plate resistance and, hence, the internal generator impedance of the amplifier circuit.

Transient and pulse behavior are dependent on the phase and amplitude response of the system at the extreme high and low ends of the frequency response spectrum, just as well as at the intermediate frequencies. A bypass condenser of any finite size, connected in parallel with any given cathode bias resistor, will introduce a phase shift which increases as frequency decreases. By choosing a large enough value of capacitance, this effect can be minimized for as low a frequency as is desired, say 20 or 30 cycles, or less. (It is necessary to bypass a common cathode resistor even in push-pull amplifiers, or all harmonics will be reintroduced to both grids in-phase; this will increase the total distortion very greatly.)

The designer of an amplifier incorporating more than about 20 db. of inverse feedback soon finds that he is going to total phase shift in the feedback loop at less than 180° at frequencies of one or two cycles or less, if he is to avoid low-frequency parasitic oscillations, to say nothing of the peak in amplitude and general instability of response which take place if the phase shift is not sufficiently less than the criterion of 180°. Thus, the point remains that the low-frequency phase shift causes pulse and transient instabilities of various orders when bypassed self-bias resistors are employed; that these types of distortions are extremely undesirable in high-quality audio equipment; and that by the use of fixed bias, these difficulties can be solved more economically and without the use of extraordinarily large condensers. How this is done will be shown shortly.

It cannot be denied that the use of fixed bias has its drawbacks. The first point to be considered is that some means must be provided to balance inequalities in plate current between the two sides of the push-pull amplifier. The reason for this is that modern output transformers, which have cores of very large permeability, are susceptible to core saturation if there is current unbalance in the split primary windings. If this unbalance is less than about 10%, the effect will be a loss of low-frequency response; if it is more, serious distortion will result.

Unbalance can be easily corrected

by any one of several simple and inexpensive methods. A resistor of suitable value, or even better, a potentiometer used at the cathode of the overconducting tube, connecting it to ground, will remedy the situation. A very common way to adjust for this is to connect each leg of a small wirewound pot to each cathode and ground the tap. This is excusable because a tube which has too low a d.c. current resistance will usually have, in addition, a low plate resistance. The small amounts of current feedback introduced by these cathode balancing resistors will tend to raise the offending tube's plate resistance and lower its transconductance until it is in balance with the other tube. This is desirable when full use of the distortion-cancelling effect of push-pull operation is wanted.

Another method is to provide separate bias-supply bleeders for each of the tubes, which may then be balanced empirically by adjusting the grid bias values separately. These adjustments are necessary at all times, even in self bias operation where one employs tubes of high transconductance, such as the 6A5G or 6AS7G. It is also well to remark that as tubes age, these adjustments must be corrected from time to time. This is the reason for the permanent plate current metering and screwdriver adjusting pots found in professional high-quality equipment.

Another point is that the maximum permissible value of input grid resistor is appreciably smaller under fixed bias than under self bias. In the case of the 6V6 and 6L6, 0.1 megohm may be used at most, as against .5 megohm in self bias. For members of the 2A3 family of triodes, .05 megohm is permissible, as against .5 megohm in self bias. The reason for this is that there seems to be a small amount of grid current that must be allowed to flow, because of the connection between grid current and the larger plate current excursions which take place under the fixed bias conditions. There may be less potential difference between the plate and the cathode than there is between the cathode and the grid, in which case one obtains a little more grid rectification than occurs in the self-bias condition where plate current excursions are not so great.

Since a given *RC* constant must be upheld in order to preserve a given bass response and phase shift characteristic, the conclusion is reached that some large values of coupling capacitance are needed if conventional *RC* coupling circuits are to be employed and extremely good response is desired. For example, a good combination to use in feedback loops is an .1 μfd. condenser coupled to a grid resistor of .5 megohms resistance. To get the same quality of response when .05 megohms is the largest permissible grid resistance, one would have to use an 1 μfd. coupling condenser. This is not too good, because the condenser becomes rather bulky and therefore difficult to wire in. As a consequence it tends to have a rather high capacitance to ground and too high a leakage current with all the associated dangers. Any ordinary condenser will probably also have too high a power factor because the leakage resistance is too low. In high-impedance circuits, the power factor consideration is negligible, but the leakage current may upset the bias of the grid by making it a few volts more positive with respect to ground. This is not a desirable condition, even though it is easily compensated for, because the leakage resistance of the coupling condenser is likely to decrease further as the part ages in operation.

It is for these reasons that transformer and impedance coupling methods are advisable, especially when not too much, if any, inverse feedback is to be applied around this circuit element. The d.c. resistance of the wire windings of the coupling inductance from the grid terminal to ground is never more than a few thousand ohms and is much less than that if the part is of any quality. At the same time, of course, the impedance to the audio signal can be as large as desired, just so long as enough inductance is provided. This method, however, is expensive; the parts are bulky, and there is always some trouble with hum pickup. Furthermore, though frequency response can be made very good, it will be found that there is too much phase shift at the near extremes of the response band for any significant amount of inverse feedback to be employed. This can be compensated for by the use of complicated *RC* networks linking, say, the primary and secondary of an interstage transformer, and near ideal results are possible. One can see an example of this type of engineering in the schematic of a very well respected amplifier which features the use of a triode output stage.

The author believes that cathode followers do the job better. Fig. 1A shows a system for direct coupling push-pull cathode follower drivers to the grids of the output tubes. It must be remembered that the bias of the output tubes must be increased because of the zero signal *IR* drop in the cathode follower load resistors. One should also remember that the negative voltage swing of the signal delivered by a cathode follower is limited to the amount of bias under which the tube operates, although there is no limit to the positive swings but the available plate supply voltage. This is nothing to worry about. The combined signal of the two cathode followers will be distortionless; so if the output tubes are now put under heavy negative bias, they can still operate linearly for all input signals, peaks on the more negative (the more nonlinear) side of the operating point already being reduced by the cathode followers. A power tube operating heavily biased does not draw much zero-signal plate current at all. It is easy to see therefore that this system can give a pretty high order of efficiency while it sacrifices nothing to distortion.

The cathode followers have many desirable properties. The grid circuit of the output tubes will have very low impedance and resistance to ground. This will satisfy the requirement that

	SELF BIAS	FIXED BIAS	
Plate voltage	250	250	v.d.c.
Screen voltage	250	250	v.d.c.
Plate current—			
Zero signal	70	40	ma.
Peak signal	79	79	ma.
Screen current			
Zero signal	5	3	ma.
Peak signal	13	13	ma.
Load resistance, c.t.	10 000	10,000	ohms
Grid bias	—15	—25	v.
Power output	10	16	watts
Total Harmonic distortion	5%	5%	

Operating conditions are for 2 tubes in push-pull "Class AB_1"

Table 1. Operating conditions of the 6V6 as a push-pull "Class AB_1" power output stage.

Table 2. Operating characteristics of the 2A3. 6A3, 6B4, and 6A5 low mu triodes.

	SELF BIAS	FIXED BIAS	
Plate voltage	300	300	v.d.c.
Plate current—			
Zero signal	80	80	ma.
Peak signal	100	147	ma.
Grid bias	—62 / (780 ohm resistor)	—62	v.
Load resistance	5000	3000	ohms
Power output	10	15	watts
Harmonic distortion	5%	2.5%	

Operating conditions are for 2 tubes in push-pull "Class AB_1"

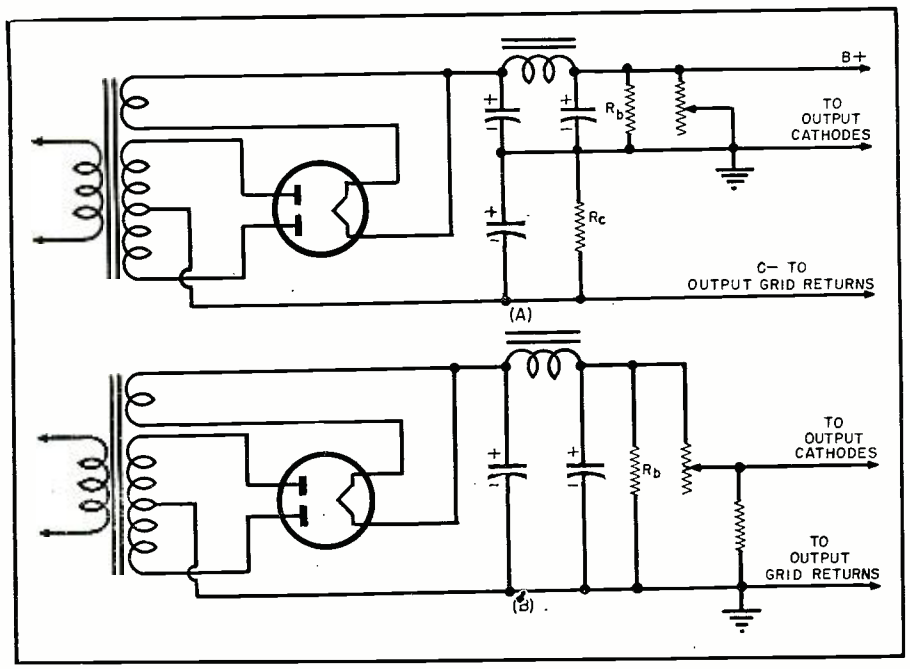


Fig. 2. How bias is obtained from main power supply: (A) Back bias and (B) self bias.

the grid leak be small. The low impedance to ground prevents high-frequency losses due to capacitance to ground leakage as does the coupling property of the cathode follower itself. The low impedance of the input circuit makes it quite possible to drive the output tubes very hard, without any of the usual positive peak flattening and clipping when the input signal approaches the value of the fixed bias and the grids approach within less than a volt of cathode potential. Not too much distortion will result if the grids are driven slightly above cathode potential, provided the drivers are capable of delivering power.

The cathode followers introduce no phase shift in themselves; there is not the customary 180° shift due to the presence of a tube stage, and due to the extremely high input impedance there will be far less high-frequency attenuation at the input to the cathode follower stages than there would be at the input to any other type of grid-driven stage, such as the output stage.

The slight attenuation of signal voltage characteristic of cathode followers is very easily compensated for by providing a little more gain in the previous stages.

Now let us discuss some of the means for obtaining fixed bias. None of them offers the simplicity, economy, or compactness of the self-bias method, but this is no more than an engineering detail to the perfectionist. There are some ideas incorporated into the circuits given here which may prove helpful in other design problems.

The first, and most obvious, method is to use a battery. Fig. 1B shows the correct connection. This is the same circuit connection as was used with the specially-designed "C" batteries or "bias cells" in the days before the "all-electric" a.c. or a.c.-d.c. power supply. Bias cells are still used in some high-gain microphone stages, where self or grid-leak bias will create hum problems. This system is rare nowadays in power output stages because the batteries do not last long enough in such service. They dry out, are bulky, expensive, and have too poor a regulation due to the high internal resistance necessary to good shelf life.

Figs. 2A and 2B show how bias is obtainable from the main power supply bleeder; Fig. 2A is sometimes termed "back bias." Fig. 2B shows the self-bias method by comparison. Back bias approaches self bias in operation as less and less current flows through the main bleeder and the constant-current portion of the power-supply load. If the bleeder current is of large enough magnitude, the voltage across the bias determining resistor becomes as nearly constant as desired. The bypass capacitance will help in further smoothing the bias voltage.

This method can be quite inexpensive to install, because the additional cost of a heavier power transformer and filter system and the heavier bleeders will not be as much as that of a completely separate bias supply. The main power supply will also benefit by improved regulation and dependability. The main defect of this system is that effective plate supply voltage is lost, just as in self bias. When one has to supply a good 60 volts bias, as with 2A3's, this is undesirable.

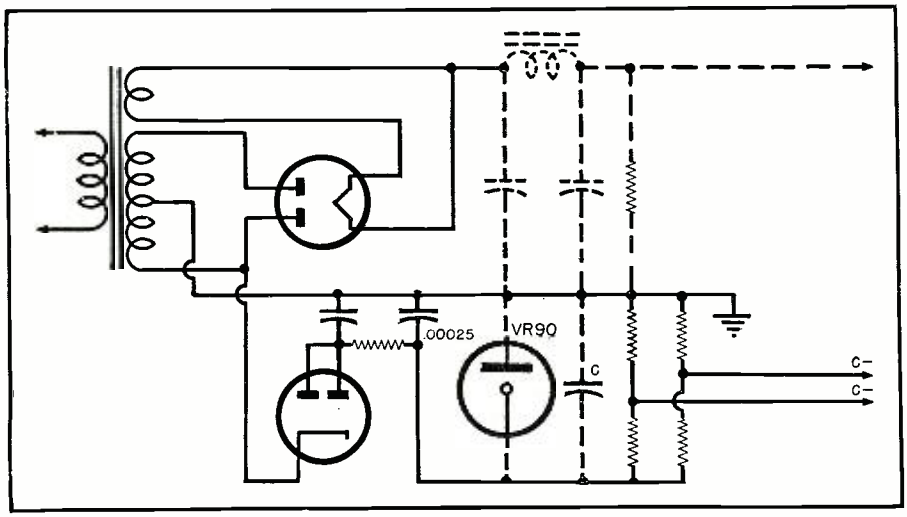
In Fig. 3 is shown a widespread and popular circuit known as the "side rectifier." It works by rectifying the negative phase of the supply cycle, instead of the positive phase, as in the usual positive supply. Although it would be desirable to employ a full-wave rectification circuit, this is not possible if one is to use any of the common cathode-type rectifiers, unless one wishes to employ two tubes. The type 6H6 or 6AL5 will not allow enough current to flow for good regulation, although the separate cathode pins for each diode section make the use of a full-wave circuit possible.

Some power transformers are supplied with a bias tap about 60 to 70 volts up from one side of the high voltage winding center tap. This sort of tap will usually deliver the right amount of bias for a pair of 2A3's from the proper rectifier and filter. Adjusting resistance values and tap bleeders to get any required smaller bias voltage is a simple matter indeed. This circuit requires a rectifier tube which will usually draw a fairly heavy filament current. Type 6X5, for example, will draw 0.6 amperes at 6.3 volts.

The circuit of Fig. 4A affords two advantages over previous ones. The first advantage is the elimination of a rectifier tube and the saving of its filament current. The midget selenium rectifier will run more coolly than the tube and will have better reg-

(*Continued on page* 120)

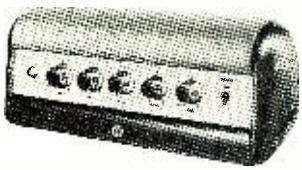
Fig. 3. Schematic diagram of a popular circuit usually referred to as the side rectifier.



MICROPHONES

- Pressure
- Velocity
- Cardioid
- Varacoustic
- Hand Sets
- Sound Power Telephones
- Stands, Plugs, Cables and Connectors

AMPLIFIERS

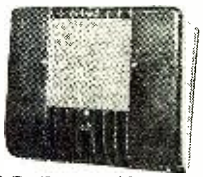


- Pre-Amplifiers
- Line Amplifiers
- Voltage Amplifiers
- Power Amplifiers
- Remote Amplifiers

SPEAKERS

- Cone Type
- Horns and Drivers
- High-Fidelity Speakers
- Speaker Accessories

SPEAKER HOUSINGS



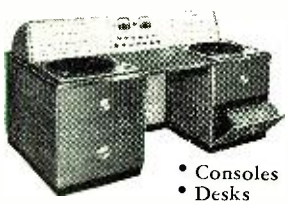
- Baffles, All Types
- Console Cabinets

INTERCOM SYSTEMS

- All Master Systems
- Master-Remote Systems
- Combination Systems

PORTABLE SOUND SYSTEMS

CUSTOM-BUILT EQUIPMENT



- Consoles
- Desks
- Turrets
- Cabinets

CONSOLETTES

- Single Channel
- Dual Channel
- Custom-Built

Why shop around?

It's easy to get the right equipment from RCA's full line of matched sound products

Buy your sound products the easy way. The wide variety of RCA Sound Products simplifies your problem of finding the right equipment for your sound jobs.

Every item in RCA's extensive sound line is electronically engineered with its own special characteristics to give top performance, dependable long-life service with quality appearance. Not only is the RCA Sound Products line built right, it is also priced right to enable you to build a steady volume of profitable business.

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Please send me copy of RCA's new Catalog 218 on complete line of matched sound products.

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MARS Station of the Month

MARS BEAMS WEEKLY BROADCASTS

MARS—Army Headquarters station, WAR, located at the Pentagon Building, Washington, D. C., broadcasts a weekly message each Tuesday at 0100Z and at 0400Z. (This is Monday at 8 p.m. and 11 p.m., Eastern Standard Time; Monday at 7 p.m. and 10 p.m., Central Standard Time; Monday at 6 p.m. and 9 p.m., Mountain Standard Time; and Monday at 5 p.m. and 8 p.m., Pacific Standard Time.)

Simultaneous broadcasts are made on frequencies 6997.5 kc., 14405 kc., and 20994 kc. Each message is sent three times, once at 10 words per minute, once at 15 words per minute, and once at 20 words per minute.

Designed especially to transmit quasi-official traffic and training information to MARS members, the broadcast offers an excellent opportunity to all amateurs in building up their code proficiency.

THE once proud blacksmith shop at Fort McPherson, Georgia, is no more. The reverberating clang of hammer on red-hot iron and anvil has been replaced by the beat note, the intermittent whine of dots and dashes of a radio transmitter. For the little brick structure which once housed the Post blacksmith shop is now the home of A4USA, Military Amateur Radio System Headquarters Station for the Third Army Area.

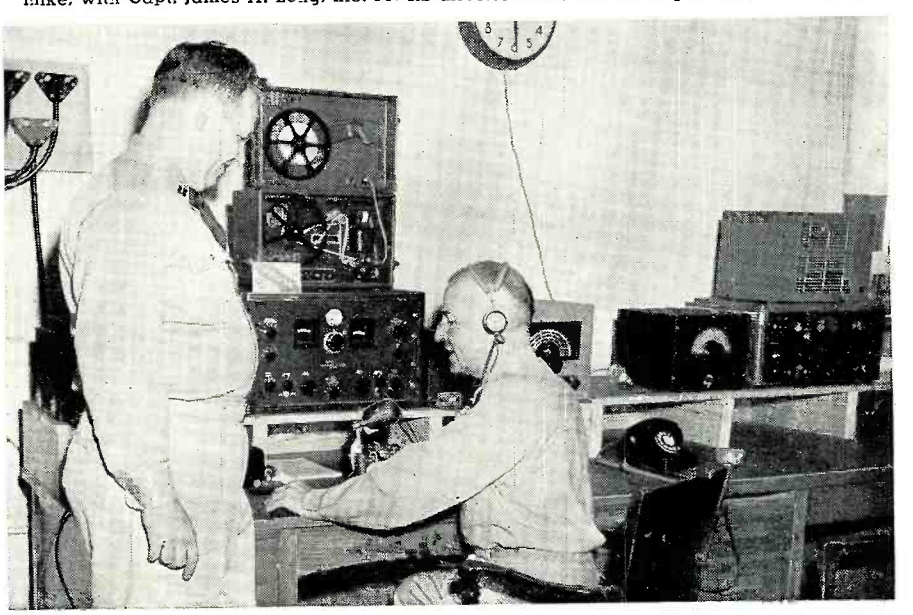
The smithy has proved an ideal location for the amateur shack, according to Major Harold B. Lynn, director, Third Army MARS. It furnishes Army hams with a private meeting place and with station facilities for off-duty amateurs to pound brass and rag-chew.

Instruction rooms are available where a code school is conducted. Most of the students have had some previous experience in radio and code. The course includes preparation for the FCC examination for an amateur license.

Basic equipment in A4USA includes a BC-610, a Super Pro, an SX-28, a *Meissner* Signal Shifter, and a VH-152. Equipment is also available for transmitting the weekly bulletins to all MARS members in the Third Army Area (both tape machine and electronic key are used). The BC-610 is used on all bands, 80 through 10, both c.w. and phone. Doublet antennas are used on 80, 40 and 20, but a rotary beam is up for 10 meter use.

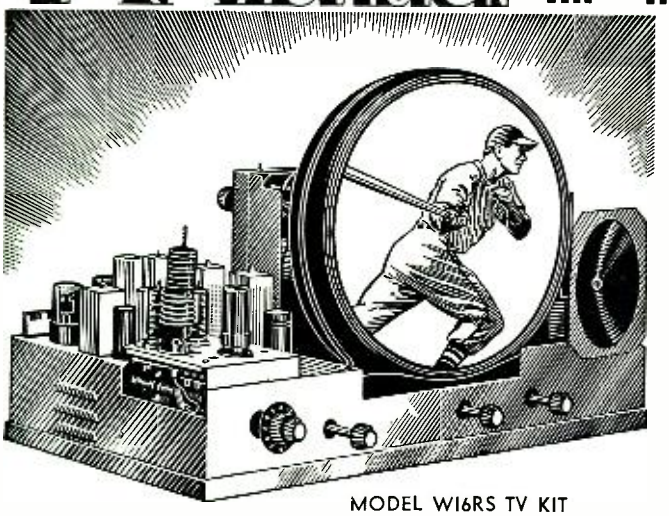
A4USA was control station in the MARS-Army Standby Communications Net during the August hurricane which struck Florida and swept northward through the Third Army area. With 14th Air Force Headquarters at Orlando, Florida, A4USA monitored all frequencies used by the emergency nets of Florida and Georgia. Seventy-one member stations were alerted in the Third Army net. Reports direct from the storm area were intercepted and transmitted direct to WAR, MARS-Army Headquarters Station in Washington, D. C. Emergency traffic, including storm reports, were broad-

Maj.-Gen. William C. Chase, Third Army Chief of Staff, calls CQ at the W4USA-A4USA mike, with Capt. James A. Long, first MARS director of the Third Army area, standing by.



TRANSVISION

TELEVISIO KITS AN INSTRU ENTS



MODEL WI6RS TV KIT

16"

Build it in 1 Day!

GIANT 160 Sq. In. PICTURE; Has 16" PICTURE TUBE

(All-Glass Picture Tube, giving bright, clear, steady picture.)

- **KIT COMES SEMI-WIRED and ALIGNED Can be completed in one day!**
- **SAVE by installing the set yourself.**

• LESS THAN $200!

SAVE UP TO ½ **on the cost of equivalent picture-size sets. For *NEW LOW PRICES*, see your Transvision Outlet listed below.**

Eliminate the Variables in Television Installation with the Transvision FIELD STRENGTH METER

Improves Installations! ! Saves ½ the work! !

Has numerous features and advantages, including—(1) Measures actual picture signal strength . . . (2) Permits actual picture signal measurements without the use of a complete television set. (3) Antenna orientation can be done exactly . . . (4) Measures losses or gain of various antenna and lead-in combinations . . . (5) Useful for checking receiver re-radiation (local oscillator) . . . (6) **12 CHANNEL SELECTOR** . . . (7) Amplitudes of interfering signals can be checked . . . (8) Weighs only 5 lbs. . . . (9) **Individually calibrated.**. . . . (10) Housed in attractive metal carrying case . . . (11) Initial cost of this unit is covered after only 3 or 4 installations . . . (12) Operates on 110V, 60 Cycles, AC.

NEW LOW PRICE

Model FSM-1, complete with tubes Net $79.50

New! Transvision 5" OSCILLOSCOPE

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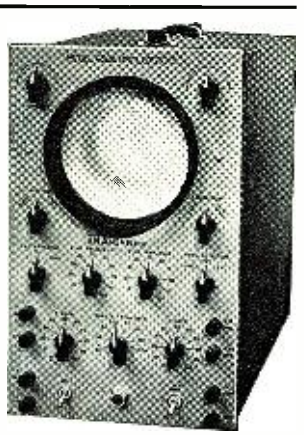
Vertical Amplifier Response to 1 MC—Sensitivity: .15 RMS Volts/inch.

SPECIFICATIONS: Hor. Amp. 2 cycles to 500 kc . . . Decade Attenuators (Frequency Compensated) . . . Direct connection to deflection plates . . . Z Axis Input . . . Calibration Test Signal . . . Pushpull amplifiers on horizontal and vertical . . . Three stage amplification on both . . . Sweep Frequency to 50 kc.

Vert. Amp. 2-6SN7; Hor. Amp. 2-6SN7, 5BP1, 5Y3, and 2x2; 884 Sweep Generator. Cased in hammertone grey cabinet, complete with booklet on "How to Use an Oscilloscope." GUARANTEED.



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MASS:	1306 Boylston St., Boston		53 W. Norwich Ave., Columbus
MICH:	23216 Wilson Ave., Dearborn	PENNA:	235 N. Broad St., Philadelphia
N. J.:	601 Broad St., Newark		620 Grant St., Pittsburgh
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cast until the hurricane emergency was declared terminated.

No damage was sustained by A4USA as a direct result of the hurricane. However, many MARS members in the central and lower Florida report their antennas were literally "gone with the wind" as cyclones up to 150 miles an hour struck their homes.

—30—

CANADIAN MICROWAVE RELAYS FOR TV

SIMILAR to relays for television that have been installed in the United States, *Philco* microwave equipment was used to present television programs to 2,000,000 visitors who attended the Canadian National Exhibit in Toronto recently. This is believed to be the first use of such relays in Canada.

Particularly timely since the Canadian Broadcasting Company is just developing television broadcast networks in the Dominion, the telecasts included television shows from WBEN-TV (Channel 4) from Buffalo, N. Y., and still pictures and recordings from the experimental station VE9KE at the *Philco* factory in Toronto to the site of the fair.

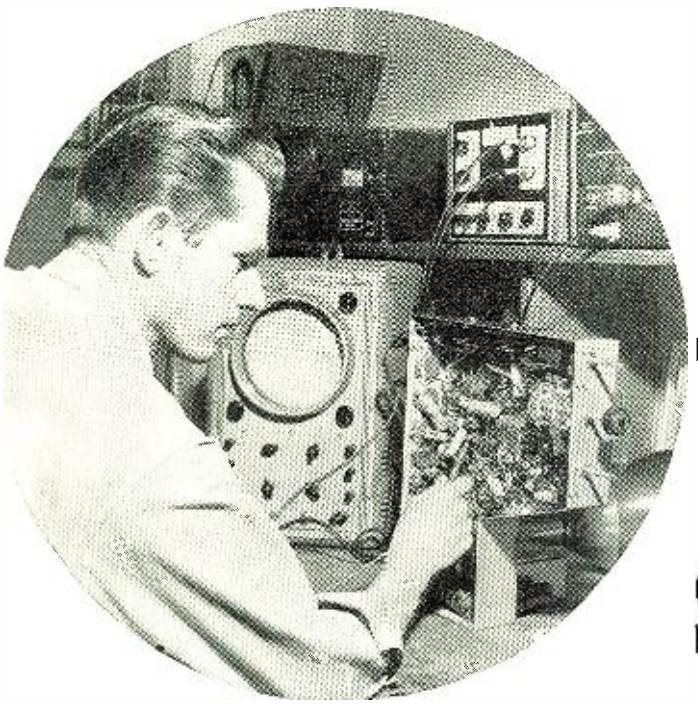
Signals from the Buffalo television station were picked up by a special high-gain antenna, fed to the input of the relay transmitter, beamed by microwave to the relay receiver at the fairgrounds, and then displayed on typical home television sets. —30—

TV SET SHIPMENTS BY AREAS

TELEVISION SERVICES AREA	HALF-YEAR (1949)	ACCUMULATIVE (SINCE 1-1-47)
Albany, N. Y.	9,801	22,580
Albuquerque, N. M.	71	317
Atlanta, Ga.	3,184	8,015
Baltimore, Md.	21,158	49,259
Birmingham, Ala.	2,199	2,222
Boston, Mass.	49,286	88,233
Buffalo, N. Y.	12,092	21,196
Charlotte, N. C.	1,718	1,949
Chicago, Ill.	77,278	156,694
Cincinnati, O.	19,196	33,283
Cleveland, O.	31,406	52,714
Dallas, Texas	2,016	8,303
Davenport, Iowa	473	921
Detroit, Mich.	36,535	62,871
Erie, Pa.	690	993
Greensboro, N. C.	562	562
Houston, Texas	2,106	4,365
Huntington, W. Va.	30	30
Indianapolis, Ind.	5,704	6,276
Jacksonville, Fla.	95	95
Kansas City, Mo.	4,549	5,098
Los Angeles, Calif.	60,407	137,332
Louisville, Ky.	2,042	5,161
Memphis, Tenn.	1,970	5,072
Miami, Fla.	2,800	3,643
Milwaukee, Wisc.	10,439	23,378
Minneapolis, Minn.	4,711	10,947
Nashville, Tenn.	58	113
Newark, N. J.	59,978	163,504
New Haven, Conn.	10,733	27,805
New Orleans, La.	1,691	5,674
New York City	152,619	425,648
Oklahoma City, Okla.	2,810	2,838
Omaha, Nebr.	1,109	1,146
Philadelphia, Pa.	75,222	204,461
Phoenix, Ariz.	22	22
Pittsburgh, Pa.	15,185	21,323
Portland, Ore.	425	559
Richmond, Va.	2,879	6,100
St. Louis, Mo.	12,944	29,196
St. Petersburg, Fla.	51	95
Salt Lake City, Utah	861	1,862
San Antonio, Texas	87	87
San Francisco, Calif.	7,897	20,194
Seattle, Wash.	2,591	7,160
Syracuse, N. Y.	2,196	4,599
Toledo, O.	7,378	13,008
Tulsa, Okla.	203	203
Washington, D. C.	22,709	53,305
Miscellaneous	—	5,961
TOTAL	742,166	1,706,372

Reported by RMA Companies

STOP DREAMING! START PLANNING.



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LATEST FIGURES show over 2,200,000 TV receivers now in use in the U. S. Twelve million sets are predicted by 1953, and practically every area of the nation will be within range of a TV station! Servicemen will have greatr and greater opportunities, and those servicemen with *specialized* Television and FM training will have greater and greater opportunities, and those of AM only—both in competing for jobs and in trying to make a go of their own repair businesses.

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SAMPLE LESSON FREE! **"Television and FM Trouble Shooting"**—this lesson is devoted to live, "dollar-and-cents", practical practice based on day-to-day servicing problems. Read this interesting lesson and see for yourself how CREI training can help you. Mail coupon for this sample lesson, free booklet and details.

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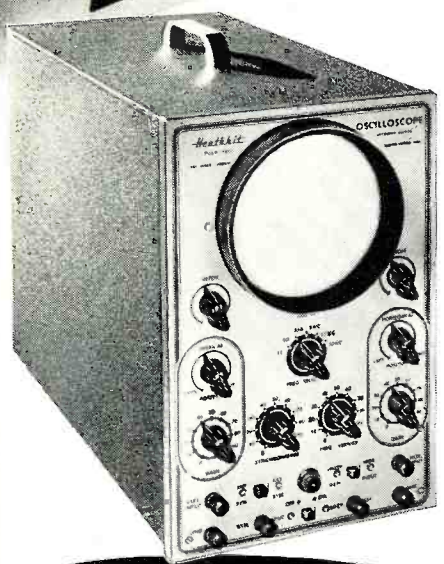

$39.50

New 1950 Heathkit

PUSH-PULL EXTENDED RANGE 5" OSCILLOSCOPE KIT

Features

- The first truly television oscilloscope.
- Tremendous sensitivity .06 Volt RMS per inch deflection.
- Push-pull *vertical and horizontal* amplifiers.
- Useful frequency range to 2½ Megacycles.
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- New television type multivibrator sweep generator.
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- Still the amazing price of $39.50.

The new 1950 Push-Pull 5" Oscilloscope has features that seem impossible in a $39.50 oscilloscope. Think of it—push-pull vertical and horizontal amplifiers with tremendous sensitivity only six one hundredths of a volt required for full inch of deflection. The weak impulses of television can be boosted to full size on the five inch screen. Traces you couldn't see before. Amazing frequency range clear useful response at 2½ Megacycles made possible by improved push-pull amplifiers. Only Heathkit Oscilloscopes have the frequency range required for television. New type multi-vibrator sweep generator with more than twice the frequency range. 15 cycles to 70,000 cycles will actually synchronize with 250,000 cycle signal. Dual positioning controls will move trace over any section of the screen for observation of any part. New magnetic alloy CR tube shield protects the instrument from outside fields. All the same high quality parts, cased electrostatically shielded power transformer, aluminum cabinet, all tubes and parts. New instruction manual now has complete step by step pictorials for easiest assembly. Shipping Weight 30 lbs. Order now for this winter's use.

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Features

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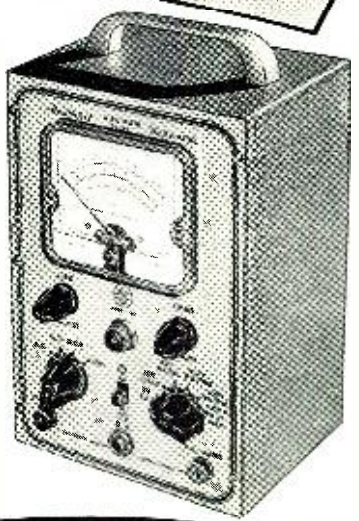
- Uses 1% precision ceramic divider resistors.
- Burn-out proof meter circuit.
- 24 complete ranges.
- Isolated probe for dynamic testing.
- Most beautiful VTVM in America.
- Accessory probes (extra) extend ranges to 10,000 Volts and 100 Megacycles.
- Modern push-pull electronic voltmeter circuit.
- Electronic AC circuit. No current drawing rectifiers.
- Shatterproof plastic meter face.



A new Model V-2 Heathkit VTVM with new 200 microampere meter four additional ranges—full scale linear ranges on both AC and DC of 0–3 V., 10 V., 30 V., 100 V., 300 V., and 1,000 V. Accessory probe listed elsewhere in ad extends voltage range to 3,000 and 10,000 volts D.C New model has greater sensitivity, stability and accuracy—still the highest quality features—shatterproof plastic full view meter face—automatic meter protection, push-pull electronic voltmeter circuit, linear scales—db. scale—ohmmeter measures 1/10 ohm to 1 billion ohms with internal battery—isolated DC test prod for dynamic measurements—11 megohm input resistance on DC—AC uses electronic rectification with 6H6 tube. All these features and at the amazing price of only $24.50. Comes complete with cabinet—panel—three tubes—new Mallory switches—test prods and leads, 1% ceramic divider resistors and all other parts. Complete instruction manual for assembly and use. Better start your laboratory with this precision instrument. Shipping weight 8 lbs. *Model V-2* .....

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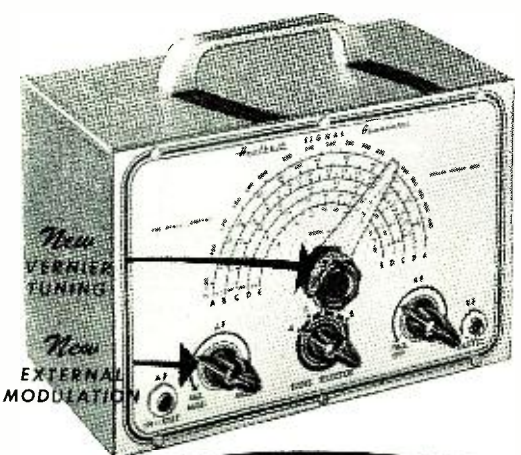
New 1950 VERNIER TUNING R.F. Heathkit SIGNAL GENERATOR KIT



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Features

- New 5 to 1 ratio vernier tuning for ease and accuracy.
- New external modulation switch—use it for fidelity testing.
- New precision coils for greater output.
- Cathode follower output for greatest stability.
- 400 cycle audio available for audio testing.
- Most modern type R.F. oscillator.
- Covers 150Kc. to 34Mc. on fundamentals and calibrated strong harmonics to 102 Mc.

The most popular signal generator kit has been vastly improved—the experience of thousands combined to give you the best. Check the features in this fine generator and consider the low price $19.50. A best buy for any shop, yet inexpensive enough for hobbyists. Everyone can have an accurate controlled source of R.F. signal voltage.

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CONVERSION KIT FOR G-1 GENERATORS

Conversion kit for G-1 generators for vernier tuning and external modulation includes new high band coil for greater output. Gives all the features of new G-5 listed above. Order G-5 Conversion Kit No. 316..... **$4.50**

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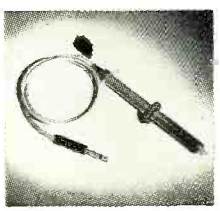
A LABORATORY INSTRUMENT NOW WITHIN THE PRICE RANGE OF ALL

Measures Inductance from 10 microhenries to 100 henries capacitance from .00001 MFD to 1000 MFD. Resistance from .01 ohms to 10 megohms. Dissipation factor from .001 to 1. "Q" from 1 to 1000.

Ideal for schools, laboratories, service shops, serious experimenters.

An impedance bridge for everyone — the most useful instrument of all, which heretofore has been out of the price range of serious experimentors and service shops. Now at the lowest price possible. All highest quality parts. General Radio main calibrated control. General Radio 1000 cycle hummer. Mallory ceramic switches with 60 degree indexing — 200 micro-amp zero center galvanometer — ½ of 1% ceramic non-inductive decade resistors. Professional type binding posts with standard ¾" centers. Beautiful birch cabinet Directly calibrated "Q" and dissipation factor scales. Ready calibrated capacity and inductance standards of *Silver* Mica, accurate to ½ of 1% and with dissipation factors of less than 30 parts in one million. Provisions on panel for external generator and detector. Measure all your unknowns the way laboratories do — with a bridge for accuracy and speed.

Internal 6 volt battery for resistance and hummer operation. Circuit utilizes Wheatstone, Hay and Maxwell circuits for different measurements. Supplied complete with every quality part — all calibrations completed and instruction manual for assembly and use. Deliveries are limited. Shipping weight, approximately 15 lbs.



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No. 310. Extends range of any 11 megohm VTVM to 3,000 and 10,000 Volt ranges. A necessity for television. Shipping Wt., 1 pound. **$4.50**

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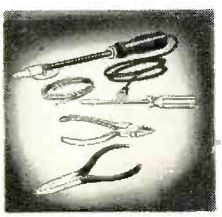
No. 309 Kit to assemble. R.F. probe extends VTVM range to 100 Mc. Complete with 1N34 crystal Ship. Wt., 1 lb. ... **$6.50**



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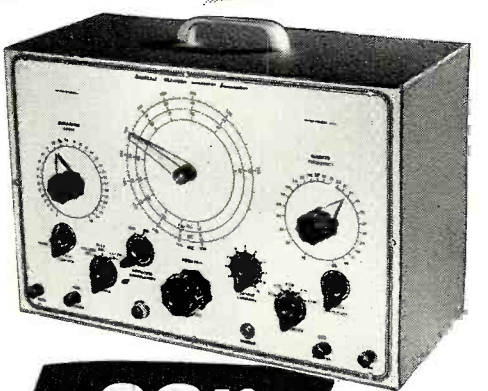
TOOL KIT

Now a complete tool kit to assemble your Heathkit. Consists of Krauter diagonal cutters and pointed nose assembly pliers, Xcelite screwdriver, 60 Watt 110V. soldering iron and supply of solder Shipping Wt., 2 lbs. Complete kit $5.95



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2. Has gear driven roller chart
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Check the features and you will realize that this Heathkit has all the features you want. Speed — simplicity — beauty — protection against obsolescence. The most modern type of tester — measures each element — beautiful Bad-Good scale, high quality meter — the best of parts — rugged oversize 110V. 60 cycle power transformer — finest of Mallory switches — Centralab controls — quality wood cabinet — complete set of sockets for all type tubes including blank spare for future types — fast action gear driven roller chart uses brass gears to quickly locate and set up any type tube. Simplified switching cuts necessary time to minimum and saves valuable service time. Short and open element check. No matter what arrangement of tube elements, the Heathkit flexible switching arrangement easily handles it. Order your Heathkit Tube Checker today. See for yourself that Heath again saves you ⅔ and yet retains all the quality — this tube checker will pay for itself in a few weeks — better build it now.

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Experimenters and servicemen working with a square wave for the first time invariably wonder why it was not introduced before. The characteristics of an amplifier can be determined in seconds compared to several hours of tedious plotting using older methods. Stage by stage, amplifier testing is as easy as signal tracing. The low distortion (less than 1%) and linear output (± one db.) make this Heathkit equal or superior to factory built equipment selling for three or four times its price. The circuit is the popular RC tuning circuit using a four gang variable condenser. Three ranges 20-200, 200-2,000, 2,000-20,000 cycles are provided by selector switch. Either sine or square waves instantly available at slide switch. All components are of highest quality, cased 110V. 60 cycle power transformer. Mallory F.P. filter condensers, 5 tubes, calibrated 2 color panel, grey crackle aluminum cabinet. The detailed instructions make assembly an interesting and instructive few hours. Shipping Wt., 13 lbs.

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BATTERY ELIMINATOR KIT

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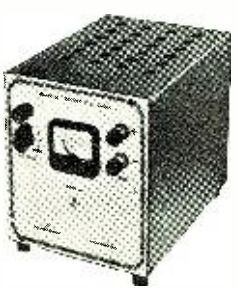

Now a bench 6 Volt power supply kit for all auto radio testing. Supplies 5 - 7½ Volts at 10 Amperes continuous or 15 Amperes intermittent. A well filtered rugged power supply uses heavy duty selenium rectifier, choke input filter with 4,000 MFD of electrolytic filter. 0 - 15 Volt meter indicates output. Output variable in eight steps. Excellent for demonstrating auto radios. Ideal for servicing — can be lowered to find sticky vibrators or stepped up to equivalent of generator overload — easily constructed in less than two hours. Complete in every respect. Shipping Wt., 18 lbs.

NEW Heathkit
SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

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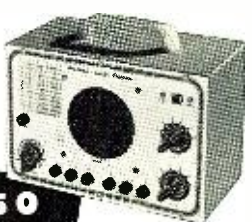

$19.50

The popular Heathkit signal tracer has now been combined with a universal test speaker at no increase in price. The same high quality tracer follows signal from antenna to speaker —locates intermittents—defective parts quicker—saves valuable service time—gives greater income per service hour. Works equally well on broadcast — FM or TV receivers. The test speaker has assortment of switching ranges to match push pull or single output impedance. Also test microphones, pickups — PA systems — comes complete — cabinet — 110V. 60 cycle power transformer — tubes, test probe, all parts and detailed instructions for assembly and use. Shipping Wt., 8 lbs.

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An electronic switch used with any oscilloscope provides two separately controllable traces on the screen. Each trace is controlled independently and the position of the traces may be varied. The input and output traces of an amplifier may be observed one beside the other or one directly over the other illustrating perfectly any change occurring in the amplifier. Distortion — phase shift and other defects show up instantly, 110V. 60 cycle transformer operated. Uses 5 tubes (1 6X5, 2 6SN7's, 2 6SJ7's). Has individual gain controls, positioning control and coarse and fine sweeping rate controls. The cabinet and panel match all other Heathkits. Every part supplied including detailed instructions for assembly and use. Shipping Wt., 11 lbs.

New Heathkit
FM TUNER KIT

CABINET EXTRA

$14.75

A truly fine FM Tuner with the coils ready wound, all alignment completed — all that is necessary is wiring and it's ready to play — uses super regenerative circuit — 110V. 60 cycle transformer operated — two gang tuning condenser — slide rule calibrated dial — two tubes — complete instructions including pictorial enable even beginners to build successfully. Shipping Wt., 4 lbs.

Beautiful mahogany cabinet for FM Tuner (shown above) extra $3.75

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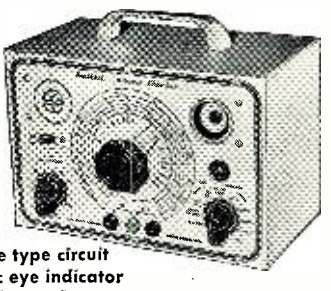
$19.50



Features

- Power factor scale
- Measures resistance
- Measures leakage
- Checks paper-mica-electrolytics
- Bridge type circuit
- Magic eye indicator
- 110 V. transformer operated
- All scales on panel

Checks all types of condensers, paper-mica-electrolytic-ceramic over a range of .00001 MFD to 1000 MFD. All on readable scales that are read direct from the panel. NO CHARTS OR MULTIPLIERS NECESSARY. A condenser checker anyone can read without a college education. A leakage test and polarizing voltage for 20 to 500 volts provided. Measures power factor of electrolytics between 0% and 50%. 110V. 60 cycle transformer operated complete with rectifier and magic eye tubes, cabinet, calibrated panel, test leads and all other parts. Clear detailed instructions for assembly and use. Why guess at the quality and capacity of a condenser when you can know for less than a twenty dollar bill. Shipping Wt., 7 lbs.

Heathkit
3-TUBE ALL WAVE RADIO KIT

$8.75

CABINET EXTRA

An ideal way to learn radio. This kit is complete ready to assemble, with tubes and all other parts. Operates from 110V AC. Simple, clear detailed instructions make this a good radio training course. Covers regular broadcasts and short wave bands. Plug-in coils. Regenerative circuit. Operates loud speaker. Shipping Wt., 3 lbs.

HS30 Headphones per set.....$1.00
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Mahogany Cabinet..... 2.95

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Build this high fidelity amplifier and save two-thirds of the cost. 110V. 60 cy. transformer operated. Push pull output using 1619 tubes (military type 6L6's), two amplifier stages using a dual triode (6SL7), as a phase inverter give this amplifier a linear reproduction equal to amplifiers selling for ten times this price. Every part supplied; punched and formed chassis, transformers (including quality output to 3-8 ohm voice coil), tubes, controls, and complete instructions. Add postage for 20 lbs.

12" PM Speakers for above....$6.95

Mahogany Speaker Cabinet, 14½" x 14½" x 8".....$8.75

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DM 35 12 VOLT DYNAMOTOR

NO. 274. New input 12 Volt at 18.7 Amperes. Supplies 675V at 275 MA or ½ above voltage from 6 volts. Excellent for auto use. Shipping Wgt. 11 lbs. Each **$7.50**

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NO. 230. Easily assembled 110V AC or DC ball bearing fully enclosed motor from Army surplus dynamotor. Purchaser to make simple changes and shaft extensions, detailed instructions and all parts supplied. Motor approximately 5,000 R.P.M. Ideal for tool-post grinder, flexible shaft tool, model drill press, saw. Shipping Weight 6 lbs. **$3.95**

COLLINS AUTOTUNE CONTROL HEAD

NO. 278. Brand new controls used on the ART/13, 100 Watt, Transmitter. Types 7, 8, 10, and 11 available. Get a spare while available as new cost is over $22.00 each. Shipping Wgt. 3 lbs. Price any type (mention when ordering). Each **$4.50**

300 MA SELENIUM RECTIFIERS

NO. 209. Rated 300 MA at 36 Volts, complete with mounting brackets. Shipping Wgt. 1 lb. 3 FOR $1.00

1N90 FEED THROUGH INSULATOR

NO. 276. Heavy duty feed through, 2" diameter 4" long, complete with brass hardware and gasket. Shipping Wgt. 2 lbs. 2 FOR **$1.00**

1N86 STRAIN INSULATOR

NO. 277. Husky army type 1¼" diameter, 5¼" long. Brown porcelain. Shipping Wgt. 4 lbs. 4 FOR **$1.00**

G.E. BC 306 ANTENNA TUNING UNIT

NO. 231. Matches any aerial to 150 Watt transmitter, used on BC 375. Brand new. Add postage for 20 lbs. **$2.95**

G. E. 1,000 VOLT 350 MA DYNAMOTOR

NO. 213. An ideal dynamotor for mobile operation in taxicabs, police cars, sound systems and amateur stations. Supplies above voltage from 12 Volts or 500V. at 350 MA from 6 Volts. Complete with starting relay, and fuses. New. Our Dynamotor A. Shipping Weight 72 lbs. **$5.95**

POWER TRANSFORMER *Specials*

NO. 226. Primary 117V. 60 cycle. Secondaries supply 746 V.CT at 220 MA, 6.3V. at 4.5 A., and 5V. at 4A. Will handle 13 tube radio receivers. Supply is limited, order early. Shipping Weight 11 lbs. each. **$3.95 . . 3 for $9.95**

T32 TABLE MICROPHONE

NO. 210. One of the Army's best. Built by Kellogg, ideal for factory call system, public address, amateur use. Brand new in original cartons. Add postage for 5 lbs. **$2.95**

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NO. 211. Tiny Delco motor only 1" x 1¼"x2" 10,000 RPM. Operates from 6 to 24 V. Excellent for models. Add postage for 1 lb. **$2.95**

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NO. 227. Push pull 6V6's to 6 - 8 ohm voice coil excellent characteristics, **3 for $1.95**

RCA SATURABLE REACTOR TRANSFORMER

NO. 246. New RCA No. CKV30531 AC current 750 MA DC current 2 Amperes. Rated 1.75 henries. Shipping wgt. 4 lbs. Each **$1.00**

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NO. 247. New cased 110 V 60 cy. Power Transformer. Supplies 440V Ct. at 60 MA, 6.3V at 2A. and 12.6V at 1 Amp. Excellent for military sets. Shipping Wght. 6 lbs. Each. **$1.95**

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NO. 248. Heavy duty RCA No CKV-30529. Input has primaries 600 to 200 and 25 ohms secondary 250,000 ohms C.T. Shipping Wgt. 2 lbs. Each **$1.00**

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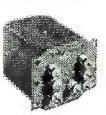


NO. 252. New cased 110V 60 cy. Power Transformer. Supplies 480V CT at 50 MA and 6.3 V at 2.1 Amps. A beautiful transformer. Shipping Wgt. 4 lbs. Each **$1.50**

MILITARY POWER TRANSFORMERS

NO. 229. Convert your military receivers without rewiring the filament. "A" type supplies 500 VCT at 50 MA, 5V. at 2A. and 24V. at ½ A. "B" type supplies 500 VCT at 50 MA, 5V. at 2A. and 12V. at 1 Amp. State whether A or B type desired. Shipping Weight 4 lbs. **$2.95**

WALKIE TALKIE TRANSFORMER

No. 744. Carbon microphone input transformer and output to headphone transformer, all in one case, excellent for building your own. Shipping Wt. 1 lb. **4 for $1.00**

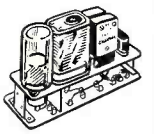
LOW PASS FILTER UNIT

No. 637. 3000 cycle cutoff consists of 3 inductances and 4 capacitors in network, 500 ohms in and out. Excellent for clipping all frequencies above 3000 cycles. Drawn steel case, shipping Wt. 5 lbs. **$2.50**

FM PUSH BUTTON TUNER

NO. 224. Brand new ten push button tuning assembly from Army FM receiver. Contains 4 gang 100 MMF silver plated tuning condenser. Add postage for 10 lbs. **$2.50** EACH

BC 746 TUNING UNIT



NO. 257. Plug in transmitter tuning unit from army Walkie Talkie. Contains antenna and tank coils, tuning condenser, transmitting and receiving crystals. Ideal transmitter foundation. Shipping Wgt. 1 lb. Each **$1.00**
(Same as above except transmitter crystal in 80 meter amateur band $2.50 each)

T30 THROAT MICROPHONE

NO. 258. Makes excellent contact microphone for musical instrument or vibration pick-up. Shipping Wgt. 1 lb. $1.00 each
Extension cord with switch for above $ .50 each

BC731 CONTROL BOX with Weston Model 476 AC Voltmeter

NO. 208. Excellent buy in motor control box. Size 8"x10"x5½". Contains Weston 0-150V. AC 3½" voltmeter, motor starting switch, 28 fuses all 30 Amp 110V. and 8 fuse holders. Fuses and holders alone worth the price. Shipping Weight 18 lbs. **$7.95**

METER SPECIAL

NO. 237. Brand new DeJur Model 312 0-800 M.A. D.C. Square 3" 0-10 M.A. basic meter with built in shunt. Probably the best buy ever offered in a surplus meter. Shipping Weight 1 lb. **$2.95**

HEARING AID HEADPHONES

NO. 216. The Army's best — eliminate flat ears and outside noise. Complete with transformer for conversion from low to high impedance. With cord and plug complete.
Add postage for 1 lb. **$1.00**

BC 451 CONTROL BOX

NO. 236. Control box for 274N transmitters. Contains proper cw voice switch, 4 channel switch, power switch, mike jack and telegraph key.
Add postage for 2 lbs. $1.95

100 MA FILTER CHOKE

No. 641. Heavy 1.5 henry choke in drawn steel case, 50 ohm resistance, conservatively rated at 100 MA. Shipping Wt. 1 lb. **50c**

FILAMENT TRANSFORMER

No. 922. 220V. 60 cy. primary supplies 12.6V. at 3.5 Amps, 15.6V at 1 Amp. Supplies 6.3 at 3.5 Amps and 7.8V. at 1. Amp from 110V. Shipping Wt. 8 lbs. $1.50

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Burlington O-300 VAC Meter
No. 290. Model 32XA 3½" round AC Voltmeter 0-300 VAC full scale. Scale also calibrated 0-600V. Bakelite case. A beautiful meter in original carton. Shipping Wt. $3.95

DRIVER TRANSFORMER

No. 651. Couples 3000 ohm plate to push pull parallel grids hermetically sealed. Ship. Wt. 1 lb. **$1.00**

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No. 745. Companion transformer to above driver. A push pull output, 3000 ohms to 3.2 ohm voice coil, or to 1250 ohms at 80 MA. A high quality cased unit. Shipping Wt. 2 pounds. $1.00

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DO YOU KNOW?

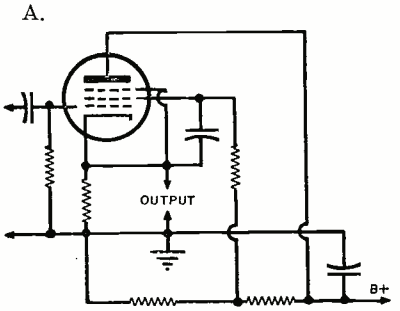
By DAVID SCOTT

113. What are the characteristics of a cathode follower circuit?

A. *A cathode follower circuit has no gain, inherent inverse feedback, or low output impedance, and one end of its output is at ground potential, making it very adaptable to coaxial cable circuits.*

114. Draw a simple schematic of a cathode follower circuit.

A.



115. How may noise factors be kept low in amplifier designs?

A. *Thermal noise and shot effect is kept at a minimum by using low values of coupling resistors and low-current tubes, especially in the first stage, or whenever the signal is less than ten millivolts.*

116. What is the purpose of deliberately using non-linear or distorting amplifiers?

A. *Distorting amplifiers are used to introduce changes to the over-all gamma of a picture and is done by varying the bias voltage to operate a different portion of the* I_p-E_g *curve.*

117. What are the three important considerations of coaxial cable?

A. *Coaxial cable considerations are: (1) Surge impedance; (2) attenuation-amplitude-frequency response, and (3) time delay-phase-frequency response.*

118. What is the bandwidth of a television channel?

A. *Six mc. includes the video and audio signals and their respective carriers and guard bands.*

119. What is the purpose of a single sideband transmission.

A. *With a normal double sideband transmission symmetrically disposed about the carrier, a frequency deviation of only 2.5 mc. on each side of the carrier would be practical with a 6 mc. channel width. By moving the carrier to within 1.25 mc. of the lower limit of the channel and shaving the lower sideband off, a frequency swing of 4.5 mc. is possible, thereby providing greater picture detail.*

120. What is meant by quasi-single or vestigial sideband transmission?

A. *A band elimination filter having too sharp cut-off characteristics would induce bad phase shifts. Therefore, the cut-off characteristic is tapered so that about 1.25 mc. of the lower sideband is left. This is called "quasi-single" or "vestigial" sideband transmission.*

121. How far may a television signal be transmitted?

A. *The effective range of a television signal is usually taken as the "line-of-sight" distance that can be seen from a transmitter antenna to receiver antenna. This is not a hard and fast rule, however, just a practical one.*

122. What is meant by carrier polarization?

A. *Polarization is the direction of the electric field relative to the earth's surface. Vertical antennas produce vertically polarized waves; horizontal antennas produce horizontally polarized waves.*

123. What is the effect on the impedance of an open circuit on a quarter-wave section of coaxial cable?

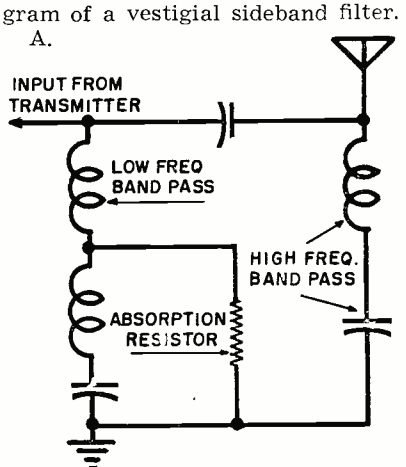
A. *If a quarter-wave section of coaxial cable is open circuited at the far end, it has very low impedance at the near end.*

124. What is the effect on the impedance of a short circuit on a quarter-wave section of coaxial cable?

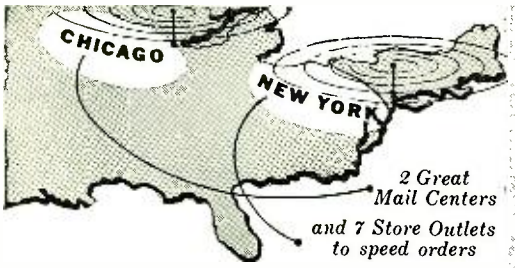
A. *If a quarter-wave section of coaxial cable is short-circuited at the far end, the near end impedance is very high.*

125. Draw a simple schematic diagram of a vestigial sideband filter.

A.



(To be continued)



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10" ALNICO PM SPEAKER

Fine performance at a new low in price. 10 watt cap. 6.8 oz. Alnico V magnet. Voice coil impedance of 3.4 ohms.

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Handles 14 to 18 watts with excellent sound quality. 6.8 oz. Alnico V magnet, 6-8 ohm voice coil. Ideal for use with FM receiver or P.A. system.

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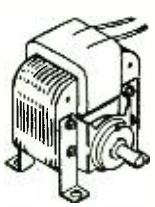
Rim-driven. 9" turntable. Constant speed (78 rpm), self-starting. 110 V., 60 cycles only.

No. 99N8003R (weight: 6 lbs.) **$2.25**



1/20 HP MOTOR

Many uses for this fine 1/20 hp motor. 2900 rpm. 115 v., 50-60 cycles, AC, 3¼" x 2¾" x 3½" high. Shaft ¼" dia., ¾" long.

No. 99N7079R (weight: 3 lbs.) **$3.89**

DELCO VOLUME CONTROLS

STOCK NO.	OHMS	PRICE EACH
99N2155R	50,000	24¢
99N2157R	100,000	24¢
99N2160R*	300,000	22¢
99N2161R	500,000	27¢
99N2162R	600,000	27¢
99N2165R	1 Megohm	27¢
99N2167R	2 Megohm	27¢
99N2168R	3 Megohm	27¢
99N2172R	500,000 tapped at 100,000	29¢
99N2174R*	500,000 tapped at 200,000	27¢
99N2176R	1 Megohm tapped at 100,000	29¢
99N2177R*	1 Megohm tapped at 200,000	27¢
99N2181R	SPST Snap-on Switch	8¢

*Will not take switch

Here's Value!

POWER TRANSFORMER

A real bargain! Single shell mtg. electrostatically shielded. Extruded shell for 2-hole mounting. Primary 117 V. 50/60 cycles. Secondary output: 600 V. CT at 50 mil, 6.3 V. at 2A, 5V. CT at 2A. Color-coded leads.

No. 99N5156R (weight: 3 lbs.) **$1.39**

NAME BRAND 6-VOLT VIBRATOR

Popular universal 4-prong vibrator—replaces the great majority of vibrators, including Mallory 294, 4-4, Radiart 5300, SO-1, Utah NP-42, Delco 5.040,000, 5,052,378 and Meissner EO1. Stock up and save!

No. 99N3950R (weight: 8 oz.) **98¢**

SOLAR TYPE DY ELECTROLYTIC CONDENSERS

25c each  **10 for $2.25**

STOCK NO.	CAP. MFD.	VOLTAGE
99N3486R	30+30+15/30	300/50
99N3445R	50+50/40	150/25
99N3475R	30+15+15+15	300
99N3452R	10+15/20	350/25
99N3492R	40+40/5/20	350/250/25

Special Buy!

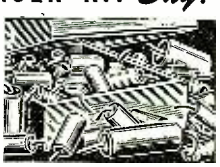
FILTER CHOKE

Excellent quality 25 Henry Filter Choke, 60 M.A., 200 ohms DC resistance. Unshielded, strap type mounting. Overall dimensions 2⅜" x 2" x 1⅝". Mtg. center 2⅞".

No. 99N5155R (weight: 8 oz.) **49¢**

CONDENSER KIT *Buy!*

Pick up 25 top quality tubular condensers for a song. Wax impregnated, non-inductively wound. From .002 mfd. to .5 mfd. Long, flexible pigtail leads. Meets RMA standards.



No. 99N278R (weight: 1½ lbs.) **97¢**

SNIP NOW—MAIL FOR FREE CATALOG

LAFAYETTE RADIO, Dept. RK-9
901 W. Jackson Blvd., Chicago 7
100 Sixth Avenue, New York 13

☐ Check here for FREE Catalog (Please don't check if you have already gotten your catalog.)

☐ Please fill attached order. I enclose $.....in postal note, money order or check. I am including shipping charges based on weight and zone.

NAME.....

ADDRESS.....

CITY ZONE STATE

What's New in Radio

ASTATIC BOOSTER

Heretofore a manufacturer of microphones, phonograph pickups, cartridges, and related equipment, *The Astatic Corporation* of Conneaut,

Ohio, has entered the television field with the production of a television booster utilizing four tubes.

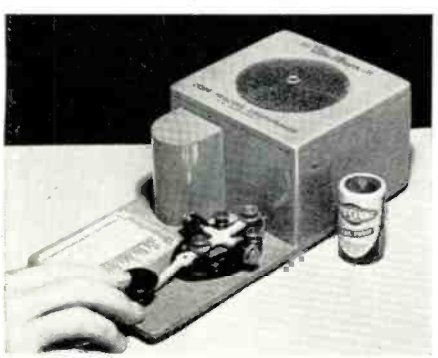
With high gain the principal feature of this Model AT-1 booster, coverage of all 12 television channels is attained without peaking or drop-off. Dual tuning controls that permit separate adjustment without sacrifice of signal quality are also said to minimize, or eliminate, interference by means of the added selectivity. Another aspect of the booster is the variable gain control preventing picture distortion when signal input is in excess of the amount required.

A self-contained power supply operates from 115 volt, 60 cycle a.c. power lines. The cabinet is in mahogany, with a furniture finish.

CODE PRACTICE SET

Intended for use by radio hobbyists, amateurs, and even professionals, a new type of telegraphic code practice set produced by the *Martin Manufacturing Company* uses only one 1½ volt flashlight cell.

Called the "Duplex Practicode," this set has a 4-inch PM speaker and is



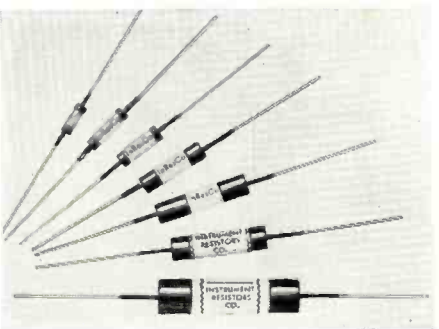
complete with a professional telegraph key and flashlight cell. It is portable and external terminals are included for long distance operation, so that as many as six sets may operate on one line.

Although it is priced at $8.95, it is not a toy and is absolutely safe for anyone to use. It generates an "easy-to-copy" tone, and its high volume is said to be comparable to the d.c. note obtainable from professional sets. Write the company at 194 Gelston Avenue, Brooklyn 9, N. Y., for information.

MIDGET RESISTORS

Special features of the *Instrument Resistors Company* midget size wirewound resistors are the enameled wire used, the special Bakelite form that eliminates shrinking, swelling and temperature effects, and the moisture and fungus proof coating.

The company, located at 1036 Commerce Avenue, Union, New Jersey, announced that its new resistors meet all requirements where precision resistance values and exceptionally



small size must be utilized at lowest cost. Although they are no larger than molded resistors, these Type IR units are wirewound to a standard tolerance of plus-minus 1 per-cent, and maintain this accuracy indefinitely.

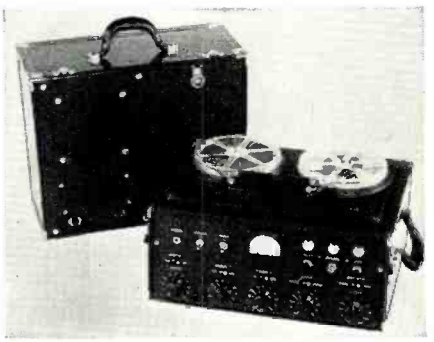
Complete details on the IR types (inductive) and the IRN types (non-inductive) can be obtained from the company.

COMMERCIAL TAPE RECORDINGS

Musical concerts, professionally recorded on magnetic tape, are now being produced by the *Amplifier Corporation of America,* 398-2 Broadway, New York, N. Y.

In conjunction with Vox and Polydor, *Amplifier Corp. of America* has secured exclusive rights to the finest transcriptions in the musical libraries of these prominent European studios. Special equipment designed by the company is used in copying.

Recordings of one hour duration are available for dual-track recorders, and half-hour recordings may be had for single-track units. To accommodate most of the tape units now in use, recordings are made at the standard RMA tape speed of 7½ inches per second.



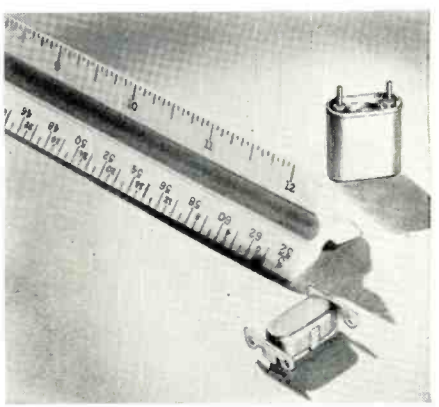
A catalogue of programs may be secured by writing to the company.

STEVENS THERMOSTATS

A positive operating thermostat, designed for precise control of low-wattage electrical circuits, is being produced by the *Stevens Manufacturing Company, Inc.,* Mansfield, Ohio.

Adapted for communications and electronic equipment and appliances, this unit may be utilized alone or in conjunction with disc type thermostats. A wide variety of terminal arrangements is in production, in many operating ranges up to a maximum of 600 degrees F. Temperatures as low as minus 60 degrees C. do not impair normal operation.

In the *Stevens* line, two styles are available: the standard, which is semi-sealed, and the type that is hermetically sealed in a metal enclosure.



All of the thermostats are pre-calibrated in pots, simulating actual service conditions before shipment.

MAGNASCREEN ENLARGER

A strong and light-weight plastic is the material used in the MAGNAscreen made by the Plastics Division of *Willson Camera Co.,* Philadelphia, Pa. This marks a new approach to the production of large-size images from television screens of nominal dimensions.

The MAGNAscreen, framed in mahogany or walnut, comes in three sizes, 8 by 10 inches, 9 by 12 inches, and 11 by 16½ inches. Weight of the largest size is less than 3 pounds, including frame and mounting brackets. To illustrate the principle, mounting the screen in front of a 10-inch screen, the image can be enlarged to the size of a 16-inch tube.

NEW TV TUBES

Recently the receiving tube division of *Raytheon Manufacturing Company*, 55 Chapel St., Newton 58, Mass., announced production of two tube types, the 1X2, a filament-type rectifier, and the 6BQ6GT, a beam pentode, for use in television receivers.

As a high-voltage rectifier in TV tubes or in r.f., fly-back, and power line frequency types of rectifier circuits, the 1X2, of miniature construction, can be utilized to advantage.

The 6BQ6GT is designed for use as a horizontal deflection amplifier. By employing a T-9 bulb and a standard octal base, space may be saved by use of the 6BQ6GT. The plate connection through a top cap allows for better isolation of the high plate voltage.

SEQUENCE SELECTOR

In line with the recent FCC u.h.f. allocations, the *Radio Craftsmen, Inc.*, 1617 S. Michigan Ave., Chicago, Ill., have designed a "Sequence Selector" which will permit the service technician to align a TV set to any of the new frequencies, as well as in any sequence or combination of u.h.f. or v.h.f.

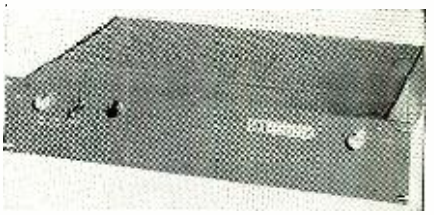
The device is one of the features of the *Craftsmen* RC-100 receiver now being produced as a solution to "fringe area" problems. This new model is suitable for custom installation in cabinets, or in wall panels.

When setting the converter, all the service technician need do is arrange a number of cartridges in the sequence desired by the set owner, without regard to the channel number of the station.

TRAVELING WAVE AMPLIFIER

A valuable tool to use in the field of nuclear physics and as an amplifier for wideband oscilloscopes is the Model 202P amplifier manufactured by the *Spencer-Kennedy Laboratories, Inc.*, 186 Massachusetts Ave., Cambridge 39, Mass. The regulated power supply has a gain of 20 db. with a bandwidth of 200 mc. and insures constant gain within 1 per-cent, plus or minus, for line voltage variations of plus or minus 10 per-cent.

The combination of a linear phase shift and rise time of .003 microseconds makes this chain amplifier ideal for radar, oscillography, and high speed pulse amplification. The stabilized gain and four volts output make it well adapted for use as a preamplifier for signal, sweep and pulse generators,



vacuum tube voltmeters, TV testing, and general laboratory measurements.

Chassis of the Model 202P is of lightweight aluminum, size 3½ by 19 by 11 inches, and it can be either rack or table mounted.

"PROSPECTOR" DETECTOR

Possessing both ruggedness and sensitivity for field operation, a uranium and radioactivity detector called the "Prospector," has been designed by the *Kelley-Koett Manufacturing Company,*

(*Continued on page* 124)

HALLICRAFTERS S-56 11 TUBE FM-AM CHASSIS $59.95

★ Wide Range Audio 50 to 14,000 C.P.S.
★ Automatic Frequency Control on F.M.
★ Input for Phono Pick-Up
★ Pre-selection on Broadcast Band
★ Latest Hallicrafters Production
★ In Original Factory Cartons
★ Regular $110.00 Dealers Net
★ Order Your S-56 with a P.M. Speaker

FM-AM HALLICRAFTERS S-56 NOW AVAILABLE AT McGEE $59.95

Model S-56 Hallicrafters, high fidelity, 11 tube AM-FM radio receiver chassis for broadcast and FM 88 to 108 mc. Automatic frequency control on FM, holds the receiver in perfect tune. Phono connection on rear of chassis. Full range tone control with bass boost. Push-pull 6K6 tubes in audio system. Frequency response essentially flat, from 50 to 14,000 CPS. Wide vision accurately calibrated slide rule dial, with pre-selection on broadcast band. Output transformer matches 500 ohm line. 4 antenna terminals; two for AM and two for FM. This is the finest type home radio that we know of today. Better get your order in early. Designed to be used in commercial radios selling in the **$400.00** to **$600.00** class. The regular dealers net on this chassis is **$110.00.** However, a lucky purchase enables us to offer these brand new, factory cartoned S-56 Hallicrafter chassis, complete with tubes and operation instructions, at only **$59.95,** less speaker. Speaker matching transformer 500 ohm to voice coil **$2.50** extra. Chassis size 12¾"x10"x7¾". Weight 25 lbs. Brand new factory cartoned. Buy your S-56's with a wide range PM speaker. Pick your combination from the prices listed below and save.

S-56 WITH 12" 21 OZ. P.M. $74.95

Hallicrafters S-56 chassis with tubes, 500 ohm to speaker matching transformer and our model A-50 super heavy duty 12 inch 21 oz. Alnico V PM speaker (regular $50.00 list). This gives you the complete radio for custom installations. Shipping weight 38 lbs. Stock No. S-56A50: A-50 Speaker S-56 and transformer all for **$74.95.**
G.I. Dual Speed Changer Stock No. GI-73 **$17.95** extra.

S-56 WITH 12" COAXIAL P.M. $71.95

Hallicrafters S-56 chassis with tubes, 500 ohm to speaker matching transformer and our model CR-13X 12 inch coaxial PM wide range speaker. This gives you a complete radio for custom installations. Shipping weight 33 lbs. Stock No. S-56CR13X: CR-13X speaker S-56 and transformer all for **$71.95.**
G.I. Dual Speed Changer Stock No. GI-73 **$17.95** extra.

S-56 WITH 15" JENSEN P.M. $79.95

Hallicrafters S-56 chassis with tubes, 500 ohm to speaker matching transformer and model A-15 PM Jensen 15 inch 6 lb. magnet speaker. This gives you a complete radio for custom installations. Shipping weight 47 lbs. Stock No. S-56A15PM. Jensen Speaker S-56 and transformer all for **$79.95.**
G.I. Dual Speed Changer Stock No. GI-73 **$17.95** extra.

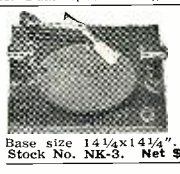
WEBSTER CHICAGO 77-1 NET $17.88

WEBSTER CHICAGO MODEL 356 NET $33.59

Webster Chicago Model 356 3-Speed Automatic Record Changer. Plays all records automatically. Tendon Tip needle with quick change lever. This is the finest 3-Speed Changer on the market. Net **$33.51.**
Webster Chicago 77-1. Plays 7" records either 33⅓ or 45 RPM automatically. Base size 10⅛ x 7 5/16 x3½ above and 3 5/16 below. Net **$17.88.** Spiders for RCA records 10 for **25c.**

G.I. DUAL SPEED CHANGER WHEN PURCHASED WITH S-56 OR S-59 $17.95

General Instrument Dual speed automatic record changer plays 10—12" or 12—10" 33⅓ or 78 RPM records automatically. Latest model with astatic reversible cartridge and Permanent needle. While our stock lasts we offer this changer, Stock #GI-73 for only **$17.95** when purchased with S-56 or S-59 Hallicrafters or **$19.95** when purchased by itself. Weight 11 lbs.



CAPEHART CHANGER SCOOP $6.95

While our stock lasts we offer these Capehart changers for only $6.95 each. Plays 10-12" or 12-10" records automatically. These changers are in good condition, but have been removed from sets to make way for 3 speed changers. They need adjusting, however, you service men with a little ingenuity can put them to profitable use. These changers are equipped with True Timber Variable Resistance Cartridge with permanent needle. (Requires same gain as G.E. Variable Reluctance.) Connecting instructions furnished. Base size 14¼x14¼". Shipping weight 23 lbs. Extra pick up arm with Standard Crystal Cartridge $1.00 extra. Stock No. NK-3. **Net $6.95 each. 2 for $12.95.**

TAKE YOUR PICK OF THESE CHANGERS $12.95

VM-400 $12.95

VM-400 INTER-MIXES 10" and 12" records. Base size 12½ x 13". This changer is second to none. Original sale price **$25.00.** Net Price **$12.95;** two for **$25.00.** 78 RPM. Weight 14 lbs.

CRESCENT 350 $12.95

CRESCENT Model 350 with Astatic L-70 cartridge. Plays 10-12", or 12-10" records at 78 RPM. Base size 11½ x 13". Net Price **$12.95.** two for **$25.00.** A red hot changer value. Weight 14 lbs.

FARNSWORTH $12.95

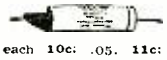
FARNSWORTH, triple post changer, with Caltron V.R. cartridge; as used on top price radios. Shuts off on last record. Base size 12 x 14½". 78 RPM. Net Price **$12.95;** two for **$25.00.** Weight 18 lbs.

STEWART-WARNER

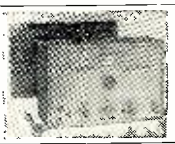
AERO—Made for STEWART-WARNER. Plays 10-12", or 12-10" records at 78 RPM. With Webster swivel-action cartridge and permanent needle. Base size 12¼ x 13½". Net Price **$12.95;** two for **$25.00.** Weight 12 lbs.

MADE TO FIT LEATHERETTE COVERED BASES. May Be Ordered with Any Changer Advertised. Only $1.95

PLASTIC BY-PASSES



SOLAR OR EQUAL—Tubular By-Passes. All plastic and branded—600 volt rated. .001, .002, .005. .01. .02, each **10c**: .05. **11c**: .1. **12c.**



$50.00 Value G.E. YGA-4 Audio Oscillator. 25 to 16,000 CPS. While they last. Weight 30 pounds **$19.95.**

WEBSTER-56 $14.95

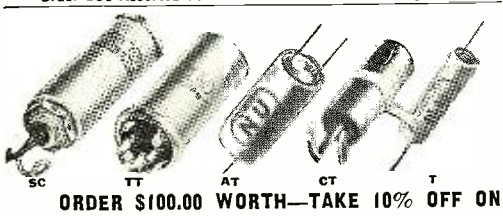
Webster Chicago Model 56. Without a doubt one of the best 78 RPM Record Changers. On the market while our limited stock lasts. Weight 18 lbs. **$14.95** each.
Detrola Utah. This Changer is small, easy to service and used on innumerable original equipment sets. Weight 12 lbs. Net **$12.95.** Two for **$25.00.**

General Industries Recording heavy duty phono motor with T.T. 78 RPM Scoop price **$5.95**
Deluxe quality 78 RPM phono motor with T.T. **$2.95**
Dual speed phono motor 33⅓ or 78. Reg. $11.00 list. scoop price. . **$4.95**
Dual speed phono motor 33⅓ or 78. Reg. $11.00 list, scoop price. **$4.95**

SOLAR METAL F.P. CONDENSERS
POPULAR TWIST MOUNTING IN ALUMINUM CANS

8 Mfd. 450 volt FP condenser . . . **29c**	25-25 Mfd. 25v FP. **19c**
16 Mfd. 450 volt FP condenser . . . **34c**	40 150v, 20 25v FP. **15c**
20 Mfd. 450 volt FP condenser . . . **39c**	40-40 Mfd. 150v FP. **29c**
30 Mfd. 450 volt FP condenser . . . **39c**	24-16 Mfd. 350v. **39c**
20 Mfd. 525 volt FP cond. Special **49c**	20-10 350v 20 25v. **39c**
30 450v, 20 25v FP. **39c**	15-15 450v 20 25v. **59c**
40 250v, 20 25v FP. **19c**	40-40 Mfd. 450v. **59c**

Order 100 Assorted Solar Condensers and Take 10% Discount from Above Prices.



SC TT AT CT T

NATIONAL UNION CLOSE-OUT SALE

ORDER $100.00 WORTH—TAKE 10% OFF ON N.U. COND.

NATIONAL UNION TYPE AT AND CT—ALL FRESH STOCK AND BOXED—1 YEAR GUARANTEE

10 MFD. 25v. **15c**	50 MFD. 150v. **35c**	40-20 150v. . . . **35c**
25 MFD. 25v. **20c**	80 MFD. 150v. **35c**	16 MFD. 450v. **40c**	50-30 150v.. **50c**
100 MFD. 25v. **25c**	8x 8 450v. **40c**	30 MFD. 450v. **50c**	80-40 150v.. **60c**
24 MFD. 150v. **30c**	16x16 450v. **50c**	20-20 150v. . . . **30c**	20-20 450v. . . . **60c**

NATIONAL UNION ALUMINUM CAN "TWIST TAB" TYPE TT

National Union Type TT Electrolytic Condensers. Aluminum can F.P. type Twist Tab mounting common negative grounded to case. **Individually cartoned in green N.U. boxes.** Each condenser supplied with 1 bakelite insulating plate and 1 metal grounding plate. Save over half on these. All sizes and one-year guarantee.

100 MFD. 25v. . . **19c**	40-20 MFD. 150v. **35c**	40-40, 150v., 25 MFD. 25v. . . **40c**
500 MFD. 25v. . . **19c**	40-40 MFD. 150v. **40c**	40-40-20 MFD. 150v. **60c**
10 MFD. 450v. . . **25c**	50-50 MFD. 150v. **50c**	40-40-40 MFD. 150v. **60c**
20 MFD. 450v. . . **30c**	80-40 MFD. 150v. **60c**	80-40, 150v., 25 MFD. 25v. . . **60c**
30 MFD. 450v. . . **40c**	10-10 MFD. 450v. **40c**	10-10, 450v., 20 MFD. 25v. . . **50c**
40 MFD. 450v. . . **50c**	16-16 MFD. 450v. **45c**	10-10-10, 450v., 20-25v. **70c**
80 MFD. 450v. . . **60c**	40-40 MFD. 450v. **60c**	10-10-10-10, 450v. **70c**
20-20 MFD. 150v. **30c**	20-20-20 450v. **65c**	

N.U. THREAD MOUNT ALUMINUM CAN TYPE SC

National Union Type SC-SCN-SCS Upright Aluminum Can Condensers. With pal nut mounting. Flexible insulated leads. Individually cartoned in green N.U. boxes. Save over half on this. One-year guarantee.

4 MFD. 450v. **25c**	8x 8 450v. . . **50c**
8 MFD. 450v. **30c**	16x16 450v. . . **60c**
16 MFD. 450v. **35c**	20x20 450v. . . **70c**
40 MFD. 450v. **50c**	

100-600V. BY-PASSES, $6.95
MAKE YOUR OWN ASSORTMENT

T .0001, T .00025, T .0005, T .001, T .002, T .005, T .006—**5c** Each.
T .02, T .03, T .04—**6c** Each.
T .05—7c Each; T .1—8c Each.
T .25—**10½c** Each; T .5—**15c** Each.

N.U. CONTROLS 100 for $29.25

Individually cartoned volume controls, all have off-on switch attached.

NU	5M-A	5,000 OHM	**24c**
NU	10M-B	10,000 OHM	**24c**
NU	25M-A	25,000 OHM	**24c**
NU	50M-B	50,000 OHM	**29c**
NU	100M-B	100,000 OHM	**29c**
NU	250M-TX	250,000 OHM Tapped	**29c**
NU	500M-TX	500,000 OHM Tapped	**39c**
NU	1 MEG-TX	1 MEG OHM Tapped	**39c**
NU	2 MEG-TX	2 MEG OHM Tapped	**39c**
NU-500M-CB		500,000 OHM	**39c**

100 National Union Controls **$29.95.** Assorted as follows: 25 of the 1st 3 Types, 25 of the 2nd 3 Types, and 50 of the last 4 Types.

100 RADIO TUBES $29.95

250,000 Tubes for fast sale. Tremendous value. Tubes up to $3.00 list. 100 Cartoned and branded Hyvac Miniature Tubes for $29.95. Over a million sold. Guaranteed full replacement. 34c Each in smaller quantities.

1R5	12BE6	12AU6	6SU7	12S8		
1T4	12AT6	12BF6	6AQ5	9001		
1U5	35W4	6BA6	6AQ6	9002	6BA7	**$29.95**
3A4	35B5	6BE6	6C4	6BH6	6BJ6	
1S5	50B5	6AT6	6X4	117Z3	35C5	**for 100**
3V4	12AT7	6AL5	6W4	19T8		
3Q4	12AU7	6AQ5	6AG5	6BJ6		**34c each**
3S4	12AX7	6BF6	6AU6	6AT6		
12BA6	12BA7	6AU7	6T8			

Popular GT Tubes, individually cartoned and branded Hyvacs. $35.00 per hundred. 39c Each in smaller quantities.

6V6	6X5	6SK7	12SF7	12SN7	32L7	**39c each**
6SN7	6SD7	6SQ7	6J5	12BF7	6BG6	
6C5	5Y3	25L6	6SJ7	6SL7	6SU7	**100 for $35.00**
6P5	6K7	70L7	12SJ7	35Z5		
12A8	5Y3	1B4	6SF5			**HYVAC 6AK5 6SN7 6J6 59c EACH**
1S8	6K6	12K8	80			
12S8	6SA7	12A6				

HYVAC—12SA7GT, 12SK7GT, 12SQ7GT, 35L6GT, 50L6GT, 39c each. These types are more costly and cannot be included in the 100 for **$35.00** deal. They net you **39c** each.

STANDARD BRAND TUBES CARTONED and UNCARTONED 49c

0Z4G	1G6	5V4	6F7	6SA7	6T7	7B8	7S7	12F5	12SQ7	26	43	6BE6
1A4	1H6	5Y3	6H6	6SC7	6V6	7C4	7V7	12H6	12SR7	27	45Z5	50Y5
1A6	1J6	6A3	6J5	6SD7	6X5	7C5	7Y4	12J5	12Z3	30	50B5	41
1B4	1L4	6AB7	6J7	6SF5	6Y6	7C6	7Z4	12K8	14A7	32	56	35B5
1B5	1R5	6AC7	6K5	6SF7	6Z7	7C7	10Y	12Q7	14B6	33	57	3Q4
1C6	1S5	6AG7	6K6	6SG7	6ZY5	7E5	12A6	12SC7	14C7	34	58	14A4
1C7	1T4	6B8	6K7	6SH7	7A4	7E7	12A8	12SF5	14H7	35	7UL7	12J7
1D5	1V	6C4	6K8	6SJ7	7A5	7F7	12AH7	12SF7	14Q7	35W4	75	6AT6
1D7	2A5	6C5	6L5	6SK7	7A6	7H7	12AT6	12SG7	14R7	35Y4	76	6BA6
1D8	2A6	6C6	6L7	6SL7	7A7	7L7	12BA6	12SH7	19	35Z4	77	
1F4	2A7	6D6	6N7	6SQ7	7B4	7N7	12BD6	12SJ7	25L6	35Z5	78	
1F5	3S4	6D8	6R7	6SR7	7B5	7Q7	12BE6	12SL7	25Z5	38	80	
1G4	5T4	6F5	6S7	6SS7	7B6	7R7	12C8	12SN7	25Z6	39		

NAME BRAND 1½ VOLT LOCTALS, ETC.

1LN5	1LD5	1LH4	1LC6	1LA6	1LB4	
1LC5	1LG5	3LF4	1LE3	1LA4	—	69c
1A7	1H5	1A5	1N5	3Q5	1T5	
1Q5	1P5	1C5	1G4	1G6	117Z6	69c

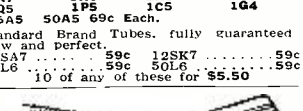
10 for $6.50

35A5 **50A5 69c Each.**

Standard Brand Tubes, fully guaranteed New and perfect.

12SA7	59c	12SK7	59c
35L6	59c	50L6	59c

10 of any of these for **$5.50**



Astatic Light Weight Pick Up. Less than one ounce pressure with 4V, L-82 Cartridge, **$2.29.**
Same as above only with 1 Volt, L-70 Cartridge, Net **$1.99.**
Webster light weight Arm (Stamped) with 4 Volt Cartridge. Net **$1.95.**
Webster Plastic Arm with 3 Volt Cartridge **$1.95.**
Micro Groove Arm with 1 Mill Needle **$3.95.**

PHILCO MIKE SALE BRAND NEW WITH 20 FT. OF CABLE

$9.95 605 $14.95 630 $14.95 VI

High imp. dynamic mike made for Philco 605, 20 ft. cable. Reg. **$26.00** list. Sale price **$9.95.** 3 for. **$26.95**

High imp. dynamic mike made for Philco 630, 20 ft. cable. Reg. **$36.50** list. Sale price **$14.95.** 3 for. **$41.95**

High imp. studio velocity. Made for Philco VI, 20 ft. cable. Reg. **$40.00** list. Sale price **$14.95.** 3 for. **$41.95**

McGEE RADIO COMPANY

Prices F.O.B. K.C. Send 25% Deposit with Order, Balance sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

"COAXIAL" 12 INCH SPEAKER $12.95

ALNICO V MAGNETS

RESPONSE 40-17000 C.P.S.

Molded High Fidelity Cone

Nationally Famous Maker

12 and 15 INCH SIZES

REGULAR $32.50 LIST

12-INCH COAXIAL SPEAKER MODEL CR-13X

Newly designed by one of America's finest speaker builders. Made for FM and AM high fidelity radios and record players. This speaker is incorporated in radios of the 500 dollar bracket. It has an especially designed 12" 6.8 oz. Alnico V Magnet PM for the low range Woofer and a coaxially built in 3" Alnico V tweeter for the extended high range. The high pass filter is concealed under the pot cover. Just hook to any 8 Ohm output transformer. Will work in place of any home radio speaker as most speakers have an 8 Ohm Voice Coil, only 2 wires to connect. Will handle 18 Watts peak. Wide range response 40 to 17,000 Cycles. This speaker should sell for $35.00. Why buy any ordinary speaker when we offer a 12" Coaxial PM for only $12.95. Shipping weight 8 lbs. **Model CR-13X, $12.95.** Two for.....**$24.95**

12 INCH COAXIAL SPEAKER MODEL CR-13X $12.95

15 INCH KING COAXIAL MODEL 5-15X $24.95

15 INCH KING COAXIAL — SALE PRICE $24.95

"IT WOOFS AS IT TWEETS"

The King Coax. A 21.5 oz. 15 inch Alnico V PM speaker with a built-in high frequency tweeter. Will respond to from 50 to 12,000 cycles. This is a ruggedly built speaker with a curvilinear one piece molded cone. Built-in high pass filter. Just hook to any 8 ohm output. Built by the maker of our ever popular 12 inch coax model CR-13X. This speaker has a retail list of over $60.00. We offer you our 5-15X 15 inch coax for only **$24.95. Shipping weight 16 lbs.**

HIGH FIDELITY OUTPUT TRANSFORMER $6.95

Why not order with one of the above speakers?

6600 OHMS PLATE TO PLATE

Why pay $20.00 or $30.00 for an output? Supreme quality and high fidelity output transformer. Designed to match push-pull plates (2—6L6, 2—6V6, or 2—6AQ5) class AB, to 4-8-15-250 and 500 ohms; with 10% feedback winding. Housed in a compound filled case: 3⅞x4½x3". Actual net weight, 6 lbs. If you want the best quality from your audio system, order this transformer. Response essentially flat from 20 to 20,000 cycles. We have tried several high fidelity outputs in our lab and find this to be the best value. Even though your amplifier only puts out 10 or 15 watts, this 34 watt job is what you should have. Connecting instructions are furnished. Stock No. A-403, shipping weight 8 lbs. Net price.....**$6.95**

40 WATT CAPEHART HIGH FIDELITY

OUTPUT TRANSFORMER $7.95

Stancor built for Capehart for this finest combination. 40 watt capacity all windings interwound to increase high frequency response and decrease capacity losses. High inductance in coils makes for best efficiency at low audio frequency. This high fidelity output transformer is fully shielded and has a net weight of 6 lbs. Made to match push pull 6L6 tubes 5,000 ohm plate to plate. Has tertiary winding for 10% feed back and voice coil windings of 4 and 8 ohms. Frequency response plus or minus 2 DB from 30 to 15,000 cycles. Down 6DB below 20 cycles and above 20,000 cycles. Furnished with connecting instructions. Size 3½x4½x3⅞ all. Shipping weight 8 lbs. Stock No. SX-55, net.....**$7.95**

3000 SPEAKERS
450 OHM FIELD WITH P.P. 6K6 OUTPUTS

HERE'S THE GREATEST SPEAKER VALUE EVER

10" 450 ohm, with P.P. 6K6 output.....**$1.99**

8" 450 ohm, with P.P. 6K6 output.....**1.99**

6x9" 450 ohm with P.P. 6K6 output.....**1.99**

All factory cartoned. **$1.99** each or buy 10 assorted for **$18.50.** These speakers produced for Majestic by Utah Celtron and Carbonama. Buy for less than half of the factory cost.

POPULAR FIELD COIL SPEAKERS

5" Utah 450 ohm speaker, with output for 50L6. This is a quality 5" speaker. Has full size coil and humbucking coil. A real special.....**$1.49**

4x6" 450 OHM OPERADIO

4x6". 450 ohm speaker, made by Operadio. Special, only.....**99c**

12" DYNAMIC BARGAINS

12" 450 ohm field speaker.....**$2.49**
12" 210 ohm field speaker.....**2.49**
12" 800 ohm field speaker.....**2.49**

Some have outputs. All are fine speakers by Magnavox, Operadio, Oxford, etc. Hottest special ever offered, each.....**$2.49**

CHOKES FOR RECEIVERS

50 MA., AC-DC Choke. Special.....**39c**
75 MA., AC-DC Choke. Special.....**49c**
150 MA. Choke, fully shielded, 8 henry. Special.....**98c**

Push-Pull 6L6's—5,000 Ohm Output Transformers, Fully Shielded

1¼" core. Hi-Fi Output. Made for Capehart's best sets. Weighs 4 pounds. P.P. **6L6's to 8 ohm voice coil.....$2.95**

HEAVY DUTY P.M. SPEAKERS

IDEAL FOR AUTO SET REPLACEMENTS

6" square 3.16 oz. Alnico V magnet.**$2.29**
7" square 3.16 oz. Alnico V magnet. **2.49**
6x9" 3.16 oz. Alnico V magnet.....**2.49**
8" square 3.16 oz. Alnico V magnet. **2.98**

All late production, not surplus. All have ¾" voice coils and are made with a small square back to mount in any set.

5½" UTAH and output

5½" Utah PM, with 3Q5 output. Made for the famous overseas Zenith. Made with a 3 oz. magnet. A buy for only....**$1.95**

6½" QUAM and output

6½" Quam PM speaker. 2.15 oz. Alnico V, with 50L6 output transformer. A $4.00 value. Special, only.....**$1.95**

6" G.E. PM and output

6" G.E. PM speaker. 3 oz. Alnico V magnet, with 8000 ohm output transformer. A $5.00 value. A honey for.....**$2.49**

Here's a sizzler. 8" Utah PM, with 4.64 oz. Alnico V magnet and 1" voice coil. A $5.00 wholesale value. Special....**$2.98**

FAMOUS 12" MAGNAVOX

Famous 12" Magnavox PM speaker. 21 oz. Alnico 3, heavy seamless cone. We have sold 10,000 of this fine speaker. Only 800. Very special. **$4.95;** 5 for.....**$22.95**

1,500 6½" OPERADIO

6½" Operadio PM speaker. 1.47 Alnico V magnet. We have 1500 of this beautiful speaker. Fully dust proofed. 6½" PM made by Operadio. 1.47 oz. Alnico V PM. Buy a load at this unheard-of price. Each, **$1.29;** 10 for only.....**$12.00**

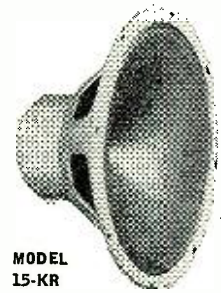
6" OXFORD and output

6" square Oxford. 1.5 oz. magnet, with P.P. output. Special, each.....**$ 1.79**
20 to a carton. Buy 20 for only....**17.00**

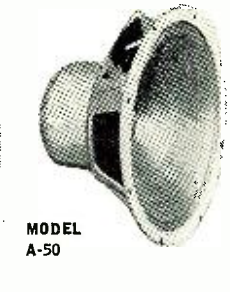
10" OXFORD PM SPEAKER

10" Oxford PM speaker. 7 oz. Alnico V magnet. **Special, half price.....$3.49**

MODEL 15-LS
15" 50 WATT P.M.
$16.95



MODEL 15-KR
15" JUKE BOX
$9.95



MODEL A-50
12" 50 WATT P.M.
$14.95

15 INCH DELUXE 50 WATT P.M. $16.95

Model 15-LS. 15" 21½ oz. Alnico V Magnet PM Speaker. Will take 35 watts with ease. Thousands of dollars were spent in building the fine tools to produce this speaker. The 8 ohm voice coil is 1½" in diameter and has been heat treated and plastic coated. Constructed to eliminate loose voice coils, wires and warping. Made by a renowned builder of fine speakers. Truly the King of juke box speakers. Shipping weight 14 lbs. Net Price **$16.95.** Two for.....**$32.95**

15 INCH "JUKE BOX" P.M. ONLY $9.95

Model 15-KR—Pre-War or Post-War, you never bought a speaker like this for such a scoop price. Made by a nationally known builder of fine speakers. A full 15" 12½ oz. Alnico V magnet speaker of juke box quality. Has standard 8 ohm voice coil. Will take up to 18 watts average or 25 watts peak. Here is a speaker that will bring out those low notes. Latest 1948 production; not line through-outs. Every speaker is guaranteed new and perfect. We may not be able to continue this offer for long, so place your order now. Stock No. 15-KR. INCLUDE POSTAGE. Wt. 10 lbs. **A $35.00 value for only....$9.95**

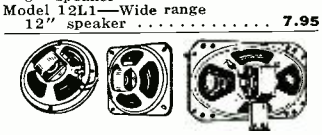
12 INCH 50 WATT SUPER HEAVY DUTY P.M. $14.95

Model A-50—12", 50 watt super heavy duty permanent magnet speaker. Has 1½" 8 ohm treated voice coil and one piece molded cone. Heavy half inch machined nut, with bolt secured **21 oz. Alnico V magnet. Frame is of heavy construction with metal pot cover.** Finished in silver-grey enamel. This speaker is the best value possible today. Efficiency is two to three times that of ordinary speaker. Especially recommended for all public address systems and high quality home audio systems. Will handle 35 watts with ease and 50 watts peak or short lengths of time. Its retail value is $50.00. But, by our large purchase, we are able to offer it to you for only **$14.95.** Do not confuse this speaker with surplus merchandise. This is the latest production. Model A-50. Shipping weight 13 lbs. Net **$14.95.** 2 for.....**$29.00**

12" WIDE RANGE P.M. SPEAKER $7.95

Wide range 6.8 oz. Alnico V PM speakers. Curvilinear molded cones with 1¼" 8-ohm voice coils. Offered in 6-, 8- and 12-inch sizes. Response from 60 to 10,000 c.p.s. Top quality by a nationally known maker.

Model 6-L1—Wide range 6" speaker.....**$4.95**
Model 8-L1—Wide range 8" speaker.....**5.95**
Model 12L1—Wide range 12" speaker.....**7.95**



SMALL SPEAKERS, NEAR MANUFACTURER'S COST

3½" 1 oz. magnet PM speaker.....**$0.99**
4" 1 oz. magnet PM speaker.....**.99**
4x6" 1 oz. magnet PM speaker.....**1.29**
5" 1 oz. magnet PM speaker.....**.99**

These speakers are all late production. Made for us by one of America's biggest speaker manufacturers. Packed 30 to the case. Order case lots. Deduct 5c for each speaker ordered.

BIG BARGAINS IN 4 OHM AUTO SPEAKERS

4" 4 ohm field speaker.....**$1.49**
5" 4 ohm field speaker.....**1.49**
6" 4 ohm field speaker, square.....**1.49**
6½" 4 ohm field speaker, round.....**1.49**
7" 4 ohm square. Philco Motorola.**1.98**
8" 4 ohm field speaker.....**1.98**

Made by Magnavox and Cinaudagraph.

SPECIAL AUTO SPEAKERS

5½". 4 ohm auto speaker, made by Magnavox. Fits some Motorola sets. A real hot number. Special, only.....**99c**

6x9" Magnavox. 4 ohm heavy duty auto speaker. Original equipment for General Motors auto radios. Special.....**$1.95**

5,000 4" AND 5" PM'S

5,000 4 and 5" PM's. 1 oz. Alnico V with mounting bracket. When McGee buys a bargain, so can you. Made by Permaflux. All brand new factory cartoned. Every speaker guaranteed perfect. Buy yourself a good supply at manufacturer's cost. Only 5,000 to sell, each.....**$0.89**
Buy 10 assorted speakers, 10 for... **8.50**

SALE ON OUTPUTS

Regular Universal Output Transformers

2,000-14,000 ohms to voice coil.
4 watt, universal output.**$0.79**
8 watt, universal output. **.99**
12 watt, universal output. **1.19**

Special Push-Pull Output Transformers

Small ½" push-pull, for 50L6.....**49c**
¾" push-pull trans., for 6K6.....**59c**
¾" push-pull trans., for 6V6.....**59c**

Small Equipment Output Transformers

2,000 ohm, for 50L6 output.....**$0.39**
5,000 ohm, for 6V6 output.....**.39**
10,000 ohm, for 3Q5 output.....**.39**
Assortment of 10 of these trans....**3.50**

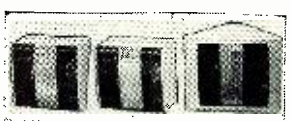
Push-Pull 6L6 Output Transformers!!!!

Special chrome plated, fully shielded heavy output transformer, for push-pull 6L6's. Made for Scott. A real $5.00 value. Your net price only.....**$2.95**

CONSOLE BASS REFLEX SPEAKER BAFFLE $19.95

6 Cubic Foot Utility Base Reflex Speaker Baffle. Size 32x22x16. Heavy construction with curved pleasing lines. Celotex lining assures non-rattle reproduction. Brown leatherette covered. Chrome front trim. Specify when ordering whether for use with a 12" or 15" speaker. Weight 40 lbs. This is an ideal baffle for our deluxe Coaxial model CR-13X. Baffle Stock No. NA-12. Net **$19.95.** CR-13X 12" Coaxial PM Speaker and NA-12 Baffle both for **$29.95.** You will be pleased with the fine tone of this combination.

PLASTIC GRILL SPEAKER BAFFLES



Juke-box operators, Sound men, here is the prettiest line of speaker baffles you have ever seen. Tri-color curved plastic grills. Good plywood construction, with matched leatherette-covered sides.

12 IN. WALL BAFFLE $3.95

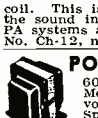
12" slanting wall baffle, with curved plastic grill. Stock No. 12-R: **$3.95.** Buy 4 for only **$14.95.**

8-10 IN. WALL BAFFLE $2.95

8" or 10" Flat mounting wall baffle, with plastic grill. Will hold either 8" or 10" speaker. Stock No. 8R: Your cost, **$2.95** each; 4 for **$10.95.**

12 IN. CORNER BAFFLE $3.49

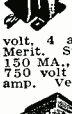
Unique design 12" corner mounting baffle. Mounts snugly into corner, giving best sound distribution. Plastic front. Stock No. 12-C: Your cost, **$3.49** ea.; 4 for **$12.95.**



HIGH QUALITY P.M. For Use With Above Batteries

12" P.M. $4.95

12 inch PM with 6.8 oz. Alnico V magnet. 8 ohm voice coil. This is the standard 12 inch PM of the sound industry. Ideal for juke boxes, PA systems and extension speakers. Stock No. Ch-12, net **$4.95;** three for **$13.95.**



POWER TRANSFORMERS

60 MA., Fully Shielded Upright Mounting. 600 volt CT. 6.3 volt, 2 amp., 5 volt, 2 amp. Special.....**$1.95**

100 MA., Fully Shielded Upright Mounting. 700 volt CT., 6.3 volt, 4 amp., 5 volt, 3 amp. Made by Merit. Special.....**$2.95**

150 MA., Fully Shielded Upright Mounting. 750 volt CT., 6.3 volt, 5 amp., 5 volt, 3 amp. Very Special Value.....**$3.95**

200 MA., Fully Shielded, Flush Mounting. 800 volt, CT., 6.3 volt, 5 amp., 5 volt, 3 amp. Special.....**$3.95**

50 Mill Flush Mounting. For small radios 6.3 5 volt and high voltage CT. Net..**$1.95**

SALE AC LINE CORDS For Radio Set Replacement

6½ ft. G.E. plastic AC cord and cap...**16c**
8 ft. G.E. plastic AC cord and cap....**22c**
6 ft. rubber AC line cord, bakelite plug. Special sale price.....**12c**

McGEE RADIO COMPANY

Prices F.O.B. K.C. Send 25% Deposit with Order, Balance C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

HALLICRAFTERS S-59 8-TUBE FM-AM CHASSIS $32.95

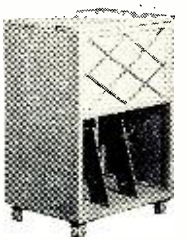
S-59 8-TUBE FM/AM CHASSIS $32.95

★ Regular $50.00 Value ★ Push Pull Audio ★ Phone Input
★ High Fidelity Response Go To 14,000 CPS

Model S-59 Hallicrafters, high fidelity, 8 tube FM/AM chassis, for custom installations. Receives broadcast 540 to 1700 KC and FM—88 to 108 Mc. Size 12½x7½x9". An excellently engineered chassis, with accurately calibrated slide rule dial. Variable tone control and 60 to 14,000 cps, wide range audio. (Push-pull 6K6) 8 ohm output transformer will match most PM speakers. No special output transformer required. Loop antenna built on, for broadcast reception. This is without a doubt the most radio chassis value we have ever been able to offer. Better rush your order in now. We have them. Heavy duty 6x9" PM speaker, for use with the blond console, pictured on the right, $2.95 extra.

S-59 8 tube FM/AM chassis, with tubes. Wt. 16 lbs. Net **$32.95**

S-59 8 tube FM/AM chassis, with tubes and regular $12.95 12" coaxial PM speaker, CR-13X. Wt. 24 lbs. Net **$42.95**



CABINET FOR S-59 $19.95

Beautiful blond console cabinet. Size 17 x 21 x 33" high. This cabinet was intended for use on a nationally known $129.00 radio-phono combination. The lower half of the cabinet is divided for albums. The upper half has a hinged lid, which covers the radio and changer. Radio panel is 8 x 15" and may be ordered ready cut for Hallicrafters S-59 or with a blank panel for installing your own chassis. Changer panel is blank, will hold a changer up to 12 x 15". Cabinet will hold a 6" or a 6 x 9" speaker. Shipping wt. 40 lbs. Stock No. JB-4 blond cabinet, ready cut for the S-59 Hallicrafters. (Will not hold S-56.) **$19.95.**

6 x 9" 4.64 Alnico V PM speaker **$2.95** extra. Stock No. JB-5X same but blank radio panel.....**$19.95**

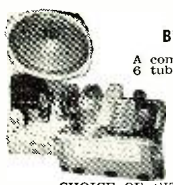
Stock No. B-1000 cabinet just as we bought them. You re-do the radio and changer area to suit your own need. Changer area is now 15 x 15" and radio area 5 x 15 x 11½". Stock No. B-1000. Shipping wt. 40 lbs...**$14.95**

STUDENTS — EXPERIMENTERS — BUY YOUR KITS FROM McGEE

6-TUBE AC 2 BAND RADIO KIT $9.95

BIGGEST RADIO KIT VALUE IN U. S.

BUILD A RADIO WITH MATCHED "DETROLA" PARTS



A complete kit of parts, tubes and ready punched chassis to build a fine 6 tube power transformer type radio chassis. (No cabinet.) We furnish every piece as well as a printed diagram and photograph. Chassis size 14 x 7½ x 7. Receives standard broadcast and 6 to 18 MC foreign short wave. 3 gang tuning condenser used on both bands. 90 mil power transformer 6v6 output tube. This kit is made up of parts intended for use in a high quality Detrola radio. Has full lighted slide rule dial. Everything goes together just like a factory built radio. Priced complete with 6 tubes. Kit model 6-ACX. Less speaker. Weight 16 lbs. Net **$9.95.**

CHOICE OF EITHER 8 OR 10 INCH DYNAMIC SPEAKER **$1.99** EXTRA

MCGEE'S NEW FM-AM-PA KIT $39.95

12 Tube Kit Model PRK-51. This is the most elaborate radio, P.A. kit that our engineering department could design. Here are its features: Receives broadcast, 550 to 1650 kc and FM, 88 to 108 mc (3 gang tuning on FM.) The audio system is wide range, 40 to 17,000 cps, 5 lb. interwound high fidelity output matches 8 ohm speaker. Twin tone controls. (base and treble boost). Phonograph inputs for standard crystal or General Electric variable reluctance. Mike input for crystal or dynamic mike. This radio may be used for an 18 watt P.A. system, a recording amplifier, or for a high fidelity T.V. sound system. Chassis size, 15½ x 7½ x 7½", ready punched. Everything furnished with the kit, including tubes: 6AG5, 6SB7Y, 2—6BA6, 6AT6, 6H6, 6BE6, 2—12AT7, 2—6V6 and 5Y3. The FM RF section is ready wired (coils and sockets), to make this kit easier for you to build. 6" slide rule dial. Complete kit model PRK-51, with photos and instructions, **$39.95.** Speaker recommended, Oxford 12". 22 oz. PM, curved cone and 1½" voice coil. Model 12-XMS **$10.00** extra.

18-WATT AMP KIT FOR INSTRUMENTS MIKES OR PICKUP $14.95

General purpose portable amplifier kit, housed in an attractive portable case, with 10" speaker. Two inputs for instruments or mike, one phono input. Variable tone control. Kit is complete with diagrams and photos and tubes: 2—12AX7, 6X4, 2—6AQ5. AC transformer type. Stock No. MM-18RC, weight 20 lbs. Net **$14.95.** Crystal mike and desk stand, **$4.95** extra.

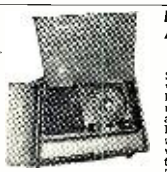
GAROD DELUXE 5-Tube Kit $10.95

This is our latest and finest AC-DC radio kit. Receives Broadcast, 540 to 1650 KC. Has full length illuminated slide rule dial. Choice of Ivory or Walnut plastic cabinet. Full high efficiency 2 gang superhet circuit, with loop antenna. Ready punched chassis, full 5" PM speaker. Every part fits. Everything furnished, including tubes. 12SA7, 12SK7, 12SQ7, 35Z5 and 50L6. This kit will go together just like it would on the production line. Diagram, photos and instructions are furnished. Shipping weight 9 lbs. Kit model XA-49. Net **$10.95.**

ONLY $9.95 BUYS A 6-TUBE RADIO KIT

6 tube superhet, broadcast AC-DC kit. Using tiny tubes. Housed in a Farnsworth plastic cabinet, with slide rule dial, R.F stage, 2 gang condenser, loop antenna and 5" speaker. This makes a factory like radio. The cadium chassis is ready punched and sockets are installed. This type of kit usually sells for at least $15.00. All parts furnished, including tubes: 12KS, 2—12SK7 12SR7, 35L6 and 35Z5. Complete with diagrams and photos. Kit model FS-6. Wt. 8 lbs. **$9.95.**

New 3-Way PORTABLE RADIO KIT ONLY $12.95



Sensational new 3-way portable radio kit. 4 tubes plus rectifier. Housed in an all aluminum, leatherette covered case made by Farnsworth, with loop antenna built-in. Size 5x9x6". Build yourself a professional looking radio with this kit. Every piece furnished including tubes: 1R5, 1T4, 1S5, and 3V4, as well as easy-to-follow diagram and photo. This set will make a full two gang superhet, that looks like a $40.00 radio. We should ask $17.00 for this kit. Stock No. FP-4X, complete kit less batteries, weight 8 lbs. Net price **$12.95.** Kit of batteries, 67½ volt "B" and "A". **$2.25** extra.

PORTABLE RECORD PLAYER KIT $9.95

Deluxe Portable Record Player Kit housed in the attractive Capitol case. Includes all parts and easy to follow diagram. Has 4" Heavy Duty PM Speaker. 78 RPM Phono Motor. All necessary parts to build a 70L7 type Amplifier. Weight 14 lbs. Model CK-1, Net **$9.95.**

BUILD YOUR OWN AMPLIFIER

TM-12—12 WATT KIT $10.95

Kit Model TM-12. 12 Watt Amplifier Kit. Ideal for a high quality record player as a P.A. System or recording amplifier. Matched component parts ready punched chassis. One control fades from phono to mike. Input compensation for G.E. Variable Reluctance pick up. Output matches 8 ohm Voice Coil. 100 Mill Power Transformer. Complete with tubes, diagram and photos. 2—6V6. 2—12AX7, and rectifier. Variable tone control. Model TM-12. Weight 10 lbs. Net **$10.95.** Crystal utility mike and desk stand $4.95 extra. TM-12 custom wired and tested $4.00 extra.

TM-20—20 WATT KIT $15.95

Kit Model TM-20. A high quality 20 Watt Audio Amplifier with 135 Mill Power Transformer and push-pull 6L6's. Inputs for mike or phono pickup. Full 5" PM speaker. Every Variable Reluctance pick up. Tone and fader controls. Has heavy duty universal output transformer, to match 8 ohm P.M Speaker. Ready punched chassis. Price includes tubes, diagram and photos. 2—6L6. 2—7N7. 7Z4. Frequency response 50 to 12,000 Cps. Kit Model TM-20. Weight 20 lbs. Net **$15.95.** Crystal mike and desk stand $4.95 extra.

GAROD PERSONAL PORTABLE KIT $12.95 with Batteries

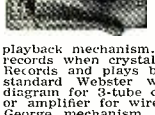
KIT MODEL X-45 $12.95

Complete Garod Personal Portable Radio Kit Model **X-45.** Made from genuine Garod factory matched parts. A complete kit to build a broadcast battery operated 4 tube receiver. Small in size 6½x3¼x4½". Weight 3½ lbs. 2 Gang Superhet circuit set comes on when lid opens. Rugged metal case with colored plastic front and back. Loop antenna in lid. Furnished with diagram and photos, tubes and 67½ B-Battery. Will go together like a factory built radio. Shipping weight 6 lbs. X-45 **$12.95.** Model X-45WT Portable Radio is X-45 wired ready to operate net **$14.95.**

DETROLA—SCOOP COILS, GANG, DIAL, PAN $2.95

Genuine Detrola Chassis pan with 6 octal sockets. Heavy glass slide rule dial, 3 Gang Tuning condenser. All RF and IF coils and band switch for standard broadcast and foreign short wave. Buy these parts for less than the coil value alone. These parts all fit the chassis properly. Only material pictured and listed above is offered. It is not a complete kit. You supply your own tubes, speaker, resistors, condensers, etc. Stock No. DET-1. Shipping weight 6 lbs. Net **$2.95.**

ST. GEORGE WIRE RECORDING MECHANISM $22.95



St. George wire recorder mechanisms. Brand new, complete wire recording and playback mechanism. (Also plays 78 RPM records when crystal pick-up is installed.) Records and plays back up to 1 hour on standard Webster wire. Furnished with diagram for 3-tube converter (adapts radio or amplifier for wire recording). A-93 St. George mechanism, weight 15 lbs. Requires 9x13x3½" space. Net, **$22.95.** Crystal pick-up for playing and recording phono records.**$1.95** extra. Webster wire, 1 hour, **$3.25**; 30 min., **$1.95**; 15 min., **$1.30.** Crystal mike and desk stand, **$4.95** extra.

3-SPEED PLAYER KIT $16.95

3 Speed Record Player Kit. Deluxe Capital portable case pictured above. All parts furnished to build a two tube 70L7 type amplifier (Tone and Volume Control), Alnico V PM Speaker. 33, 78 and 45 RPM. Phono Motor. Easy to follow assembly instructions. Shipping weight 16 lbs. Stock No. 347-K. Net **$16.95.**

WIRE RECORDER CONVERTER $12.95

With this 3-tube converter you can adapt the St. George Airking, or Webster Chicago wire recorder mechanism to any radio or P. A. system. Only 3 connections necessary. Just plug in to the phono input of your amplifier and connect to plate of output tube. AC-Transformer construction, gain for mike, 3 position switch for quickly changing from record to play-back. Priced ready wired and tested with instructions and tube 12AT7 pre-amplifier; 6AQ5 Oscillator erase; 6X4 rectifier. Stock No. RR-Y. net, **$12.95.**

Build Your Own Radio Station Miniature Broadcast Station Kit $6.95

Kit Model DE-6X. Build your own 110 Volt AC-6 tube miniature radio station—(800 to 1500 KC) broadcast from crystal mike or phono records. (Warning this transmitter must be used with only a short aerial otherwise you will transmit 2 or 3 miles.) Complete kit including tubes, diagram and instructions. Weight 4 lbs., net **$6.95.** **Model DE-6XWT.** Miniature transmitter ready to operate **$8.95.** Crystal mike and desk stand **$4.95** extra.

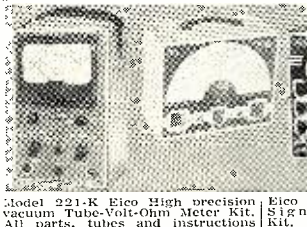
33X Crystal Mike with 20 ft. of cable, fall sale price **$10.95.**
33D Dynamic Mike with **20** ft. of cable, fall sale price **$12.95.**

8-WATT AMPLIFIER KIT $8.95

Kit Model TM-8. Similar in size and shape to Model TM-12. 8 Watt amplifier Kit for utility use, record playing, or paging. Matched component parts. Ready punched chassis. Variable tone control. One Control fades from mike to phono. Input compensation for G.E. Variable Reluctance pick up. Output matches 8 ohm Voice Coil. 75 Mill Power Transformer. Price includes tubes, diagram and photo. Push pull 6AQ5, two 12AX7, plus rectifier. Kit Model TM-8. Weight 8 lbs. Net **$8.95.** Crystal mike and utility desk stand **$4.95** extra. Model TM-8WT amplifier is TM-8 kit wired ready to operate. net **$11.95.**

WIDE RANGE AMP-KIT $29.95

It's the newest thing in audio amplifiers. McGee's wide range, 34 watt amplifier kit with inputs for crystal or dynamic mikes and any crystal phono cartridge, as well as the new G.E. variable reluctance cartridge. Output transformer is wax impregnated, weighs 6 lbs. Voice coil taps 4-8-15-250 and 500 ohms. Push-pull 6L6 output tubes. Separate electronic base and treble boost. Inverse feedback. Input tube filament is DC heated to reduce hum level to nil. Frequency response from 20 to 20,000 cps. Easy to follow diagram and photos for easy assembly of this kit. Ready punched chassis. Every part furnished, including tubes: 2—6L6, 5V4, 3—12AX7. Shipping weight 25 lbs. Stock No. XX-34, net **$29.95.**



BUILD THESE THREE TEST INSTRUMENTS AND HAVE THE BEST.

Model 400-K 5" Scope Kit. All parts and tubes furnished. Ready punched Chassis and beautiful metal case. Sensitivity .3 Volts. Sweep 15 to 30 K.C. Tube component 2, 6SJ7. 2, 5Y3. 884 and 5BP1. This Eico Scope Kit is the best. Shipping weight 30 lbs. New **$39.95.**

Model 221-K Eico High precision Vacuum Tube Volt-Ohm Meter Kit. All parts, tubes and instructions furnished. AC-DC. Ranges 0, 5, 10, 100, 500 and 1000 Volts, Ohms in 3 steps. 2 ohms to 1000 megs. New feature includes zero center for T.V. discriminator alignment. 4½" meter. Kit Model 221-K. Weight 12 lbs. Net **$23.95.**

Eico Model 320-K Signal Generator Kit. All parts, tubes and instructions furnished. 7 Bands, 150 KC to 100 M.C. Fundamentals to 34 M.C. A tremendous value Shipping weight 12 lbs. Net **$19.95.**

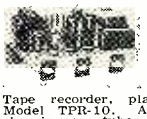
VOLT OHM METER KIT $14.95

Electronic Instrument Volt Ohm-meter Kit, 3" meter, 1000 ohms per volt sensitivity. 5 D.C. volt ranges to 2500 volts. 4 A.C. voltage ranges to 1000 volts. 3 ohms ranges to 1 meg —complete kit. Stock #511K. net **$14.95.**

1 HOUR TAPE RECORDER MECHANISM $59.95

TAPE RECORDER 1 HOUR MECHANISM TWIN CHANNELS SPECIAL $59.95

Our leader tape recorder mechanism—Size 10⅛x13⅝x7-5/16, weight 16 lbs. Tape speed full 7½ feet per second—two tracts. One hour with 7" reel, 30 minutes with 5" reel. Bias frequency to erase 50K.C. Twin erase heads, one recording head. Response flat from 60 to 8,000 cps. Non-slip and Wow-less drive. Made for high fidelity recording and play-back on tape. Furnished complete with suggested diagram and erase coil. Model TP4-X Tape recorder mechanism, sale price, **$59.95.** Recording Tape 7" Reel, **$2.50.**



AMPLIFIER KIT FOR TAPE RECORDING $19.95

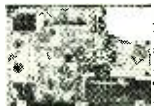
Tape recorder, playback amplifier Kit Model TPR-10. All parts, punched chassis pan, tubes, photos and diagram furnished. When wired will make a tape recorder and playback amplifier of good quality. Inputs for crystal or dynamic mike and phono pick-up. (May be connected to the detector of any radio set to record radio programs.) Output transformer matches any 8 ohm speaker. Tone control. Complete with tubes: 6SF5, 7F7. 7N7, 2—6V6, and 6X5. Shipping weight 20 lbs. Stock No. TPR-10, Net **$19.95.**

McGEE RADIO COMPANY

PRICES F.O.B. K.C. Send 25% Deposit with order. Bal. Sent C.O.D. With parcel post orders include postage.

TELEPHONE VICTOR 9045. Write for Flyer
1422 GRAND AVE., KANSAS CITY, MISSOURI

DEALERS—BUY YOUR TELEVISION AND RADIO PARTS from McGEE



Farnsworth Television Chassis Scoop.....$5.95

Farnsworth Television Chassis Model GVZ60 partially built up Chassis Size 12 x 17. Has 16 Tube sockets and over 150 small parts (Resistor and Ceramic Condensers) no coils or Transformers or tuning unit. Sweep and sync circuits are all partially wired up. This T.V. Chassis is ideal for the student and experimenter. Learn T.V. by building your own set using this chassis to start from. Furnished with a 1948 regular $3.00 Supreme Publications Television Manual, which has a complete schematic of this chassis as well as 9 pages of service information. If you want to play with Television here is a chance to get started. Farnsworth GVZ60 partially built up Chassis and 48 Supreme T.V. Manual all for $5.95. Include postage for 11 lbs. GVZ60 Chassis only..... **$2.95**

T.V. POWER TRANS. SCOOP PRICE $2.95

Order This With Your Farnsworth T.V. Scoop Chassis

GVZ60 Power Transformer, C-94230Z. 135 Mil Tapped 110 Volt primary. Supplies plate voltage and filament for part of Farnsworth T.V. Chassis. 375 V.D.C. 6.3 and 5 filament. Shipping wt. 7 lbs. Scoop price **$2.95**

FARNSWORTH T.V. CABINET $9.95

This attractive cabinet is the one built for the Farnsworth GVZ60 Chassis we offer above. All Mahogany Table Cabinet, for 10" size picture tube. Front Panel already cut. This we suggest you order with the above chassis. It is the correct cabinet and will make a nice looking T.V. set. Shipping weight 33 lbs. Stock No. RY-10. Net **$9.95.**

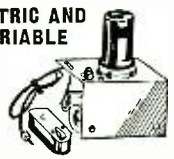
G.E. RPX010 V.R. CART. $2.95

G.E. RPX010, with permanent needle, **$2.95** each; 10 for **$24.95.**

Kit of parts to build 6SC7 type preamplifier, **$2.49 extra.**

A lucky purchase by us enables this terrific General Electric cartridge value.

GENERAL ELECTRIC AND WEBSTER VARIABLE RELUCTANCE



New Webster cartridge with removable permanent needle. Response is second to none. Offered with preamplifier (6sc7) ready wired and tested. A scoop at **$5.95** complete.

Webster M1-VR cartridge only. Net **$4.41**

New General Electric V. R. cartridge No. **RPX-040,** with removable needle. Net..... **$5.85**

General Electric V. R. cartridge RPX-041, for micro-groove records. Net.... **$5.85**

Our 6sc7 type pre-amplifier with either **RPX-040 or PRX-041** cartridge. Net **$7.95**

WIRE RECORDER and 18-WATT P.A. SYSTEM

SALE PRICE **$69.95**

Three years of wire recording experience has lead us to the development of this combination wire recorder and public address system. Housed in an attractive portable case with hinged lid on the recorder compartment. Beautiful streamlined plastic grill. Storage compartment in back panel for mike and accessories. Size 21x11x14. A full 18 watt HI FI amplifier with P.P. 6V6 tubes in output stage and separate 6AQ5 eraser circuit. This new super erase circuit eliminates all the bugs in wire recording. 12-inch Alnico V. P.M. speaker. Extension speaker jack. Mike input, tone control. Equipped with the St. George wire recorder playback mechanism that has 78 rpm turntable and General Electric Variable reluctance pickup. You can record or play phono records. Record from mike. The play-back quality is tops. Plenty of volume and good fidelity. This is also a top wire recorder. Unit is completely assembled and ready to operate. Furnished with 15 minute spool of Webster recording wire. Extra recording wire, 15 min., **$1.30;** 30 min., **$1.95;** hour, **$2.25.** Model **GE-16** Portable public address system and wire recorder shipping weight 38 lbs. Net. **$69.95.**

Crystal Mike and Desk Stand, **$4.95** extra.

30 MIN. RECORDING WIRE SCOOP PRICE $1.49

Manufacturer's stock of recording wire, on metal spool. OK for Webster, Air King, etc. 30 min. spool Stock No. 30WS, net **$1.79;** 10 for **$16.95.** Empty metal spools. **25c** each; 10 for **$2.19.**

SAVE UP TO 80%

ON NATIONALLY ADVERTISED AND BRANDED CONDENSERS

ORDER 100 ASSORTED ELECTROLYTICS—TAKE 10% OFF

ELECTROLYTICS UPRIGHT ALUMINUM CANS

These famous brand upright mounting, screw can aluminum electrolytics are marked by their catalogue number—Mallory.

RS-213	8 Mfd. 450V Aluminum Can	**.34**
RS-215	12 Mfd. 450V Aluminum Can	**.39**
RS-223	30 Mfd. 450V Aluminum Can	**.39**
RS-262	8X8 Mfd. 450V Aluminum Can	**.39**

BY PASS SALE

Bypasses, .03 400V., .3 400V., .006 600V., .04 600V., **8c** Each. **$6.95** for 100 Assorted.

1000 Volt, OK for Buffers, .002 1000V., .02 1600V., .04 1600V., .05 1600V., **10c** Each. 100 for **$7.95.**

McGee's ELECTROLYTIC SCOOP OF ALL TIMES

Popular Tubulars for Every Day Replacement

TCS50	50 Mfd. 150V	**$ .24**	ST595	8 Mfd. 450V	**$0.29**
TCS45	20X20 Mfd. 150V	**.29**	ST597	16 Mfd. 450V	**.34**
TCS47	30X30 Mfd. 150V	**.34**	ST598	20 Mfd. 450V	**.39**
TCS48	40X40 Mfd. 150V	**.39**	ST599	30 Mfd. 450V	**.45**
TCS52	10X10 Mfd. 250V	**.25**	2N-518	8X8 Mfd. 450V	**.39**
TCS53	20X20 Mfd. 250V	**.29**	3S-579	8X8 Mfd. 450V, 20X25V	**.39**
TCS75	8X8 Mfd. 450V	**.39**	35-584	8X8X8 Mfd. 450V	**.49**
TCD55	20X20 Mfd. 250V	**.29**	4S-718	8X8 Mfd. 450V, 10X10X25V	**.49**
TCD52	10X10 Mfd. 250V	**.24**	20 Mfd. 350V Tub. Aerovox		**.19**
			40 Mfd. 350V Tub. Aerovox		**.29**

$50,000 DELCO VIBRATOR SCOOP

BUICK VIBRATOR FITS ALL BUICK SETS FOR 11 YEARS 1937 THRU 1947

McGEE'S PRICE $1.95

10 FOR ONLY $17.95

Here is the hottest Vibrator Scoop in McGee's history. All new Delco Vibrators, not war surplus, but vibrators dumped by United Motors themselves. You save over half and still buy the best. This Delco Buick Vibrator replaces Mallory #7161 fits all Buick original equipment sets from 1937 thru 1947. The regular dealers net on this Vibrator is **$4.14.** McGee's sale price only **$1.95.** 10 for **$17.95.**

Standard 4-prong, 1½" can, short enough for Chrysler, Plymouth sets. 8-point, heavy duty. Replaces Mallory 294. Regular dealers' net, $2.62. McGee's price, **$1.29;** 10 for **$11.90.**

Odd 4-prong, 1½" can Delco 1301, replaces Mallory 852. Popular GM car sets. Regular $2.46. McGee's price, **$1.49;** 10 for **$12.95.**

Chevrolet vibrator, Delco No. 8622, replaces Mallory 273D. Can size 2x4½". A sync with buffers. Odd 5-prong. McGee's price, **$1.95.**

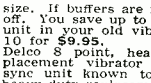
Delco No. 8611, replaces Mallory 245A. A standard 5-prong sync, no buffers. Can size 2x3½". McGee's price. **$1.95.**

Delco 8612, replaces Mallory 271HD. Offers 5-prong sync, no buffers. Can size 1½x3¼". McGee's price. **$1.49.**

Delco 8637, replaces Mallory 954. Standard 6-prong sync, no buffers. 1½x3¼" can. McGee's price. **$1.49.**

Delco 8610, replaces Mallory 245, 1½x3¼" can. 5-prong sync, no buffers. McGee's price. **$1.49.**

DELCO VIB UNITS

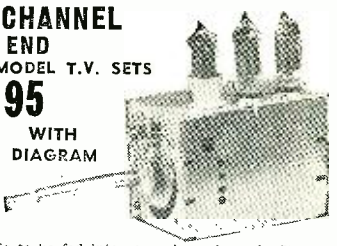


Delco sync vibrator unit, with buffer condensers attached This same unit used in all sync vibrators, regardless of case size. If buffers are not needed, simply clip off. You save up to $4.00 by replacing the unit in your old vibrator can. **$1.09** each 10 for **$9.95.**

Delco 8 point, heavy duty, non-sync replacement vibrator unit. The best non-sync unit known today. For regular and heavy duty replacement use. Small in size. Fits them all. Net **99c** each, 10 for **$8.95.**

SARKES TARZIAN 12 CHANNEL TELEVISION FRONT END

THIS SAME TUNER USED ON 1949 MODEL T.V. SETS

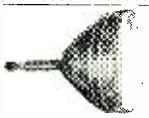


SARKES-TARZIAN, 12 channel tuner for Television receiver. This 3 tube front end is all wired, including tube sockets. The same T.V. front end as used by several nationally known manufacturers. Built in fine frequency trimmer. Offered with printed schematic diagram. Priced complete with 3 tubes, 6C4 osc., 6AG5 mixer, and 6BH6 R.F. amplifier. This unit is worth twice our price. All wired, output is to be fed into your video channel. It can be mounted and used with the Farnsworth GVZ-60 chassis, advertised to the left. Weight 2 lbs. Stock No. SK-T3. Net price, Sarkes-Tarzian, 13 channel tunes, with 3 tubes, ... **$9.95**

SALE PRICE **$9.95** WITH DIAGRAM

Stock No. IT-SK3. Same as above only without fine frequency vernier drive. This type used in intercarrier circuits. Furnished with tubes and diagram. Stock No. IT-SK3. Net **$7.95**

12QP4 $27.95—12LR4 $19.95



As usual, McGee offers you a better buy. We have on hand 100 Dumont 12QP4 Picture Tubes in original cartons, first quality, while they last only **$27.95.** This is the best value in the U.S. today.

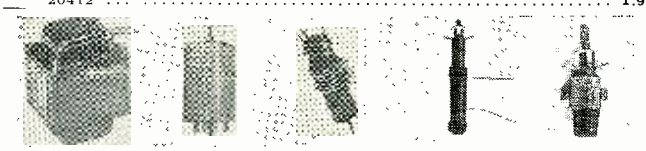
10BP4 10" Picture Tubes, manufacturer states, these tubes are well within tolerance but not quite high enough to bear our brand name. McGee's tests fail to show any difference between this and any other 10BP4. Full factory guarantee. **$19.95**

10BP4, net .....

Sockets for either above tubes **49c** each.

TELEVISION COMPONENTS COST LESS AT McGEE

MODEL	DESCRIPTION	NET
T118	Horizontal Deflection Output Transformer, Interchangeable with RCA Type 211T1 or 211T3	**$4.49**
T117	Vertical Oscillator Transformer (Blocking). Interchangeable with RCA type 208T2	**1.59**
T122	Focus Coil, 247 Ohms D.C. Resistance. Interchangeable with RCA type 202D1	**2.49**
T121	Deflection Yoke, 8.3 MH. Vertical 50 MH. Interchangeable with RCA type 201D1	**3.49**
T116	Vertical Deflection Output Transformer. Interchangeable with RCA type 204T2	**1.95**



T.V. Power Transformer, similar to R.C.A. 290 Ma. 110 Volts. 60 Cycle, 760 Volts D.C. Filaments 5 Volts at 3 amps., 5 Volts at 3 amps., and 6.3 Volts at 8 amps. Trans. size 3¾x4½x5¼". Shipping weight 10 lbs. Stock **$6.95**

T100	1st and 2nd Sound I.F. Transformers. Interchangeable with RCA type 201K1 ..... Each	**$1.29**
T101	1st Pix I.F. Transformer. Interchangeable with RCA type 201K ..... Each	**1.69**
T102	2nd Pix I.F. Transformer. Interchangeable with RCA type 202K3 ..... Each	**1.08**
T103	Sound Discriminator Transformer. Interchangeable with RCA type 203K1. ..... Each	**1.59**
T104	Horizontal (Synch.) Discriminator Transformer. Interchangeable with RCA type 208T8 ..... Each	**1.49**
T105	3rd and 4th Pix Coils. Interchangeable with RCA type 202L1 ..... Each	**.39**
T106	Cathode Trap Coil. Interchangeable with RCA type 202K4	**1.29**
T107	Video Peaking Coil, 250 MH. Shunt Resistance 10 Megohms. Interchangeable with RCA type 202L1 ..... Each	**.27**
T108	Video Peaking Coil, 250 MH. Shunt Resistance 22,000 Ohms. Interchangeable with RCA type 203L2 ..... Each	**.27**
T109	Video Peaking Coil. 120 MH. Shunt Resistance 10 Megohms. Interchangeable with RCA type 203L3. ..... Each	**.27**
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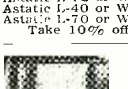

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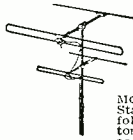

WARD T.V. ANT. $6.49

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Ward $26.50 list, all band T.V. antenna Model TVH-9. (Pictured). Stacked high and low band folded dipole with reflector. Furnished with mast as pictured. This is a terrific antenna buy. The regular dealers net was over $15.00. Buy them now at McGee for only..... **$6.49**

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The DOUBLE CHECKER

A versatile r.f. indicator which can be very useful around the ham shack.

By WALTER S. ROGERS, WIDFS

THERE are all sorts of handy and not-so-handy gadgets for checking neutralization and the presence of r.f. Some of these methods are safe, while many are very dangerous. The old wood pencil is a good example of the ill-advised methods, and the much-used neon bulb utilized as an indicator is another. Similarly, any absorption wavemeter can be lethal.

The need for a reliable, metered indicator for use around ham and experimental gear has brought about the creation of an r.f. indicator, called the Double Checker. A unit like this is simple to build.

For constructing a checker of this type, all that is needed is a sensitive meter, a pair of 1N34 germanium crystal rectifiers, a few feet of wire, and some sheet bakelite. The meter used should be a two-inch 0-1 milliampere of the type that has been offered on the surplus markets, or these may be found among the "spare parts," with other meters. The one chosen for this unit was a radar manual range indicator, made by *G-E,* their Model AXE 221. Another type that should serve with equal success is the *Weston* two-inch 0-1 ma.

The completed circuit is shown in Fig. 3A. A variation can be made as shown in Fig. 3B, using a capacity "hat" rather than the inductance version. The latter *L-C* type is more sensitive and is just as easy to make.

The bat handle, as well as the dual-wound r.f. choke form, is cut out of ⅛-inch sheet bakelite, as shown in Fig. 2. Note that the holding notch is made so that the operator's hand is well away from the meter and the other parts of the circuit. Further guards may be added as extra precaution, but if care is exercised, no burns or shocks should be suffered.

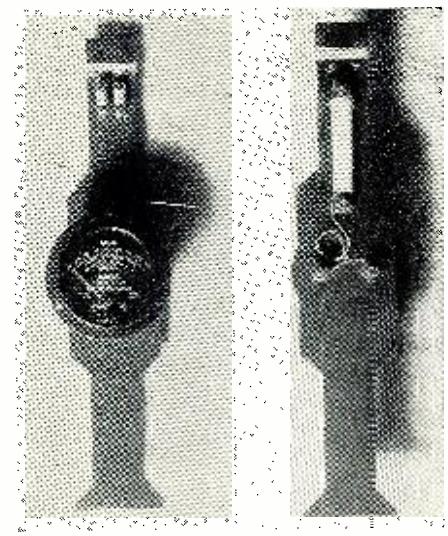


Fig. 1. Front and rear views of the completed versatile checker.

After cutting and drilling the bakelite to make the necessary changes for the meter mounting holes, it is time to wind the pickup coil. Eight turns is about right, started approximately ½ inch from the top. Any wire (26 to 34 gauge), enamel, cotton, or silk covering, will do for this and the r.f.

Fig. 2. Detailed dimensional sketches of the bakelite handle (left) and the form for the r.f. choke illustrated at right.

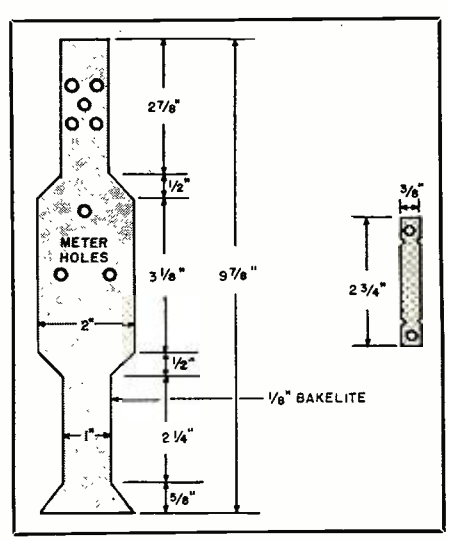
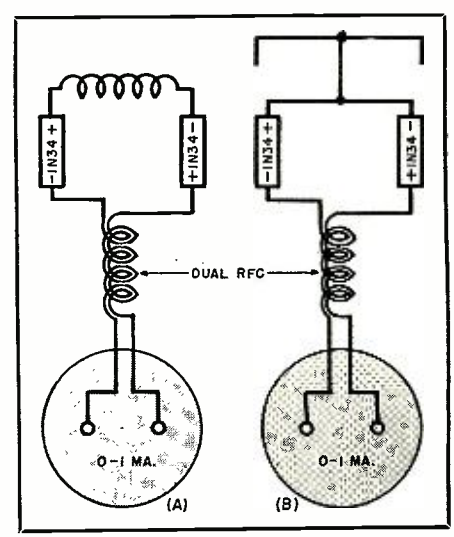


Fig. 3. (A) Circuit of the checker using inductive pickup loop. (B) Suggested circuit using a "capacity hat" pickup.



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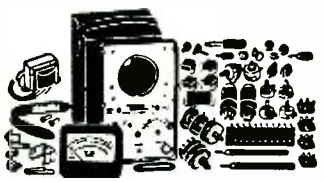

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10Y	.28	3D6	.29
211	.28	6C4	.28
803	3.63	6AR5	.54
805	3.63	6D6	.55
813	6.90	6K7GT	.54
815	1.37	6SH7	.27
843	.38	6SS7	.53
954	.18	7C4	.28
955	.18	12A6	.28
957	.18	12H6	.29
958A	.18	12K7GT	.53
1619	.18	12SH7	.29
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9004	.18	50B5	.55
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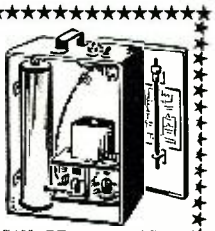

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15W Stock No.	Resistance in Ohms	25W Stock No.	Resistance in Ohms
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PW-150	150	SW-2	2
PW-200	200	SW-3	3
PW-250	250	SW-6	6
PW-300	300	SW-10	10
PW-400	400	SW-15	15
PW-500	500	SW-20	20
PW-800	800	SW-30	30
PW-1M	1000	SW-40	40
PW-2M	2000	SW-50	50
PW-3M	3000	SW-60	60
PW-5M	5000	SW-75	75
PW-7500	7500	SW-100	100
PW-10M	10,000	SW-150	150
PW-20M	20,000	SW-200	200
PW-50M	50,000	SW-250	250
		SW-300	300
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Stock No. PW 15 watt, ALL SIZES.
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14010*	15	200 ma.	150	2000V	5.25
15406*	12	225 ma.	200		5.25
510-X2	15	200 ma.	145		5.25
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choke. The winding should be securely cemented in place (clear finger nail polish, or any coil dope will do).

While the cementing material is drying, it would be a good idea to wind the dual-wound r.f. choke, using #26 or 28 wire, enough to fill the choke form. This, too, should be properly doped. As the choke is not a critical part, it is believed no further instructions are necessary.

When both of the doped coils have properly dried and are no longer tacky, you are ready to assemble the unit. Bolt the dual-wound r.f. choke in place, solder the two 1N34 rectifiers, being sure that polarity is as indicated, and mount the meter using the terminal bolts for connections as well as mounting.

It is a good idea to check the polarity by bringing the pickup end near an oscillator so that the meter reads the proper direction. The leads at the meter may have to be reversed, and the finished Double Checker should look like Fig. 1.

This unit is excellent for neutralizing or checking r.f. strays, and even as a standing-wave ratio indicator. For this purpose, it is usually necessary to tape a small piece of bakelite or stick so that the pickup is just near enough to give a center of scale reading. By comparing the maximum to minimum, there is a good indication of standing-wave ratio.

The checker has been used with coax as well as other lines. As a modulation indicator, it is far superior to a neon, and if it is used with care, there will be more *safety* in the ham shack.

—30—

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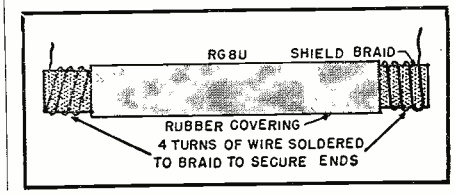
A VERY flexible, rubber covered, shielded tubing for general use in mobile installations, etc., can be made easily from RG-8U coaxial cable. All that is necessary is to cut the cable to the desired length, open the shield braid for about a half inch, and pull the polyethylene insulation and inner conductor through with a heavy pair of pliers. The polyethylene will slip out of the shielding very easily, and no difficulty should be experienced.

When the tubing is clear the ends should be finished to prevent the shielding from unraveling. With a razor blade cut the rubber insulation back for about a half-inch at both ends of the cable tubing and remove. Then take some stranded push-back wire, wrap about four turns around the exposed shielding, and solder it well (see Fig. 1). This will keep the end of the tubing clean and will also provide the ground lead for the cable. . . . M. K.

Fig. 1



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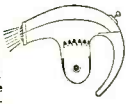

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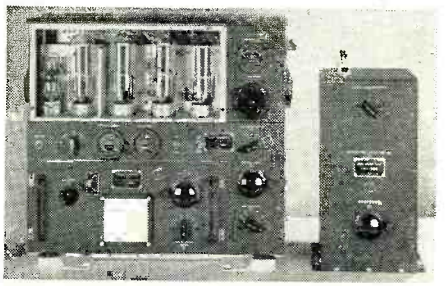

The famous transmitter used in U.S. Army bombers and ground stations during the war. Design and construction have been proved in service under all kinds of conditions all over the world. The entire frequency range is covered by means of plug-in tuning units which are included. Each tuning unit has its own oscillator and power amplifier, coils and condensers, and antenna tuning circuits—all designed to operate at top efficiency within its particular frequency range. Transmitter and accessories are finished in black crackle. Milliammeter, voltmeter, and RF ammeter are mounted on the front panel. Specifications: FREQUENCY: 200 to 500 KC and 1500 to 12,500 KC. Operates on 10 and 20 meter band with slight modification for which diagrams are furnished. OSCILLATOR: Self-excited, thermal compensated, and hand calibrated. POWER AMPLIFIER: Neutralized class "C" stage, using 211 tube and equipped with antenna coupling circuit which matches practically any length antenna. MODULATOR: Class "B"—uses two 211 tubes. POWER SUPPLY: Supplied complete with dynamotor which furnishes 1000V at 350 MA from either 12 or 24 volts. Complete instructions furnished to operate set from 110V, AC. Shipping wt. 300 lbs., complete with all tubes including a full set of spares, dynamotor power supply, seven tuning units and antenna tuning unit.

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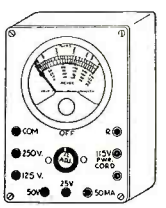

This analyzer, featuring a sensitive repulsion type meter in a bakelite case is the peak of 15 years achievement in the instrument field by a large company specializing in electronic test equipment. Specifications of the AC-DC Model Volt-Ohm-Milliammeter: AC Volts—0-25, 50, 125, 250; DC Volts—0-25, 50, 125, 250; AC Milliamperes—0-50 DC Milliamperes—0-50; Ohms Full Scale—100,000; Ohms Center Scale-2400; Capacity—.05 to 15 Mfd. Price prepaid anywhere in the U.S.A.—**$7.00**. Similar DC Meter, lacking the AC operated ranges of above. **$5.50** prepaid.

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There are more features engineered into this all purpose instrument than in any other instrument on the market regardless of price. Here are a few of its features:

- 5 Inch easy to read meter.
- 6 DC voltage ranges from 0 to 1000v. (Input resistance as high as 1 megohm per volt.)
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- 6 Resistance ranges from 2/10 ohm to 1000 megohms.
- 4 Capacity ranges from .000025 to 20 MFD.
- A zero center range for balancing FM discriminators.
- Isolating resistor built into probe.
- Sturdy natural finish hard wood case.

This outstanding development of one of the leading manufacturers of test equipment costs only **$39.50** complete with all leads, as illustrated.

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NEW 1950 KITS

New 1950 model 500 Signal Generator Kit. Modulation On-Off switch, internal modulation and external modulation jack provided. Internal 400 cycle saw-tooth audio available for external testing and fidelity checks on receivers. Precision coils for greater accuracy and maximum stability on all 5 bands. Dial calibrations from 150 KC to 104 MC. This signal generator is 115 V. A. C. 60 cycle operated and comes with everything, including complete detailed instructions. Assembling is an easy job, even for the least experienced. The lowest price and the best signal generator on the market for only **$18.75**. Also available, factory assembled, only **$28.75**.

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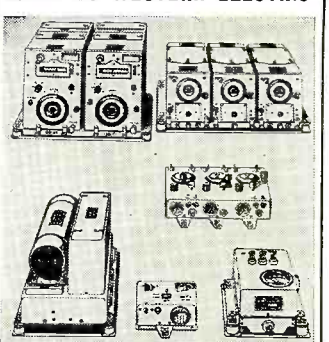
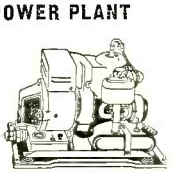
274N COMMAND SET MADE BY WESTERN ELECTRIC



A mountain of valuable equipment that includes 3 separate Communications Receivers, covering up to 9.1 MC, 2 separate 40 watt Transmitters including crystals, 4—28v. Dynamotors (easily converted to 110v. A.C. operation), Preamplifier and Modulator, 2 Tuning Control Boxes, and 1 Antenna Coupling Box complete with R.F. Ammeter. 29 tubes supplied in all. Receivers and Transmitters instantly detached from mounting racks for use in separate locations. Removed from unused aircraft and in guaranteed electrical condition. A super value at **$59.95** complete.

PE-109 DC POWER PLANT



A gasoline engine coupled to a 2000 watt 32 volt DC generator. Can be adjusted to give 12 to 40v. output. Ideal for rural areas or to run any of the surplus items that require 24-32v. DC for operation. Tested and in good condition, only **$79.95**. Converter that will supply 110v. AC from the above unit or from any 32v. DC source for **$12.95**. We also have a limited supply of brand new PE-109s in original factory packing for **$125.00** each. F.O.B. Buffalo.

BIG SAVINGS ON TUBE TESTERS

SUPERTESTER

20,000 OHM PER VOLT SUPERTESTER. Similar in appearance and made by same manufacturer as Vacuum Tube V-O Capacity Meter. Specifications as follows: DC volts at 20,000 ohms per volt: 0-3v, 15v, 60v, 300v, 1500v, 6000v. AC volts at 10,000 ohms per volt: 0-6v, 30v, 120v, 600v, 3000v, 6000v. Current: 0-60 Microamps, 0-6 MA, 60 MA, 600 MA, 6 Amperes. Resistance: 0-3000 ohms, 300,000 ohms. 3 Megs, 300 Megs. Decibels: Minus 4 to plus 77 DB divided into 6 ranges. All special 1% accurate multipliers used. No external source of power required for AC measurements although there is no frequency error in the range from 30 cycles to 1 megacycle. This SUPERTESTER has valuable features found in no other tester on the market, such as WIDEST resistance range coverage, HIGHEST AC voltage sensitivity, WIDEST power level (DB) coverage, and the lowest price—**$29.95**. We urge comparison with these specifications before buying any tester.

1950 MODEL MUTUAL CONDUCTANCE

Attractive panel and case . . . Large 4½" meter . . . Calibrated microvolt scale as well as Bad-Good scale . . . Front panel fuse . . . Individual sockets for all tube base types. Proper filament voltage supplied to test any tube ever made. Unequalled switching flexibility allows all present and future tubes to be tested regardless of location of elements on tube base. Indicates gas content. Detects shorts or opens on any element of any tube. Tests cold cathode, magic eye and voltage regulator tubes as well as all ballast, amplifier and rectifier types. Model "C"—Sloping front counter case—**$56.95**. Model "P"—Handsome hand-rubbed portable case—**$59.95**. Built-in roll chart with either model—**$5.00** Extra.

Bayonet type radio pilot light sockets for model railroad enthusiasts, etc. **$5.00** a hundred. Mazda licensed bulbs, per 10 **50c**.

BUFFALO RADIO SUPPLY, 219-221 Genesee St., Dept. RN11, BUFFALO 3, N. Y.

(*Continued from page* 79)

SWEEP-FREQUENCY GENERATORS

Manufacturer	Type No.	Frequency Range	Sweeping Rate	Output	Output Impedance	Frequency Response	Distortion	Price	Special Features
Instrument Electronics	248	20-20,000 c.p.s.	2-20 per sec.	2 w.	600 Ω	Flat	1%	$550	a) can also be used as single-frequency B.F.O. b) contains logarithmic amp. for db. measurements.
Clough-Brengle	182-A	25-15,000 c.p.s.	5-6 per sec. 1 per 5-8 sec.	100 mw.	600 Ω 20k Ω	Flat	5%	$165	Can also be used as manual single-frequency, B.F.O.'s.
	282-A	Any 0-10 kc. band between 25-32,000 c.p.s.	2-10 per sec.	100 mw.	600 Ω bal. 4000 Ω unbal.	Flat	0.5%	$425	
Clarkstan	125	40-10,000 c.p.s.	20 per sec.	50 mw.	500 Ω	Flat	—	$165	Uses photoelectric scanning of rotating disc.

SINE-WAVE GENERATORS WITH WIDER RANGE THAN NECESSARY FOR AUDIO ALONE

Manufacturer	Type number	Class	Frequency Range	Output		Output Impedance	Distortion	Accuracy of Calibration	Frequency Drift	Output variation	Hum and noise level	Price
				Matched load	Open-circuit Volts							
General Radio	700-A	B.F.O.	50 c.p.s.- 5 mc.	150 mw.	10-15	1500 Ω unbal.	3%	± (2%+5c.p.s.)	—	(Note 1)	1%	$700
Hewlett-Packard	650-A	R-C	10 c.p.s.-10 mc.	15 mw.	6	600 Ω	1%	—	±2%	(Note 1)	0.5%	$475
Boonton	140-A	B.F.O.	20 c.p.s.-5 mc.	1 watt	32	20-1000 Ω	2%	± (2%+2c.p.s.)	2%+5 c.p.s.	(Note 1)	1%	$1050
Supreme	666	B.F.O.	15-15 000 c.p.s. 65 kc.-60 mc.	150 mw.	35	50/500/5k Ω bal. 50k Ω unbal.	5%	—	—	±1 db.	—	$141.60
Hickok	288-X	B.F.O.	0-15,000 c.p.s. 100 kc.-160 mc.	—	—	—	—	—	—	(Note 1)	—	$282

Note: (1) Contains vacuum-tube voltmeter to read output voltage.

LOW LEVEL VACUUM-TUBE VOLTMETERS

Type	Manufacturer	Model Number	Voltage Range (Full-scale)	Scale Calibration	Frequency Range	Accuracy	Input Impedance	Price
R.M.S. or Average Value Meters	Ballantine	300(1) 302(1,2)	0.01-100	Logarithmic	10-150,000 c.p.s.	3%	0.5 meg., 30 μμfd.	$200
		304(1,3)	0.01-1.0	Logarithmic	30 c.p.s.-5.5 mc.	3% to 5%	1 meg., 9 μμfd.	$225
	Hew ett-Packard	400-A	0.03-300	Linear	10 c.p.s.-1 mc.	3%	1 meg., 16 μμfd.	$185
		400-B	0.03-300	Linear	2 c.p.s.-100 kc.	3%	10 meg.	$195
		400-C(1)	0.001-300	Linear	20 c.p.s.-2 mc.	3%	10 meg.	$200
		404-A(2)	0.003-300	Linear	2-50,000 c.p.s.	3%	10 meg.	$185
	RCA	WV-73-A	0.01-1000	Logarithmic	20-20,000 c.p.s.	5%	1 meg., 25 μμfd.	$149.50
	Instrument Electronics	45(1)	0.005-500	Logarithmic	5 c.p.s.-1.6 mc.	3%	2 meg., 15 μμfd.	$210
		45-B(1)	0.005-500	Logarithmic	5-250,000 c.p.s	3%	2 meg., 15 μμfd.	$200
		47(1)	0.0005-500	Logarithmic	15-20,000 c.p.s.	2%	1 meg., 18 μμfd.	$220
		47-B(1)	0.0005-500	Logarithmic	15-20,000 c.p.s.	—	50 meg.	$235
	General Radio	727-A(2)	0.3-300	Linear	20 c.p.s.-100 mc.	3%	3-5 meg., 16 μμfd.	$180
	Furzehill	378-B/2(1)	0.01-100	Logarithmic	10-500,000 c.p.s.	5%	2 meg.	$522
Peak-reading Meters	Ballantine	305(1)	Peak-to-peak 0.01-1000	Logarithmic	10-100,000 c.p.s.	2%	2.2 meg., 15 μμfd.	$280
	Measurements	67(1)	Peak-to-peak 0.03-300	Semi-log	5-100,000 c.p.s.	2%	1 meg., 30 μμfd.	$235

Notes: (1) Can also be used as voltage amplifier. (2) Battery-operated. (3) Range can be extended to 100 v. by multipliers.

(*Continued on page* 108)

SAVE MONEY SAVE TIME WITH KAYLINE

SALE

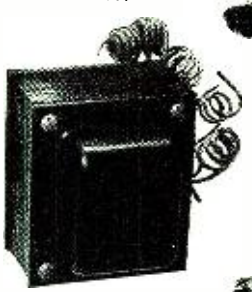
Here Are Great Buys for the Amateur and Serviceman, Industry and Laboratory in Standard and War Surplus.

Dual Filament Transformer

Mfgr. by S.N.C., Type 4P239, Pri. 120 V. 60 cyc. Sec. 2-5V. @ 3.25 A. ... **$1.25**

Westinghouse Step-down TRANSFORMER

Cat. #2F20. Frame 406 V.A. 25. Input 230 V. Output 115 V. 50-133 Cyc. .. **$2.95**



POWER TRANSFORMER

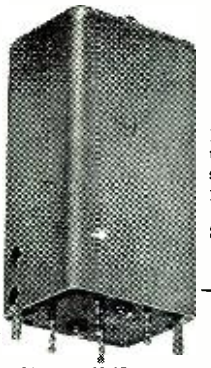
Mfgr. S.N.C., Type 8P192 90 MA with leads. 350-0-350 V., 5V-3A., 6.3 VCT.-4A **$3.25**

Allen-Bradley CONTACTOR

Bul. 700 Type B400 110 V. 60 cyc. Max. Rating: 10 amp 600 V.A.C. 4 contacts... **$2.50**

DYNAMOTOR MODEL 5051

DC input volts 27.0 amps 1.50.
DC output volts 28.5 amps .060..... **75c**



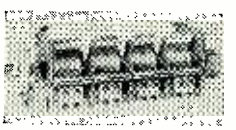
I.F. TRANSFORMER

10.7 MC Band width 50KC. Band width loaded 80KC. Stagger tuning 150 KC. **Good for standard F. M.** Temperature compensated. (Part of SCR-522A) **49c**

BRAND NEW TUBES

1B24	$3.95	371B	$2.95	807	$0.95
2C44	.70	446A/2C40	.70	872A	2.45
2E22	1.39	446B/2C40	.70	826	1.00
2C26	.55	417A	4.95	954	.65
2x2/879	.75	715B	9.95	957	.65
3A4	.49	723AB	7.95	991	.50
3B24	1.25	724B	.95	958A	.65
3B28	1.75	#44 Pilot bulbs—6 to 8 volts	10 for 40c		
5R4GY	1.29	**CRYSTAL X'DIODES**			
5U4G	.60	1N34	$0.99	9006	$0.80
6AC7	1.00	1065/2050	.90	CNU7193	.49
6AG7	1.00	8011	4.95	E1148	.40
6L6GA	.95	8014A	4.95	HY615	1.25
7C4/1203A	.35	9001	.80	VT138/1629	.50
12A6	.45	9002	.80	EF50 (British)	.49
12SH7	.69	9003	.89		
211	1.15				

4 GANG VAR. COND.



11-200 MMF. Each section counterbalanced. Weight approx. 3 lbs. 7⅝" long, 3¼" wide, 2⅞" high. Mounts any position.

Brand New **$1.00**

1" MIDGET METER

In all aluminum case. 0-1MA..... **$3.95**

Westinghouse INERTEEN CAPACITORS

15MFD 5000 V.D.C. Style 1363490C. 1.3 gal. nonflam. lqd. 4 MFD 7500 V.D.C. Style: 1363494. 1.3 gal. nonflam. lqd. Write for prices.
SOLDER 5 lb. spools, rosin core 38/62.....**$3.75**

WAVEMETER

Here's an amazing value on Wavemeters which tune from 150-210 mc and contain high quality resonant cavity wavemeter oscillator heterodyne amplifier electric tuning eye complete with 19 tubes. 110 v. AC power supply. The tubes alone far exceed the entire price of only **$9.95**

TRANSMITTER

Range 150-200 Mc

BC-1072A — An outstanding Kayline value **$19.95**

SYNCHRO-GENERATORS

For immediate delivery. Types: 5F, 5G, 5HCT, 6G, 6SG, 6DG.

Write for Prices

Westinghouse Type SG RELAY

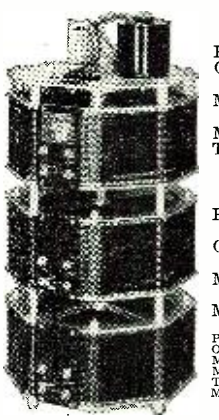
Style #155694, 230 V. 50/60 cyc. Size: 5¼ x 3¾ x 5".

Write for Prices

POWERSTATS

Variable Autotransformer Mfgr. Superior Elec. Co.

Type MX-1156L-3Y
Pri. V. 230 50/60 Cyc.
Output Volt Range 0-230 V.
Max. output 17.9 K.V.A.
Max. output 45 Amps.
Travel time 19 secs.
Motor Driven



Type 1126-3Y
Pri. V. 230 3 Phase 60cyc.
Output volt range 0-270
Max. output 7.0 K.V.A. 15 amps.
Manually operated.

Type MX1226
Pri. V. 230/115, 50/60cyc.
Output volt range 0-270V
Max. output 2.4 K.V.A.
Max. output 9 amps.
Travel time 19 secs.
Motor driven

Write for Quotations

TERMS: All shipments F.O.B. Baltimore, Md. Please send 20% deposit on all orders, balance C.O.D. Minimum $2.00. CABLE ADDRESS: KAYDISCO. Unless otherwise stated, all items are sold as is. Unless otherwise specified, shipments made Railway Express collect.

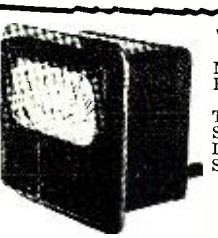
KAYLINE SERVES INDUSTRY & RESEARCH LABORATORY

WESTING-HOUSE METERS

Meter: DC Ammeter
Rating: 0-3 amps., Type KX-24
Ins. Rating: 750 V. Black dial
Size: 4¼ x4¼ x4½"
Same as above with ratings: 0-1 Amps. 0-6 Amps. 0-25 Amps.

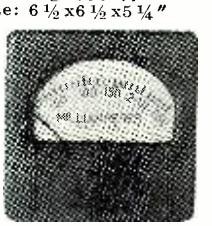
AC VOLTMETER

Rating: 0-600 Volts AC
Type: KX-24 Ins. Ratg. 750V.
Size: 4¼x4¼x7", Black Dial
Same as above with Rating 0-6000DC V.
Size: 4¼x4¼x4½"
Same with rating 0-1000 V. R-F. Black Dial
Same with rating 0-300 V. AC
Size: 4¼x4¼x7", Black Dial



WESTINGHOUSE

Meter: Milliamperes DC
Rating: Two scales 0-25 & 0-250
Type: KX-25
Style: 1058833
Ins. Ratg. 750 V.
Size: 6½ x6½ x5¼"

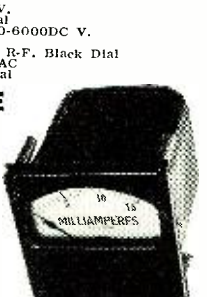


WESTINGHOUSE

Meter: Filament AC
Rating: 0-10 V. Type QA-37
Style: 1055633
Size: 4¼ x4x2¾"

Meter: Milliamperes DC
Rating: Two scale 0-20 & 0-200
Type: QX-37. Style: 1058780-A
Size: 4¼ x4x2¾"

Meter: Line Voltmeter AC
Rating: 0-6 scale line volts, 125-250 V. AC Type: QA-37
Style: 1055632. Size 4¼ x4x2¾"



WESTINGHOUSE

Meter: DC Milliamperes
Rating: 0-15 MA
Type: KX
Size: 4x4¼ x5"

Meter: Filament Meter AC
Rating: 0-10 V.
Type: KA
Style: 1058799-A
Size: 4x4¼ x5"

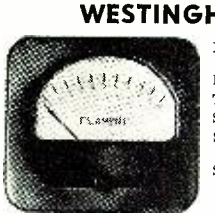
Meter: Line Voltage Preset AC
Rating: 0-6 scale, 15-150 cyc. 125 V-250 V. Type: KA
Style: 1058825-A. With external resistor (10720 ohms) Meter
Size: 4x4¼ x5"

Meter: Line Voltage Selector
Rating: 0-300 V. Type: KA
Style: 1058824-A
Ins. Rating: 750 V. Size: 4x4¼ x5"
With external resistor (11,000 ohms)

OIL FILLED CONDENSERS

Capacitors, 4 MFD, 3000 volts DC.....**$3.95**
10 MFD, 600 volts DC..... **1.00**
Capacitor, 10 MFD, 1000 volts DC..... **1.25**

WESTINGHOUSE



Meter: Milliamperes DC
Rating: 0-250 MA
Type: RX-33
Style: 1203605
Size: 2¼x2¼x1¾"
Same with Rating: 0-500 MA
Style: 1203608

Same with Rtg: 0-150 MA. Style: 1203603
Same with Rtg: 0-25 MA. Style: 1203596
Same with Rtg: 0-1 volts DC. Scaled 0-100
Same with Rtg: 0-300 V. AC (25-125cyc. FS=5MA). Type: RA33. Style: 1204030
Same with Rtg: 0-10 V. AC (25-125cyc. FS=100 MA). Type: RA33. Style: 1204022

WRITE for Detailed Information and Prices

(*Continued from page* 106)

DISTORTION AND NOISE METERS

Manufacturer	Type number	Frequency range	Input level range	Range of distortion meas. (full-scale)	V.T.V.M. range	Noise measurement	Input impedance	Accuracy	Price
General Radio	1932-A	50-15,000 c.p.s.	0.8-30 v.	0.3%-30%	—	—80 db.	100k Ω unbal. 600 Ω bridging	±5%	$575
Hewlett-Packard	320-A	400 c.p.s.; 5 kc.	70 db. attenuator	as low as 0.3%	no v.t.v.m.	—	20k Ω unbal.	—	$75
	320-B	50; 100; 400 c.p.s. 1; 5; 7.5 kc.	70 db. attenuator	as low as 0.3%	no v.t.v.m.	—	20k Ω unbal.	—	$150
	325-B	30; 50; 100; 400; 1000 c.p.s. 5; 7.5; 10; 15 kc.	—	as low as 0.3%	0.03-300 v.	—80 db.	20k Ω, 40 μμfd.	±3%	$350
	330B, 330C	20-20,000 c.p.s.	—	as low as 0.3%	0.03-300 v.	—80 db.	20k Ω, 40 μμfd.	±3%	$425
General Electric	YDA-1	50-15,000 c.p.s.	0.8-30 v.	1%-100%	1 mv.-1.0 v.	—80 db.	100k Ω unbal. 600 Ω bal.	5%	$495
Barker & Williamson	400	50-15,000 c.p.s.	over 0.3 v.	—	3 mv.-0.3 v.	—	—	±10%	$140
Doolittle	CHX-2	150-15,000 c.p.s.	over 1.0 v.	10%-100%	—	—	500k Ω unbal.	5%	$250
RCA	69-C	30-15,000 c.p.s.	0.12-80 v.	0.3%-100%	—	—85 db.	20k Ω/200 k Ω	—	$593.75

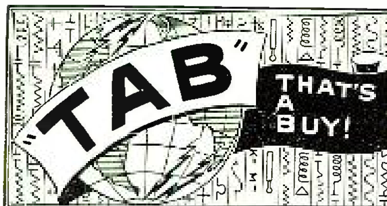
TRANSMISSION MEASURING EQUIPMENT

Type of unit	Manufacturer	Type number	Frequency range	Generator/attenuator section			Load and measurement section		Price
				Output levels	Attenuation range	Output impedance	Input impedance	Level ranges	
Attenuator and measurement set	Daven	10-A	30-17,000 c.p.s.	—	111 db.	30/150/250/600 ohms	4/8/16/150/ 250/600 ohms	+ 4 to +42 dbm.	$550
		11-A	20-20,000 c.p.s.	—	114 db.	30/150/250/600 ohms	4/8/16/150/ 250/600 ohms	+ 4 to +42 dbm.	$325
	RCA	89C	—	—	75 db.	600 ohms	30/250/600 ohms	0 to + 22 dbm.	$312.60
	Cinema Eng.	6343	20-20,000 c.p.s.	—	100 db.	5/30/150/250/ 500/600 ohms	15/30/150/250/ 600 ohms	+ 4 to +42 dbm.	$550
Signal generator and measurement set	Hewlett-Packard	205-AG	20-20,000 c.p.s.	up to 5 watts	110 db.	50/200/600/ 5000 ohms	—	− 5 to +48 db.	$425
	RCA	170-A	20-10,000 c.p.s.	up to 1 watt	—	10/250/500 ohms	250 ohms and high	5 v.-1000 v.	—
	Shallcross	692-A	1000 c.p.s.	—	53 db.	600 ohms	600 ohms	0 to +40 db.	$125

WAVE ANALYZERS AND AUTOMATIC FREQUENCY ANALYZERS

Type of unit	Manufacturer	Type number	Frequency range	Input range (full-scale defl.)	Selectivity	Input impedance	Voltage accuracy	Price
Wave analyzer	General Radio	736-A	20-16,000 c.p.s.	300 μv.-300 v.	4 cycle bandwidth	100k Ω/1 meg.	±5%	$920
		760-A	25- 7500 c.p.s.	1 mv.-10 v.	1% of tuned freq.	20,000 Ω	—	$400
	Hewlett-Packard	300-A	30-16,000 c.p.s.	1 mv.-500 v.	Adjustable 30 c.p.s.-145 c.p.s.	200,000 Ω	±5%	$625
	Western Electric	3-A	2-15,000 c.p.s.	—	Interchangeable 2 c.p.s.-200 c.p.s.	30 Ω and higher	—	—
	Electrodyne	4801	Speech freq.	—	12 simultaneous freqs. from 200-3500 c.p.s. 150 c.p.s. half-band	High impedance	—	—
Automatic spectrum analyzers	Panoramic	AP-1	40-20,000 c.p.s.	500 μv.-500 v.	Variable	250,000 Ω	±10%	$1500
	Kay Electric Co.	Sona-graph	85- 8000 c.p.s.	—	—	—	—	$1795
		Sonalator	Any 4000 c.p.s. band	—	—	—	—	$1150 1400

(*Continued on page* 110)



PRECISION RESISTORS

OVER 2¼ MILLION

"Tab"—Specialists In Precision Resistors—We Ship Types In Stock—Accuracy Up to 0.1 Percent

0.116	125	550	1670	2635	8500	25833
0.42	135	575	1680	2700	8700	26000
0.425	140	580	1710	2750	8770	26500
0.607	147.5	588	1712	2850	9000	26600
0.7	150	600	1740	2860	9100	27000
1.03	160	612	1770	2870	9445	27500
1.3	165	625	1800	2900	9500	28000
1.75	170	633	1818	3000	9710	28430
2.5	175	640	1830	3100	9800	28500
3	179	641	1865	3163	9900	29000
3.83	182	645	1892	3259	9902	29500
3.95	182.4	649	1894	3290	10000	29990
4	200	650	1895	3300	10430	30000
4.35	209.4	657	1896	3333	10500	31000
5	216	665	1897	3384	10600	31500
5.025	220	670	1898	3500	10900	32000
6.25	220.4	673	1899	3509	10936	33000
6.5	225	675	1900	3700	11000	35000
7	230	680	1901	3730	11400	37000
7.8	235	681	1902	3760	11500	38140
7.9	240	684	1903	4000	11690	38500
8	245	689	1904	4030	12000	39000
10.38	245.4	697	1905	4200	12500	39500
11.25	250	699	1906	4220	12600	40000
12	260	700	1907	4280	13000	42000
13.52	271	711	1908	4300	13100	43000
14.2	275	733	1909	4314	13500	45000
14.25	280	740	1910	4440	13550	47000
14.5	286	750	1911	4444	13600	47500
15	289	800	1912	4500	14000	48000
16	299	806	1913	4720	14250	48660
17	300	850	1914	4750	14400	49000
19	310	854	1915	4850	14500	50000
20	311.5	899	1916	4885	14550	52000
22	320	900	1917	4900	14600	53000
23	325	910	1918	5000	15000	56000
25	330	917	1919	5100	16000	57065
26	340	946	1920	5210	16500	58333
28	350	978	1922	5235	16800	60000
30	360	1000	1924	5270	17000	61430
31.5	366.6	1030	1926	5300	17500	62000
37	370	1036	1960	5500	17977	64000
48	375	1067	1980	5600	18000	65000
49	380	1100	2000	5730	18300	66600
50	389	1110	2045	5770	18380	66650
51.78	390	1150	2080	5910	18500	67500
55	400	1155	2095	6000	18800	68000
56.7	410	1162	2141	6100	19000	70000
60	414.3	1175	2142	6125	19500	72000
63	418.8	1200	2145	6140	20000	73500
68	425	1225	2150	6200	20441	75000
74	426.9	1250	2160	6300	20500	80000
75	427	1260	2180	6495	21000	82000
80	440	1300	2187	6500	21500	84000
81.4	450	1322	2195	6840	22000	85000
88	452	1350	2200	6990	22500	85750
89.8	460	1355	2250	7000	22990	88000
90	470	1400	2300	7320	23000	90000
95	475	1488	2400	7500	23150	91000
100	478	1495	2450	7700	23325	93300
101	480	1500	2463	7717	23400	95000
105	487	1510	2485	7900	23500	
105.7	500	1518	2490	7930	24000	
107	518	1600	2500	7950	24600	
120	520	1640	2525	8000	25000	
121.2	525	1646	2600	8094	25200	
					25333	
	540	1650	2625	8250	25400	

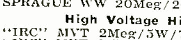
Any Size Above, Each......25c. Ten for......$1.98

100000	175000	245000	380000	620000
110000	180000	250000	400000	650000
115000	180600	265000	402000	654000
116667	185000	268000	420000	660000
120000	186600	270000	422000	690000
125000	190000	275000	425000	700000
130000	198000	294000	450000	716300
135000	200000	300000	458000	750000
140000	201000	307500	470000	761300
141000	205000	311000	478000	800000
145000	210000	314000	500000	813000
147000	215000	316000	520000	850000
150000	220000	325000	521000	900000
155000	225000	330000	525000	930000
160000	229000	333000	543000	950000
165000	230000	333500	550000	
166750	235500	350000	570000	
167000	238000	353500	575000	
	240000	375000	600000	

Any Size Above, Each......35c. Ten for......$2.98

MEGS	1.5	2.11	3.3	4.7	7.5	11.55
1	1.57	2.2	3.5	5	7.62	12
1.1	1.579	2.25	3.673	5.5	7.74	12.83
1.2	1.6	2.5	3.75	6	8	13
1.25	1.65	2.7	3.9	6.3	8.02	13.85
1.3	1.75	2.75	4	6.5	8.5	15
1.39	1.8	2.8	4.23	6.6	9.05	20
1.4	1.9	2.855	4.25	6.7	9.5	
	2	3	4.5	7	10	

Any Size Above, Each......70c. Ten for......$5.98



Vacuum Precision HiVoltage Resistors

Megohms — .12/.25/.6/.75/.83 99/1/1.3 2 5 5.75/4/8.75; ½% accy............**Ea. $1; 10 for $7.50**

HIGH VOLTAGE PRECISION RESISTORS

JAN-R29 MFC105 1Meg 1KV/½% accy..**$1.98;6for$10**
SPRAGUE WW 20Meg/20KV ½%accyJan......**$15.95**

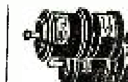
High Voltage High Frequency Resistors

"IRC" MVT 2Meg/5W/7.5KVwkg....**$1.08;10/$ 8.98**
"IRC" MVT 2.5Meg/5W/7.5KVwkg... **1.08;10/ 8.98**
"IRC" MVP 5Meg/10W/10KVwkg.... **1.49; 8/ 10.00**
"IRC" MVP 7Meg/10W/10KVwkg.... **1.49; 8/ 10.00**
"IRC" MVP 10Meg/10W/10KVwkg... **1.49; 8/ 10.00**
SPRAGUE 12Meg/10W/10KVwkg.... **1.49; 8/ 10.00**
"IRC" MVZ 30Meg/20W/25KVwkg... **1.98; 6/ 10.00**
"IRC" MVE 50Meg/25W/40KVwkg... **1.98; 6/ 10.00**

DAVEN ATTENUATORS—Brand New

P250pot50000ohms/20pos $1.98
CP630pot5000ohms/30pos 2.49
T320"Tee"dual5000/20pos 2.98
IRC 100Kohm/20pos 1.98
IRC 250Kohm/20pos 2.49

Rheostat 20ohm/50W w/knob&D'plate 69c
Rheostats 25W IRC&Ohmite SlottedShft350,500,1500 & 5000ohms. 3 for 98c



2JIGI-GE SELSYNS

Plus Data for 24V or 110V 60 cycop-er. Used TESTED Sensational Buy. **2 for $2.49**

HEINEMANN Magnetic Circuit Breakers

for AC and DC operation AMPERES .01, 2, 3, 7, 7.9, 15, 20, 30, 35, 80, 180 and 220 Amps. SPECIAL, Each **$1.49**; 10 for **$12.98**; 100 for **$120.**
KLIXON Thermal Push-Button Type C'BKRS AMPERES: 5, 10, 15, 30, 35 Amps. Each..............**79c**
10 for **$5.98**; 100 for **$45.00**
SQUARE-D Toggle Switch AN Type C'BKRS AMPERES: 5, 10, 20, 25 Amps. Each................**89c**
10 for **$7.98**; 100 for **$69.00**

UHF ANTENNA

Go Mobile with this 12"/30cm UHF Antenna AT5/ARRI Convertible Citizens' Band Threaded Coax Term Insltd Sil Pl Cont w/ waterpf gask flange &hardware forMOBILEmtgBRANDNEW **39c**
4 for **$1.00**;PL259 for above **29c**
ANT AN 130B Spring Swiveled Whip 33" lg....SPECIAL **98c**
ANT AN131A, 11 ft Compr Spring 8 Sections.......**98c**
MAST BASE MP22.....**$3.95**
MAST BASE MP48..... **3.98**
ANT MS49 to 52, 12½ ft. Whip **$1.69**
ANT MS 49 to 53, 16 ft Whip.. **2.49**
W/extra MS53, 19 ft...... **3.69**
ANT MS49 to 56 2-53's), 26½ ft Whip **5.98**

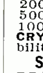
CRYSTAL DIODE SPECIALS!

1N21..........**39c**; 3 for **$ 1.00**
1N34.....**84c**; 2/**$1.59**; 10/ **7.98**
1N43.........**$1.25**; 10 for **10.00**
1N44.........**85c**; 10 for **7.50**
1N45.........**$1.00**; 10 for **8.39**
1N48...**$1.15**; 2/**$2.20**; 10/ **10.49**
1N51...**$1.08**; 2 **$2.09**; 10/ **9.98**

Xtal Htr Oven

Aluminum Cover&Case for ANY FT-243 MtdXtal.Oper 4 to 28 vacdc.......**98c**

CRYSTALS



Mtd FT243 exacting S.C. Spcs
3525Kc 4190Kc 5235Kc
3735Kc 4780Kc 5485Kc
3980Kc 5030Kc
ea. **98c**; 3 for **$2**
Write for other frequencies.
RochelleSaltCrystals **69c**; 10 for **$5.00**
Hi Accy Xtal Frequency Standards
200Kc ...**$3.98** | in BC221 **$2.95**
500Kc ... **3.98** | 4700Kc .. **.98**
1000Kc. useable | 5000Kc .. **3.98**
CRYSTALS—Mtd htr Ovens HiAccyStability 5010,5025,5035Kc. ea. **$14.98**

Sig. Corps Dry Batteries—Gtd.

BRAND NEW Shelf Dated—Tested

BA34 7½/6/4½/3/1"NegV ..**$0.39**
BA35 1½VsimBURG 4FH.... **.39**
BA36 45,22½V BURG5308... **.89**
BA37 1½V Walky-Talky..... **.29**
BA38 103½V Walky-Talky.. **1.49**
BA39 150/7½VBurgFSA100.. **1.69**
BA40 90/1½VBurg4GB60 ... **1.19**
BA41 60/25½/4½V .... **.89**
BA43 90/45/1½V .... **.98**
BA51 67½V MiniMax....... **.89**
BA70 90/60/4½V **2.50**
BA205U 3V Burg F2BP..8 for **1.00**
WESTON STANDARD CELL 1.0194 Volts Average UnMtd........**$3.98**

G-E Portable Radio Battery

2V/25AH STORAGE BATTY/Perfect substitute for RADIO 25-2 for G-E Portables. Fits Identical Space (6x 2½x2½").Mfrd WILLARD.Wire leads readily soldered to same connections. A Seven Dollar Buy for ONLY..**$2.98**
STORAGE BATTYS
2V/11AH Willard BB206U....**$1.89**
2V/27AH Willard BB54...... **1.89**
4V/40AH Willard TBY. Not New **3.95**
6V/6AH Willard NT6........ **1.75**
6V/25AH Willard........... **3.98**
6V/40AH Willard **6.98**
6V/25AH Willard........... **3.98**
36VminER18/BB52 ....**81c**

HOOKUP WIRE SPECIAL!

1000ft HookupWire 100ft asstd rolls ONLY..............**$2.49**
Plug & Cord Sets 6 ft UL. 10/ **1.20**
Intercom & Spkr Wire Twisted 500 ft **3.49**
16 ft SJ Ext Cord Hvy Dty Male & Female Plugs.......... **.98**
Wire #10, 1000 ft.........**12.95**
Wire #18, 1000 ft AN...... **4.50**
RG-8U Coax. 100 ft......... **4.98**
CABLE Std HiV HvyDty 25 ft.. **.49**
"SJ" HvyDty 2-cond Std. Ft.. ....
3c: 100 ft............... **2.49**

ROTARY SWITCHES

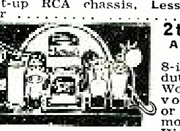
Decks	Ckts/Deck	Pos/Ckt	EACH
1	1	2	15c
1	1	3	18c
1	1	4	19c
1	1	6	27c
1	1	21	36c
1	2	2	19c
1	2	4	27c
1	2	5	30c
1	3	2	21c
1	3	3	25c
1	4	2	25c
2	1	2	19c
2	1	4	30c
2	1	5	35c
2	1	7	39c
2	1	9	45c
2	1	11	49c
2	2	3	41c
2	2	5	49c
2	4	2	45c
3	1	11	55c
3	2	4	39c
3	3	3	49c
4	1	6	59c
4	1	7	63c
6	2	5	79c
Steatite Insulation—HiV & RF			
1	1	6	69c
1	2	2	49c
2	2	3	79c
2	2	4	89c
2	2	5	95c
2	3	3	98c
3	3	3	99c
5	3	3	$1.23
5	1	6	1.05
6	2	5	1.49

AMPLIFIER KITS—10 Watts Hi Fi

HIGH FIDELITY—20 to 20,000 cps. Self-balancing, cathode follower circuit with perfect linear response, phase inverter, 2—2A3/6B4G PP, 6SJ7GT, 6SN7GT. All parts, tubes,data,less output xfmr **$14.95** Incl built-up RCA chassis

Super Wide Range High Fidelity

Frequency 20 to 20,000 cps. Max. Harmonic Distortion 1¾% at full output; only 0.5% at 5 watt output. Works with ANY Mike, Pickup or RCVR. Incorporates ALL-ELECTRONIC stage for use with GE/Pickering etc. Var. Reluc. magnetic pickup. SEPARATE Electronic Bass and Hi-Freq Tone Boost Tube Ckts. Self-balancing cath foll, phase inv, 2A3/6B4G PP output, 4 other stages plus all Pwr & built-up RCA chassis, Less Output Xfmr **$24.95**

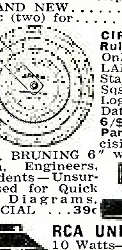


2 to 4 Watt Amplifier Buy!

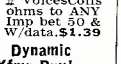
8-in. heavy duty spkr. Works 110 volts AC or DC. Removedfrom Hi-Fi Demonstrator. Includes 3 tubes, volume and tone controls, mike or phone jack. Black crackle panel for case or cabinet. Ready to operate. W/Data. ONLY **$4.98**

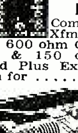
RM29A Control Unit

Complete, Self-Contained Incl Ringer Circuit. 3-Position locking type selector provides 3 types of traffic: Monitor or Direct Radio Control or as a Telephone.
BRAND NEW............ **$8.95**
Pair (two) for.............**$15.98**



CIRCULAR Slide Rule. Equiv. 12"—Only 2-⅛" Radius. LAMINATED—Print Stays On! Mult. Div. Sqs. Cubes & Roots, Log & Dec Scales Data & Case **98c**: **6/$5.**
Parallel Rules. Precision Drafting Tool Mfr. BRUNING 6" wide. For Radiomen, Engineers, Students—Unsurpassed for Quick Ckt Diagrams. SPECIAL ...**39c**





RCA UNIV Output Xfmr

10 Watts—Up to 10,000 cyc MatchesANY # VoicesCoils 3 to 4 or 15 ohms to ANY Load & Tube Imp bet 50 & 10240 ohms W/data.**$1.39**

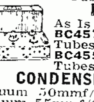
Hi Gain Dynamic Mike & Xfmr Buy!

Comb hi-gain Dyn Mike Xfmr UTC!Super Elect 3 wdg 600 ohm CT&4000 ohms Tapped 250 & 150 ohms. Fully Shielded H'sld Plus Exc Fidelity Dyn Mike. Both for **$1.49**

HI-POWER VARIABLE ANTENNA MATCHING NETWORK 1001A
1 KW RF, 1.5 to 7 Mc's Convertible High-Freq's, Pi - Network Adj INorOUT, Cased 15x15x 23"Rack Mtg, Ribbon Coil & 240mmf/7000 volt Condenser, RF Meter, HiV insulators and Manual. Will Match Most Antennas. Etched Dials BRAND NEW. Worth 10 times the price for parts alone! (Coil Dmgd) **$7.98**

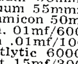
DYNAMOTORS

NEW HiEff ALNICO P'Magnet 12/24 V inpt "TAB" Tested GTD 6Vinpt/ 3A, outpt 240V/100ma or 125ma Int duty Rated 500V/50ma @ 12 or 24Vinpt "TAB" Special......**$3.49**
12 or 24V inpt, 275V/110ma & 12V/ 3A Alnico P'magnet.........**$1.95**
PE-94A, BENDIX MG-1A, 24-28VDC inpt, outpt300V/260ma, 150V/10ma, 14.5V/5A inpt & outpt filters, VReg & start relays **$9.95**
GE/WestElecDyn p/oModulatorSCR274 28VDCinpt/5Acont/7Aint, outpt 575V/ 160ma Cont, 540V/250ma Int Good Used **$1.49**
CORD CD-277 & PLUG PL-114. For Revrs BC-312-314-342-344. Fits Socket SO-4. BRAND NEW O'Seas Pkgd. **$1.98**



COLLINS ART13

5pch Amplif Dyn/Carbon Mike or Line Inpt. Aud Driver PPG & Monitor Tube. Less Tubes.**$3.98**
Same w/CLIPPER Kit, Tubes & Data....**$6.98**

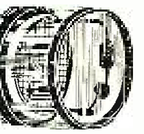


BC456 MODUL

As Is Less Tubes&Dyn.**98c**
BC457 Xmtr. As Is. Less Tubes **$3.49**
BC455 Rcvr 6-9.1 Mc Less Tubes&Dyn. As Is..**$4.95**

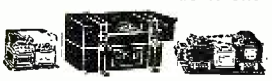
CONDENSER SPECIALS

Vacuum 50mmf/7500v **$0.98**
Vacuum 55mmf/20000v...... **4.89**
Ceramicon 50mmf Button..10/ **.98**
Mica. 01mf/600wv Tobe DP.12/ **.98**
Mica .01mf/1000vt CD 4LS.4/ **.98**
Electlytic 6000mfd/15vac.... **.98**
Elect 15mf/300vdc Sprague.7/ **.98**
Elect 50mf/350vdc FP Sprague.5/ **.98**
Elect50mf/350vdcFPSprague.5/ **.98**
Elect 30-15-10mf/250v....5/ **.98**
Elect40mf/250v&20mf/25vdc.6/ **.98**
Elect 30mf/450v & 2x20mf/ 25vdc FP **4.98**
Elect 10mf/450v & 2x20mf/ 25vdc FP ....5/ **.98**
TubularPaper.009mf/600vdc 20/ **.98**
Tubular Paper .05mf/150wv.30/ **.98**
Tubular Paper .05mf/600wv.15/ **.98**
Tubular Paper .1mf/150wv.25/ **.98**



SNOOPERSCOPE INFRARED
Image - Converter Tube. HISensivity simplified design 2" dia., Willemite screen. Complete data & Tube.
"TAB" SPECIAL **$7.90**
2/14.49; 5.28.75

CONSTANT VOLT REGULATORS



ConstV'Reg RaytheonInpt198-242V/50-60 cyc; Out 220V/500W/½% Rgltn Rack Mtg **$36**
ConstV'Reg SOLA USN Csd Inpt 95-190 V/50-60 cyc; Outpt 115V/2KW/17.4A ConstDty1%RgltnLN* $130: SameNEW $369UScost. Only **$162**
ConstV'Reg SOLA Inpt 92-138V/60cyc; Out 115V/26.1A/3KVA. NEW...**$185**
Const V'Reg SOLA Inpt 105-125V/60 cyc; Out 115V/80Watt. NEW..**$16.95**
Const V'Reg G-E Inpt 95-130V/57-63cyc; Out 113/115/117V, 0.78KVA at 0.80PF. Used Gtd $54; NEW...........**$79**

XTRA SPECIAL—New TV Parts

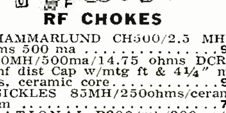
Width Control Sim 201R4.....**$0.39**
Focus Coil Sim 202D2........ **4.98**
HV-Horiz & Defl Outpt Sim 211T5 & ckt Data **2.98**
UTAH 9318 HBO Xfmr H'Sld... **.89**
UTC 88662 VBOXfmr H'Sld.... **.89**
TV Yoke SPECIAL........... **2.49**
Focus Coil Maga Kinescps..... **2.98**
ERIE HiV Cndsr 500mmf/10KV. **.39**
JEFFERS Cndsr 500mmf/20KV.. **.69**
IonTrapMagnetRCA203D1 ...... **.98**
RCA HiV DeflXfmr211T1....... **4.98**
V'OutptXfmrSimRCA204T2 .... **2.69**
TWINEX TV 300ohmCable 100 ft. **1.10**
TV TWINEX TACKER......... **2.98**
500HvyDtyStaples Boxed **2.98**

I-F XFMRS

456Kc Double Slug Tuned. Shielded..Ea. **39c**; 3/**$1.00**
Telev & FM I-F Xfmr 10 to 14 Mc Double Slug Tuned Adjustable Q Shielded. Ea. **59c**; 2 for **98c**

HAYDON CLOCK MOTOR & SWITCH

Synchronous 6 to 10 VAC/60 cy/24RPM & Switch **98c**; 12 for **$10.00**
SYNC 1RPM/115V/60cy **$2.49**



RF CHOKES

(A) HAMMARLUND CH500/2.5 MH 8 ohms 500 ma **98c**
(A) 20MH/500ma/14.75 ohms DCR 8 mmf dist Cap w/mtg ft & 4¼" mtg ctrs, ceramic core...........**98c**
(B) SICKLES 85MH/250ohms/ceramic form **70c**
(C) NATIONAL R300/mh/300ma/10 ohms @ **28c**..........4 for **98c**
(C) Two 2.5MH/125ma & .01 & .002 cdsr & Resist...............**45c**
(D) 5MH/300 ma, pi wound......**29c**
(E) MILLER 2½ & 5 mtr/2.5MH/.27 ohms/1A @ **25c**........5 for **98c**
(F) Nat'l R152/80 & 160 mtrs/4MH/ 600ma/10 ohms **98c**
(G) SICKLES HF 20MH/200ma/75 ohms **49c**
(H) Hash Chokes for Mercury Vapor Rec @ **25c**..............5 for **98c**
(I) SICKLES 1.5MH/200 ma. Ea. **25c**; 5 for **98c**

RELAYS—FAMOUS MAKE

W.E.263A Telephone 275ohm dual coil 2 section each 25 pole DPNO paladium cts. **$10.95**
CLARE A12280/115V—60cy/3SPDT & 3SPNC **$2.98**
CLARE Octal based 115VAC/DPNC & SPNO **$3.98**
CH/B8/operates 7 to 24 VDC/200 to 1200 Amps **$2.98**
S'DUNN 32AXX10 Reset & o'load 10 ma & 115 VAC.............**$4.95**
KURMAN 4ma Sens 65 0ohm/DPINO & INC/5 Amp **$2.25**
A Bradley 702/110VAC/3PSTD break 25 Amp **$4.49**
ADVANCE 4001B Antenna DPDT&SPNO 15Amp. Ceramic HF ins 75 to 110V **$2.75** @ Rec 115 VAC......**$3.25**
A Bradley Overload adj18.1/15.2/12/9 & 5.3A **$3.98**
CLARE VAC Nitrogen sld SK5010/DP DT/18-28V 2Amp Cts octal base @ **$1.49**; w/115VAC rect.....**$1.98**
GE Inst V'Rel Calib 70, 85, 110, 160V for 115 VAC.............**$9.95**
A'Bradley 110VAC/3PST/30A dbl b k **$4.49**
GE CR2792B 117A3/28V/50A/SPNO Dbl'Bk **$1.98**

KITS . . .

Kit Silver & Mica Condsrs..50/**$2.00**
Kit Silver & Mica Condsrs..30/ **1.50**
Kit Controls 50-2 meg Pots..10/ **2.00**
Kit Resistors ½&1 w/50 to 2 meg 100/ **2.50**
Kit Vitreous WW Resistors..20/ **1.00**
Kit Sockets Asstd (8-7-5-4P..25/ **2.49**
Kit Power Rheos. 25&50Watt..6/ **3.49**
Kit Rotary Switches Asstd....6/ **1.75**
Kit G&P Tube Caps ¼, ⅜, 9/16" 50/ **1.49**
Kit Coil Forms Thd'd sm. HF..50/ **1.00**
Kit Iron Core Slug & Screw..50/ **1.00**
Kit Elastic Stop Nuts Asst..50/ **1.00**
Kit Lugs Large Radio Elec. Type 100/ **1.00**
Kit Lug Small Radio Type..300/ **1.00**
Kit Knobs Asst'd with Insert..25/ **1.25**
Kit Spaghetti Sleeving Asst'd ....75 ft./ **1.00**
Kit Ceramicon Condsrs Asst'd..15/ **1.00**
Kit Fuses Asst'd Buss & Lf.300/ **1.95**
Kit Grommet Rubber Radio Assorted 100/ **1.00**
Kit Resistors 2W Asst'd...100/ **3.50**

THAT'S A BUY "TAB" THAT'S A BUY
DEPT. 11 RN SIX CHURCH ST. NEW YORK 6, N.Y., U.S.A. - CORNER CHURCH & LIBERTY STS. ROOM 200

$3 Minimum Order F.O.B., N.Y.C. Add Shipping & 25% Deposit

MUELLER Test Clip Insulators

Red & Black Prs.—20% Off Lots of 10

No. 13/Clip 11, 11A. Pair **72c**
No. 26/Clip 24, 24A. Pair **26c**
No. 23/Clip 21, 21A. Pair **46c**
No. 47/Clip 45, 45C. Pair **12c**

(*Continued from page* 108)

INTERMEDIATE LEVEL VACUUM-TUBE VOLTMETERS

Manufacturer	Model Number	Voltage Range (Full-scale)	Scale Calibration	Frequency Range	Accuracy	Input Impedance	Price
Measurements Corp.	62	1.0-100	Linear	30 c.p.s.-150 mc.	2%	2 meg., 7 μμfd.	$135
General Radio	1800-A	0.5-150	Linear	20 c.p.s.-500 mc.	2%	25 meg., 3.1 μμfd.	$345
Furzehill	281	1.5-150	Linear	50 c.p.s.-250 mc.	2%	4 meg., 9 μμfd.	$360
Barber	VM-27	1.0-100	Linear	50 c.p.s.- 50 mc.	2%	4 meg., 5 μμfd.	$150
	LKV-300	3-300	Linear	20 c.p.s.-300 mc.	3%	3.5 meg., 4 μμfd.	$60

INTERMODULATION ANALYZERS

Manufacturer	Type number	Signal generator section				Analyzer section				Price
		Low freq.	High freq.	Output level	Output impedance	Input impedance	Required input volts	Ranges (full-scale defl.)	Accuracy	
Pickering	502	100 c.p.s.	4000 c.p.s.	−10 vu. to −100 vu.	30/210/600 Ω	1.2 meg.	1.0 volt	5%; 15%; 50%	—	$550
Western Electric	RA-1257 RA-1258	40; 60; 100; or 150 c.p.s.	1k; 2k; 7k; or 12k c.p.s.	+23 to −105 dbm.	600 Ω	600 Ω or 1 meg.	−30 to +30 dbm.	5%; 15%; 50%; 100%	±5%	—
Altec-Lansing	—	40; 60; or 100 c.p.s.	2k; 7k; or 12k c.p.s.	—	600 Ω	600 Ω	−70 to +40 dbm.	0.3%; 1%; 3%; 10%; 30%; 100%	—	—

Audio Test Instruments

(*Continued from page* 72)

(a) Condenser microphones as sound standards
(b) Sound-level meters

IV Instruments for measurement of characteristics of audio signals
(a) Distortion and noise meters
(b) Harmonic and wave analyzers
(c) Audio spectrum analyzers
(d) Frequency meters
(e) Wow meters

V Multiple instruments (Signal source/meter in one unit)
(a) Transmission measurement sets and audio chanalysts
(b) Intermodulation analyzers

VI Accessory units
(a) Calibrated attenuators
(b) Auxiliary instrument amplifiers
(c) Universal impedance bridges

VII Miscellaneous measuring and accessory instruments

This classification has been followed in all the listings of test equipment in the various tables in this article, and a complete index indicating where each table may be located is included at the bottom of this page.

The tables themselves are complete and self-explanatory. Each table represents a complete listing of the commercial units which are available for performing the particular function. It also includes the basic specifications, characteristics, and prices of the instruments listed, to aid in their selection to fit specific needs. Wherever certain information is not included in the table, it is because the information is not available or is not listed in the specifications.

There have also been included in this listing certain units which are not strictly considered audio test equipment, but which are useful accessories in performing tests on audio systems. Signal tracers and auxiliary instrument amplifiers might be considered in this category. In these listings a certain amount of judgment has been exercised in deciding what should be considered test equipment and what should be omitted. (For example, commercial broadcast and other audio amplifiers have not been included in the auxiliary amplifier listing, even though some of them may have characteristics superior to those listed.)

The first table lists the names and addresses of all of the manufacturers represented in the various tables, in the event further information about any of the instruments is desired. In many cases, local distributors can also furnish considerable additional information.

—30—

INDEX TO TABLES

SELENIUM RECTIFIERS — and — ELECTRONIC COMPONENTS

THREE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-126 VAC Type #	Current	Output 0-130* VDC Price
3B7-4	4 AMP.	$32.95
3B7-6	6 AMP.	48.90
3B7-15	15 AMP.	70.00

Input 0-234VAC Type #	Current	Output 0-250*VDC Price
3B13-4	4 AMP.	$56.00
3B13-6	6 AMP.	81.50
3B13-15	15 AMP.	120.00

CENTER TAPPED RECTIFIERS

Single Phase

Input 10-0-10VAC Type#	Current	Output 0-8*VDC Price
C1-10	10 AMP.	$6.95
C1-20	20 AMP.	10.95
C1-30	30 AMP.	14.95
C1-40	40 AMP.	17.95
C1-50	50 AMP.	20.95
C1-80	80 AMP.	28.95
C1-120	120 AMP.	38.95

CUSTOM DC POWER SUPPLIES

Built to your specifications. For:

- INDUSTRY
- LABORATORIES
- UNIVERSITIES
- GOVERNMENT AGENCIES

We will be pleased to quote on your requirements.

SINGLE PHASE FULL WAVE BRIDGE RECTIFIERS

Input 0-18VAC Type #	Current	Output 0-12*VDC Price
B1-250	250 MA.	$0.98
B1-500	500 MA.	1.95
B1-1	1 AMP.	2.49
B1-1X5	1.5 AMP.	2.95
B1-3X5	3.5 AMP.	4.50
B1-5	5 AMP.	5.95
B1-10	10 AMP.	9.95
B1-15	15 AMP.	13.95
B1-20	20 AMP.	15.95
B1-30	30 AMP.	24.95
B1-40	40 AMP.	27.95
B1-50	50 AMP.	32.95
B1-60	60 AMP.	36.95
B1-80	80 AMP.	44.95
Input 0-36VAC Type #	**Current**	**Output 0-26*VDC Price**
B2-150	150 MA.	$0.98
B2-250	250 MA.	1.25
B2-300	300 MA.	1.50
B2-450	450 MA.	1.95
B2-1	1 AMP.	3.95
B2-2	2 AMP.	4.95
B2-3X5	3.5 AMP.	6.95
B2-5	5 AMP.	9.95
B2-10	10 AMP.	15.95
B2-15	15 AMP.	24.95
B2-20	20 AMP.	27.95
B2-30	30 AMP.	36.95
B2-40	40 AMP.	44.95
Input 0-54VAC Type #	**Current**	**Output 0-38*VDC Price**
B3-150	150 MA.	$1.25
B3-250	250 MA.	1.95
B3-600	600 MA.	3.25
B3-5	5 AMP.	13.95
B3-10	10 AMP.	24.95
Input 0-72VAC Type #	**Current**	**Output 0-50*VDC Price**
B4-600	600 MA.	$3.95
B4-3	3 AMP.	14.95
B4-5	5 AMP.	17.95
B4-10	10 AMP.	27.95
Input 0-115VAC Type #	**Current**	**Output 0-90*VDC Price**
B6-150	150 MA.	$1.95
B6-250	250 MA.	2.95
B6-600	600 MA.	5.95
B6-750	750 MA.	6.95
B6-1X5	1.5 AMP.	10.95
B6-3X5	3.5 AMP.	18.95
B6-5	5 AMP.	24.95
B6-10	10 AMP.	36.95
B6-15	15 AMP.	54.95
Input 0-234VAC Type #	**Current**	**Output 0-190*VDC Price**
B13-600	600 MA.	$12.95
B13-1X5	1.5 AMP.	19.95
B13-3	3 AMP.	35.95
B13-5	5 AMP.	48.95
B13-10	10 AMP.	69.95

*Select Proper Capacitor to Obtain Higher DCV Than Indicated.

RECTIFIER CAPACITORS

CF-14	3000 MFD	12VDC	$1.69
CF-15	6000 MFD	12VDC	2.95
CF-1	1000 MFD	15VDC	.98
CF-2	2000 MFD	15VDC	1.69
CF-20	2500 MFD	15VDC	1.95
CF-3	1000 MFD	25VDC	1.25
CF-4	2X3500 MFD	25VDC	3.45
CF-5	1500 MFD	30VDC	2.49
CF-6	4000 MFD	30VDC	3.25
CF-7	3000 MFD	35VDC	3.25
CF-8	100 MFD	50VDC	.98
CF-19	500 MFD	50VDC	1.95
CF-16	2000 MFD	50VDC	3.25
CF-21	1200 MFD	90VDC	3.25
CF-9	200 MFD	150VDC	1.69
CF-10	500 MFD	200VDC	3.25
CF-12	125 MFD	350VDC	2.49

RECTIFIER TRANSFORMERS

All Primaries 115VAC 50/60 Cycles

Type #	Volts	Amps.	Price
XF15-12	15	12	$3.95
TXF36-2	36	2	3.95
TXF36-5	36	5	4.95
TXF36-10	36	10	7.95
TXF36-15	36	15	11.95
TXF36-20	36	20	17.95
XFC18-14	18VCT	14	5.95

All TXF Types are Tapped to Deliver 32. 34, 36 Volts. XFC Type is Tapped to Delive 16, 17, 18 Volts Center Tapped.

RECTIFIER CHOKES

Type #		Amps.	Price
HY5	.02 Hy	5	$3.25
HY8X5	.02 Hy	8.5	7.95
HY10	.02 Hy	10	9.95
HY12	.02 Hy	12	12.95
HY15	015 Hy	15	13.95

RECTIFIER SURGE PROTECTION

When an inductive DC circuit is opened, a high-voltage surge is produced that may damage a rectifier power supply. This danger can be reduced by the application of a non-linear resistance device known as Thyrite. Further information will be found in Catalog No. 719.

RECTIFIER MOUNTING BRACKETS

For Types B1 through B6, and Type C1 ..... $0.35 per set
For Types B13 ..... .70 per set
For Types 3B ..... 1.05 per set

RECTIFIER KIT No. 612-10

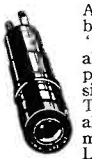
6 and 12 VDC at 10 Amps.

This unit will deliver unfiltered direct current for operation of motors, dynamotors, solenoids, electroplating, battery charging and similar equipment
The two output voltages can be used simultaneously, and can be varied above and below their nominal ranges.
Complete with schematic diagram and instructions; Shpg. wt., 12 lbs. **$15.95**

FILTER KITS FOR No. 612-10

1 section choke input, 10% ripple.. **$ 9.64**
2 section choke input. 2% ripple. **19.28**

PILOT LIGHT ASSEMBLIES



Aircraft type, panel mounting, amber jewel. Knurled rim controls "DIM-BRIGHT." Bakelite and aluminum construction. Bulb replaceable from front panel. For single contact bayonet bulbs, up to T-3¼ size. Dimensions: 2¾" overall length, ¾" diameter, ⅝" panel mntg. hole. IMMEDIATE DELIVERY. 500 to carton, nested.

Request sample and prices on company letterhead.

WRITE FOR SELENIUM RECTIFIER CATALOG NO. 719 ON COMPANY LETTERHEAD

VACUUM CAPACITORS

Standard Brands

12 Mmfd.	20 Kv	$4.95
50 Mmfd.	20 Kv	4.95
50 Mmfd.	32 Kv	5.95

OIL CONDENSERS

2 Mfd. 200VDC Bathtub	$0.20
.5 Mfd. 400VDC. Telephone Type	.20
2 Mfd 400VDC Bathtub	.30
2X.1 Mfd 600VDC Bathtub	.39
6 Mfd. 600VDC w/mtg. clamp	.79
8 Mfd 660VAC/2000VDC w/brkts	3.50
.15-.15 Mfd 8000VDC Voltage Doubler Type 26F381 w/brkts	3.95

SPECIAL—LIMITED QUANTITY

Sprague Vitamin Q Photo-Flash Capacitors. 8 MFD—3000 VDC—36 watt/sec. 4½"x3¾" x1¾". Weight, 1 lb., 12 oz. each.
Price ..... **$5.95 ea.**
3 for $15.00

ATTENTION !!.

Bulletin No. 713, listing various government and commercial surplus items, is now available upon request.

VOLTAGE REGULATORS

These solenoid operated carbon pile regulators will stabilize the output of 12-18 VDC power supplies, simply by connecting the coil leads across the output of the rectifier, and the carbon element leads in series with the load. Price each **$2.49**

D-C POWER SUPPLY FTR 3377-AS

Rating 115 VAC to 115 VDC, .77 Amperes. Operates fans, motors, magnetic chucks, business machines, relays, etc. Descriptive literature available.
Brand new, ready to operate **$16.50**

D-C PANEL METERS

Attractive, rugged, and reasonably priced. Moving vane solenoid type with accuracy within 5%.
0- 6 Amperes D-C
0-12 Amperes D-C — Any range $2.49 each
0-15 Volts D-C

Minimum order $3.00. NO C.O.D.'s under $25.00. 25% deposit on C.O.D. Add 10% for Prepaid Parcel Post and Handling. Terms: Net 10 days in the presence of approved credit.

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Within the Industry

(*Continued from page 28*)

the organization of manufacturers' representatives that bears his name. Besides his work with that group, he is national secretary-treasurer of "The Representatives" of Radio Parts Manufacturers, Inc.

* * *

ALBERT DELIGHTER has been named assistant to the president of *Standard Transformer Corporation,* Elston, Kedzie, and Addison Sts., Chicago, Ill.

A native of Chicago, Mr. Delighter joined the firm three years ago and was employed in the accounting and cost accounting departments. He attended Northwestern University and Carleton College and is a veteran of the Army Air Corps.

* * *

"THE REPRESENTATIVES" of Radio Parts Manufacturers, Inc., Los Angeles Chapter, elected three sales representatives to the group, bringing the total membership to 47 and making it one of the largest regional chapters within the national organization.

Elected to senior membership were Robert M. Hardie and Richard E. Osborne, both of 1127 Wilshire Blvd., Los Angeles 14, California. Frederick Ireland, 1000 No. Seward Ave., Hollywood 88, California, was made an associate member.

* * *

GEORGE G. EDLEN, a recent addition to the sales organization of *M. J. Shapp and Co.,* 121 N. Broad St., Phila., Pa., will make his headquarters in Baltimore and will contact manufacturers and government agencies in the Baltimore-Washington area. A graduate physicist, Mr. Edlen has done radar research at M.I.T., and prior to joining the *Shapp Co.* was research engineer at Johns Hopkins in Baltimore. . . . **KEN STARKEY** is the new general manager of the *Pilgrim Distributing Company,* 910 W. Jackson Blvd., Chicago, Ill., which handles *Sylvania, Radiart, Amphenol, Centralab, Jerrold, Webster, Quam Nichols, Astatic,* and *Merit* products, besides those of companies in other fields. Mr. Starkey brings a wide experience in the radio parts industry to his new post. . . . **SAM M. HARPER,** former sales executive for *John Meck Industries, Inc.,* of Plymouth, Indiana, has been given the post of director of the company's special products division. Mr. Harper will carry on his duties at the Plymouth location and will supervise development and sales of contract and private label TV items. . . . The new advertising and sales promotion manager of the *Trans-Vue Corporation* will be **FIL MANDL,** who was previously associated with the *Harry J. Lazarus Advertising Agency* in Chicago. —30—

WAR SURPLUS - SPECIAL SALE!

BC-604 TRANSMITTER FM 20-28 MC

11 and 15 meters. Can be operated on 10 meters—10 channel push button crystal. With all tubes and meter but less dynamotor.

Excellent Condition **$12.95**

Crystals—Set of 80 .... **14.95**

BC-605 INTERPHONE AMPLIFIER

Easily converted to an ideal inter communications set for office—home—or factory.

Original—New..... **$4.95**
Like New..... **3.95** } with schematic

CONVERSION DIAGRAM AND INSTRUCTIONS
complete with necessary parts.

This kit consists of 3 tubes—2 speakers—1 speaker baffle (for remote speaker)—100 ft. 2-cord cable—1 switch—1 line cord—2 etched plates—miscellaneous resistors—condensers—hardware—and all that is necessary to convert.

New **$8.25**

AN/APN-4

Indicator: Uses 5 CP1, Loran, convert to test scope, panadapter, etc. Contains extremely accurate 100 kc xtal to time sweeps and marker pips at 2, 20 and 100 kc. Two parallel horizontal sweeps, obtain time differences between signals, between half power points on passband curves, and numerous other scope uses. Experimenters' delight! Use the counter circuits to try the new system of FM demodulation (July Proc. IRE) or to time camera shutters, 25 tubes. Condition: used, excellent. With schematic **$29.50**

RECEIVER
Easily Converted for Use in Citizens Band

Crystal Controlled Local Oscillator. Broad Band Pass—20.7 MC I.F.'s. Complete with 7-6AJ5, 1—12SR7, 2—12SN7, 1—28D7, relays, crystals.

Schematic furnished.....Used **$7.95**

NEW CATALOG
listing many surplus values, write for your **FREE** copy TODAY.

DYNAMOTORS

DM-28—For BC-348 with Mount and Filter	New	$6.95
	Used	3.95
DY-12—For ART-13 less filter and base	New	9.95
DM-36	Used	.95
	New	1.95
BD-77	New	5.95
PE-206	New	6.95
	Used	2.75
PE-101	New	2.75
DM-53	New	3.95
	(3 for $2.00) Used	.95
DM-32	New	1.95
	(3 for $2.00) Used	.95

SURPRISE PACKAGE 20 lbs. Ass't radio parts. A $25.00 value for only..... **$1.95**

RESISTOR KIT—(Long leads New) 100 Asst'd..... **98¢**

COMMAND (SCR 274 N) EQUIPMENT

	Used	New
BC-453	$12.95	
BC-454	4.95	6.95
BC-455	7.95	
BC-456	1.95	2.95
BC-457	5.95	
BC-458	5.95	7.95
BC-459 (or T22)	9.95	
BC-696 (or T19)	14.95	24.95
ARC5 Transm. 2.1-3MC	9.95	
BC-450—3 Receiver Remote Control	.89	1.95
BC-442		2.95
3 Receiver Rack	1.95	
2 Transmitter Rack	1.50	

Complete Command set as removed from aircraft—3 receivers—2 transmitters—Relay unit—control boxes—mounting racks—plugs—modulator and dynamotors—crated.....Set **$34.50**

SPECIAL

Tubular—and—"FP"—AC-DC popular brand condensers—Good numbers—High and low voltages.....10 Asstd. **$1.69**

BC-620 F.M.—Receiver—Transmitter—2 channel crystal—Freq. 20-27.8 MC, 13 tubes—metered plate and fil.....

New **$14.95**

PE-97 6-12 Volt Vibrator Power Supply for BC 620.

Excellent—used—complete.... **$6.95** Less Vibrator — tubes—condenser..... **$2.95**

FT-250 Mount for PE-97 and BC-620..... **$1.50**

BC-223
Ideal Marine or Ham Transmitter 2000 to 5250 KC

New with all tuning units and T.U. cases..... **$29.50**

Tuning Units—For BC-223 .... **2.50**

Cases–for Tuning Units–for BC-223 **.95**

MIKES—HEADSETS

HS-23 Hi Imp.	New	$2.95
HS-33 Lo Imp.	New	2.95
HS-30 Hi Imp.	New	1.50
	Used	.79
T-17D Carbon Mike	New	2.75
T-24 Hi Imp. Carbon Mike	New	1.19
T-30 Throat Mike	New	.98
T-45 (or Navy) Lip Mike	New	.98
CD-307 Extension Cord for Headsets	New	.59

MISCELLANEOUS SPECIALS

ARB Receiver 200 to 9000 Kc.	Exc., Used	$19.95
AVT 120 Receiver 2300 to 6500 Kc.	Used	4.95
SCR 522 Transceiver 100 to 156 MC.	Used	34.95
BC 1206 Receiver 200 to 400 KC	New	5.95
	Used	3.95
MN 26 C or Y Receiver	New	24.95
	Used	17.50
RA 10 DA Receiver	New	24.95
	Used	17.50
RT 7—APN-1 Transceiver	New	9.95
APN-1 complete	New	34.50
R-78—APS 15—Complete with Tubes	Excellent	34.50
AM 61 Indicator Amplifier	New	12.50
BC 929 Scope	New	17.95
	Used	12.95
SCR 625 Mine Detector	New	39.50
C 1 Autopilot with Tubes, Etc.	Used	2.95
ASB-7 Scope	Used	12.95
BC 461 Veeder Root Meter	New	.59
BC 442 Less Condenser	Used	1.49
BC 342-J—BC-312-J—Manual		1.00
SCR 269 G Manual		2.50
BC 306 Antenna T.U. for BC 375		1.50
A-27 Phantom Antenna—2000 to 4500 KC	New	.95

APS-13 UHF Antenna—Suitable for 400 MC citizen band, ideal for UHF experimenters. With director and reflector elements....Brand New, 2 for 98c

CONDENSERS

	Each
2 mfd. 4000 VDC G.E.	$2.95
	4 for 10.00
2 mfd. 5000 VDC. G.E.	3.95
	3 for 10.00
1 mfd. 6000 VDC	2.75
	2 for 5.00
.25 mfd. 15000 VDC	4.95
.00025 mfd. 25000 VDC	2.95

TUBES

304 TL	90c each	4 for $3.00
5BP1		1.95
5BP4		2.95
4AP10		1.95
211		.49
1625		.29
872A-GE		2.95
872A		1.29

BEAM INDICATORS

I 82—5"	New	$4.95
Transmitter selsyn for above		$2.45
	both for	7.00
I 81—3"	New	$3.45
Transmitter Selsyn for above		$2.45
	both for	5.25
I 81	Used	2.45

All Shipments FOB Chicago or Los Angeles unless specified. 20% Deposit required on all orders. Minimum order accepted—$5.00. California and Illinois residents, please add regular sales tax to your remittance.

ARROW SALES, Inc.
Dept. N

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THE AUDIO COMPARATOR

Novel test unit permits selection of a minimum of 9100 basic audio component combinations for comparison.

BECAUSE high-fidelity audio fans are skeptical of beautifully-printed response curves and advertising claims, Boston's *Radio Shack Corporation* has given them an entire room dedicated to the premise that the listener's own two ears can best decide what is best for him—in terms of reproduction quality and of economy. Confirmed skeptics find an oscilloscope, an audio oscillator, and sweep frequency records available for extra jury duty!

Although this room, called *The Radio Shack* "Audio Comparator" (hear and compare), was opened in 1947, it has been growing to meet the demands of an expanding industry and of an increasingly informed audience to whom 15,000 c.p.s. does not admit the necessity for "within 5%."

Today the "Audio Comparator" is capable of a minimum of 9100 basic audio component combinations (total number *unlimited*) quicker than you can say "Fletcher-Munson"—without losing a single note of music when switching from one combination to another. The equipment involved includes pickups, turntables, changers, amplifiers, tuners, loudspeakers, wire and tape and disc recorders, microphones, and test instruments.

The "Audio Comparator" was designed not only for the convenience of customers in choosing equipment, but also for the use of *The Radio Shack* engineering department as a guide to purchasing and for debunking false or misleading claims. Suggestions to manufacturers, made after exhaustive "Audio Comparator" aural and visual tests, have often resulted in the improvement of new equipment for the benefit of the industry and the public.

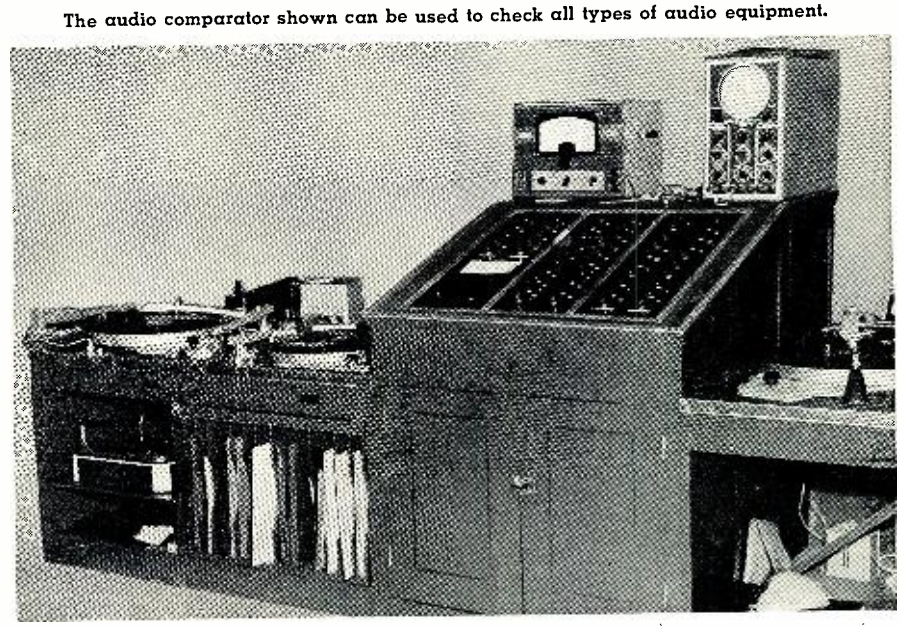
Many comparisons result in answers unobtainable by other methods. For example, take this typical microphone test. Mikes are grouped together, the amplifier is selected, disc or tape recorder is selected, sound source (voice or music) is selected, and then the mikes are switched. The result is a recording from which the listener may actually determine sensitivity, directivity, and quality. Equally important, he hears the mikes as *reproduced* by a speaker without the accompaniment of the originating sound source—as in the case of feeding the amplifier into a speaker instead of a recorder while the mikes are being compared.

In simultaneous comparisons of tape, wire, and disc recorders, constant tone of the a.f. generator is applied for "wow" test, and the sweep frequency generator for over-all response in conjunction with the oscilloscope. Phono records and radio may also be recorded as part of the test.

For the music lover who already owns, let us say, an adequate amplifier-pickup combination, but who wishes to improve his speaker installation, the procedure is as follows. His amplifier and pickup are duplicated by switching in like or similar equipment on the panel board. A record is played—preferably one of the listener's *own* records so that his familiarity with it will eliminate the possibility that a *Radio Shack* record might sound "better." Then a speaker similar to his present model is switched in.

From this familiar and unprejudiced norm, his own ears lead him to the selection that best fits his requirement, taste, and budget. —30—

The audio comparator shown can be used to check all types of audio equipment.



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3" Shield.....$1.47
5" Shield.....1.97

R·H·S
SPECIALS OF THE MONTH

NOW AVAILABLE

1000 KC Crystal.....$2.97
Socket.....07

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

1B21	$ 2.87	3EP1	$ 2.87	305A	$12.95	843	$ .39	C100D	$ 1.95	O1A	$ .25	6A6	$ .89	6U5	$ .65	19	$ .98
1B22	3.95	3E29	8.97	307A	3.95	845W	4.25	CK507AX	1.95	1A3	.57	6A7	.69	6U7G	.55	24A	.67
1B23	8.95	3EP7	1.75	316A	.54	851	15.95	CK1005	.19	1A4	1.09	6A8	.79	6V6	.97	25L6	.53
1B24	4.69	3GP1	6.75	327A	2.75	860	2.49	CK1006	.98	1A4P	.97	6AB7	.79	6V6GT	.63	25Z5	.49
1B26	4.57	4-65A	14.49	338A	3.95	861	10.95	CK1090	2.95	1A5GT	.49	6AC7	.77	6X4	.59	25Z6	.49
1B27	8.95	4-125A	27.45	350A	1.25	864	.49	EF50	.45	1A6	.79	6AF6G	.79	6X5GT	.49	26	.57
1B29	3.49	4-250A	37.45	350B	1.89	865	2.95	F123A	12.95	1A7GT	.67	6AG5	.77	6Y6G	.67	27	.47
1B36	4.59	4AP10	5.95	353A	2.95	866A	1.05	F125A	14.95	1AB5	.49	6AG7	.98	6Z7G	1.15	28D7	.38
1B38	47.50	4B24	3.95	353B	7.95	866JR	1.10	F127A	27.50	1B4	1.19	6AH6	1.29	6ZY5G	.69	30	.57
1D21	5.75	4C35	19.50	362A	1.95	869B	27.95	F128A	69.50	1B5/25S	.89	6AJ5	.79	7A4/XXL	.59	31	.89
1N21	.95	4E27	17.75	368AS	3.95	872A	1.49	F606	22.50	1C5GT	.67	6AK5	.85	7A6	.67	32	.97
1N21B	1.65	4J32	97.50	371B	.85	874	.57	F660	125.00	1C6	.89	6AK6	.79	7A7	.57	32L7GT	.97
1N23	.79	5AP1	1.95	388A	2.95	876	.98	F862A	450.00	1C7G	.89	6AL5	.65	7AG7	.72	33	.69
1N23B	1.95	5AP4	1.95	393A	3.85	878	1.98	FG17	2.89	1D5GP	.97	6AQ5	.59	7B4	.57	34	.69
1N34	.85	5BP1	1.89	394A	3.85	884	1.39	FG27A	9.75	1D7G	.89	6AQ6	.59	7B6	.59	35/51	.57
1P24	.79	5BP4	3.75	417A	14.50	885	1.39	FG81A	3.85	1D8GT	.95	6AT6	.47	7B7	.59	35A5	.67
1S21	3.95	5CP1	1.85	434A	3.50	902P1	3.85	FG95	17.95	1F4	.75	6AU6	.59	7C4	.37	35B5	.65
2AP1	3.89	5CP1A	9.95	446A	1.25	905	3.98	FG105	9.95	1F5G	.75	6AV6	.47	7C5	.57	35C5	.65
2C21	.27	5CP7	9.95	450TH	17.95	908	4.95	FG172	19.95	1G4GT	.69	6B4G	.89	7C7	.59	35L6	.54
2C22	.19	5C30	7.95	450TL	37.50	923	.97	FT210	13.95	1G6GT	.69	6B6G	.79	7E5	.67	35W4	.39
2C26	.19	5D21	27.95	527	9.95	930	.85	GL146	9.95	1H4G	.69	6B7	.89	7E6	.59	35Y4	.49
2C34	.27	5FP7	1.35	559	.85	931A	2.69	GL451	3.25	1H5GT	.54	6B8G	.89	7E7	.69	35Z3	.57
2C40	6.59	5GP1	5.95	575A	12.95	953B	19.95	GL562	85.00	1H6GT	.87	6BA6	.55	7F7	.69	35Z4	.44
2C43	8.95	5JP1	24.95	700A/B/C/D	34.50	954	.37	GL697	69.50	1J6GT	.89	6BE6	.57	7H7	.64	35Z5	.39
2C44	.67	5JP2	11.75	701A	3.60	955	.37	HY115	.85	1L4	.55	6BF6	.57	7L7	.69	36	.35
2C46	6.87	5J29	17.50	702A	3.25	956	.39	HY615	.79	1LA4	.79	6BG6G	1.47	7N7	.67	37	.29
2C51	8.25	5J30	49.50	703A	3.95	957	.24	HYE1148	.39	1LA6	.89	6BH6	.57	7Q7	.59	39/44	.27
2D21	1.17	5LP1	13.95	705A	1.10	958A	.35	KC4	49.50	1LB4	.89	6BJ6	.59	7R7	.69	41	.52
2E22	1.29	5NP1	2.89	706CY	18.75	959	.37	KU610	9.75	1LC5	.79	6C4	.25	7W7	.89	42	.49
2E24	4.87	6C21	19.69	707B	14.95	991	.27	ML100	49.50	1LC6	.57	6C5	.47	7X7	.89	43	.49
2E26	3.49	6F4	5.59	708A	3.95	1603	3.95	ML101	139.50	1LD5	.79	6C6	.57	7Y4	.57	45	.52
2J21A	10.95	6J4	5.95	713A	.95	1611	.97	ML501	69.50	1LE3	.89	6C8G	.69	7Z4	.57	45Z3	.57
2J22	8.95	7BP7	4.65	714A	12.95	1613	.59	ML502	149.50	1LG5	.89	6D6	.47	12A	.57	45Z5	.49
2J26	7.95	9GP7	12.50	714AY	3.95	1614	1.45	REL21	2.95	1LH4	.65	6D8G	.87	12A6	.19	46	.69
2J27	13.95	9JP1	6.95	715C	24.95	1616	.98	REL36	.79	1LN5	.67	6E5	.69	12A7	.98	47	.69
2J30	49.50	9LP7	2.25	717A	.59	1619	.24	RK21	.79	1N5GT	.59	6F5	.47	12AS6T	.59	50A5	.69
2J31	9.75	10BP4	24.95	721A	2.95	1624	.98	RK23	4.85	1P5GT	.67	6F6	.65	12AH7GT	.85	50B5	.55
2J32	5.95	10Y	.49	723A/B	24.95	1625	.37	RK25	3.65	1Q5GT	.67	6F7	.85	12AT6	.45	50L6	.52
2J33	19.95	12DP7	14.95	724A/B	3.95	1626	.39	RK33	.27	1R4	.69	6F8G	.87	12AU6	.67	50Y6	.57
2J34	19.95	12GP7	13.95	725A	8.95	1629	.27	RK34	.27	1R5	.69	6G6G	.69	12AU7	.79	53	.87
2J37	17.50	12HP7	13.95	726A	14.95	1630	3.95	RK59	1.95	1S4	.79	6H6	.47	12BA6	.57	56	.45
2J38	12.95	15E	1.29	730A	10.95	1631	1.45	RK63	18.95	1S5	.57	6J5	.49	12BE6	.49	57	.38
2J39	34.50	15R	.79	750TL	45.00	1632	.98	RK65	24.95	1T4	.57	6J6	.77	12C8	.49	58	.49
2J40	49.50	23D4	.29	800	1.95	1633	.98	RK72	.97	1T5GT	.79	6J7	.67	12DE8	.58	59	.89
2J46	89.50	24G	.47	801A	.49	1636	4.75	RK73	.97	1U4	.59	6K6GT	.45	12F5GT	.58	70L7	1.17
2J48	39.50	30 Spec	.35	802	4.25	1638	.79	RX21	3.19	1V	.69	6K7	.49	12H6	.27	71A	.67
2J49	24.95	45 Spec	.29	803	4.95	1641	.69	RX120	8.95	2A3	.97	6K8	.79	12J5	.27	75	.53
2J50	42.50	75TL	2.95	804	8.95	1642	.27	S836	2.95	2A4G	1.07	6L5	.89	12K7	.54	76	.39
2J53	14.95	100R	1.85	805	4.95	1665	1.10	TZ40	2.95	2A5	.69	6L6	1.17	12K8	.59	77	.43
2J54B	39.50	100TH	11.50	807	1.10	1851	.97	V70D	6.95	2A6	.79	6L6GA	.87	12Q7	.49	78	.45
2J61	39.50	100TS	2.35	808	1.39	1960	2.95	VR65A	.98	2A7	.89	6L7	.79	12SA7	.57	80	.39
2J62	39.50	204A	57.50	809	2.75	2050	.75	VR75	.97	2V3G	.99	6N7	.79	12SC7	.57	81	1.29
2K25	23.95	205B	1.75	810	6.95	2051	.43	VR78	.65	2X2	.39	6Q7	.59	12SF7	.57	82	.87
2K28	14.95	211	.49	811	2.10	7193	.19	VR90	.67	2X2A	.69	6R7	.79	12SG7	.57	83	.72
3API	4.85	215A	.65	812	2.79	8005	4.75	VR105	.79	3A4	.37	6S7	.89	12SH7	.35	83V	.89
3B22	2.69	217C	9.95	812H	6.90	8011	.69	VR150	.55	3A5	.99	6SA7	.44	12SJ7	.49	84/6Z4	.63
3B23	4.85	218	47.50	813	7.75	8012	1.47	VT127	2.25	3B7	.35	6SC7	.59	12SK7	.57	85	.69
3B24	1.59	221A	1.95	814	2.75	8013A	1.45	VU111	.59	3D6	.35	6SD7GT	.69	12SL7	.59	89	.39
3B25	4.87	225	8.70	815	2.45	8014A	22.50	WL468	7.95	3Q4	.59	6SF5	.49	12SN7	.52	117L7/M7	1.29
3B26	1.79	227A	2.95	816	1.10	8016	1.25	WL530	17.50	3Q5GT	.67	6SF7	.59	12SQ7	.49	117N7	1.37
3B27	3.85	231D	1.25	826	.42	8020	3.25	WL531	7.95	3S4	.67	6SG7	.59	12SR7	.49	117P7	1.27
3BP1	2.95	249B	2.49	829B	7.45	8025	4.95	WL532	3.50	5R4GY	1.10	6SH7	.49	12Z3	.79	117Z3	.57
3C21	5.95	249C	2.89	830B	3.49	9001	.37	WL538	.69	5T4	.89	6SJ7	.57	14A4	.79	117Z3	.65
3C22	39.50	250R	7.45	832A	4.25	9002	.34	WL578	1.95	5U4G	.57	6SK7GT	.55	14A7	.69		
3C23	2.47	250TH	18.95	833A	32.50	9003	.37	WL616	87.50	5V4G	.89	6SL7GT	.65	14B6	.67		
3C24	.45	250TL	18.95	834	5.75	9004	.37	WL619	19.95	5W4	.79	6SN6GT	.97	14F7	.69		
3C30	.49	274B	1.19	836A	.99	9005	1.95	WX3245	49.50	5X4G	.59	6SN7GT	.65	14F8	.89		
3C31	3.49	282B	9.75	837	1.69	9006	.24	OA2	1.57	5Y3GT	.37	6SQ7	.45	14H7	.65		
3CP1	2.67	294A	4.57	838	3.25	C5B	7.95	OA4G	.95	5Y4G	.49	6SR7GT	.57	14N7	.89		
3D21A	1.49	304TH	4.95	841	.49	C6A	8.45	OB2	1.75	5Z3	.49	6SS7	.59	14Q7	.57		
3DP1	1.97	304TL	1.39			C6J	4.95	OZ4	.57	5Z4	.79	6T7G	.98	14R7	.67		
														15	.89		

OIL CONDENSERS
ALL RATINGS DC

.25mfd.	600v	$0.37	1mfd.	2000v	$1.07
.5mfd.	600v	.37	2mfd.	2000v	1.47
1mfd.	600v	.37	4mfd.	2000v	3.77
2mfd.	600v	.37	8mfd.	2000v	3.97
2x2mfd.	600v	.77	15mfd.	2000v	4.95
4mfd.	600v	.57	.1mfd.	2500v	1.45
6mfd.	600v	.97	.25mfd.	2500v	1.77
8mfd.	600v	1.07	.5mfd.	2500v	1.98
10mfd.	600v	1.27	.05mfd.	3000v	1.75
.25mfd.	1000v	.47	.25mfd.	3000v	2.65
.5mfd.	1000v	.57	.5mfd.	3000v	2.75
1mfd.	1000v	.67	1mfd.	3000v	2.98
2mfd.	1000v	.77	2mfd.	3000v	3.47
4mfd.	1000v	1.37	4mfd.	3000v	4.45
8mfd.	1000v	1.97	12mfd.	3000v	6.97
10mfd.	1000v	2.07	1mfd.	4000v	4.25
15mfd.	1000v	2.47	2mfd.	4000v	4.85
20mfd.	1000v	3.27	3mfd.	4000v	5.45
.5mfd.	1500v	.77	1mfd.	5000v	4.98
1mfd.	1500v	.97	4mfd.	5000v	5.45
2mfd.	1500v	1.17	.1mfd.	7000v	2.97
4mfd.	1500v	1.77	.01mfd.	7500v	2.45
2 1mfd.	1500v	5.47	.02mfd.	7500v	2.75
.1mfd.	2000v	1.07	.03mfd.	7500v	2.97
.25mfd.	2000v	1.17	1mfd.	7500v	6.95
.5mfd.	2000v	1.27	.02mfd.	12000v	9.97

HIGH CAPACITY CONDENSERS
ALL RATINGS DC

2x3500mfd.	25v	$3.47	200mfd.	35v	$ .57
2500mfd.	3v	.35	100mfd.	50v	.45
3000mfd.	25v	2.45	4000mfd.	18v	1.95
2x1250mfd.	10v	1.27	4000mfd.	30v	3.25
1000mfd.	15v	.98	2350mfd.	24v	2.25
			10000mfd.	25v	4.57

TRANSFORMERS—115 V. 60 Cy.
HI-VOLTAGE INSULATION

6350v @ .025 arms..... $12.95
2500v @ 4 ma; 6.3v @ 1A; 2½v @ 2A..... 5.97
2500v @ 15 ma... $4.29 2100v @ 10 ma... 3.97
1700v @ 4 ma; 6.3v @ 1A; 2½v @ 2A..... 4.98
1600v @ 4 ma; 700v CT @ 150 ma; 6.3v @ 9A 4.97
1500v @ 7 ma; 2.5v @ 1.75A..... 4.47
525-0-525v @ 60 ma; 925v @ 10 ma; 2x5v @ 3A; 6.3v @ 3.6A; 6.3v @ 2A; 6.3v @ 1A..... 6.97
500-0-500v @ 175 ma..... 4.95
500-0-500v @ 25 ma; 262-0-262v @ 55 ma; 6.3v @ 1A; 2x5v @ 2A..... 4.45
425-0-425v @ 75 ma; 5v @ 3A; 6.3v @ 1.5A... 3.98
400-315-0-100-315v @ 200 ma; 2.5v @ 2A; 5v @ 3A; 2x6.3v @ 9A..... 5.95
385-0-385-550v @ 200 ma; 2.5v @ 2A; 5v @ 3A; 3x6.3v @ 6A—pri 110/220..... 6.27
385-0-385v @ 70 ma; 2.5v @ 10A; 5v @ 6A; 5v @ 3A..... 4.95
340-0-340v @ 300 ma; 1540v @ 5 ma..... 4.95
600v CT @ 100 ma; 5v @ 2A; 12½v @ 2A; 12½v @ 3A..... 3.37
300-0-300v @ 65 ma; 2x5v @ 2A; 6.3v @ 2½A; 6.3v @ 1A..... 3.47
255-0-255v @ 240 ma; 325-0-325v @ 12 ma.... 4.98
120-0-120v @ 50 ma..... .97
80-0-80v @ 225 ma; 5v @ 2A; 5v @ 4A..... 3.49
36v @ 15A..... $9.95 24v @ 10A..... 4.47
18v @ 15A..... 8.95 13.5v CT @ 3.25A 2.47
12.6v CT @ 10A; 11v CT @ 6.5A..... 6.95
12v CT @ 10A; 2x9v CT @ 10A..... 7.49
3x10.3v CT @ 7A..... 6.95
8v CT @ 1A..... .97
6.3v @ 21¼A; 6.3v @ 2A; 2½v @ 2A..... 4.45
6.3v @ 12A; 6.3v @ 2A; 115v @ .1 amps..... 3.45
6.3v @ 10A; 6.3v @ 6A..... 2.47
6.3v CT @ 3.5A; 2x2.5v @ 3A..... 2.97
6.5v @ 8A; 6.5v @ 5A; 5v @ 3A; 2.5v @ 1.75A 4.45
6.3v @ 1A; 2.5v @ 2A. $2.25 6.3v @ 1A..... .77
5v @ 20A; 10KV ins.. 9.97 .6v @ 15 arms.. 1.77
5v @ 3A; 2.5v @ 2A. 2.97 2.5v @ 10A... 3.97

SELENIUM RECTIFIERS
Full Wave Bridge Type

INPUT		OUTPUT		
up to 18v AC	up to	12v DC	½ Amp.	$1.47
up to 18v AC	up to	12v DC	1 Amp.	1.97
up to 18v AC	up to	12v DC	5 Amp.	5.27
up to 18v AC	up to	12v DC	10 Amp.	8.97
up to 18v AC	up to	12v DC	15 Amp.	11.57
up to 18v AC	up to	12v DC	30 Amp.	22.57
up to 36v AC	up to	28v DC	1 Amp.	3.47
up to 36v AC	up to	28v DC	5 Amp.	8.57
up to 36v AC	up to	28v DC	10 Amp.	14.57
up to 36v AC	up to	28v DC	15 Amp.	22.27
up to 115v AC	up to	100v DC	.25 Amp.	2.57
up to 115v AC	up to	100v DC	.6 Amp.	5.27
up to 115v AC	up to	100v DC	5 Amp.	22.57
up to 115v AC	up to	100v DC	3 Amp.	17.97

FILTER CHOKES
HI-VOLTAGE INSULATION

10 hy @ 400 ma...	$5.97	1 hy @ 800 ma...	14.97
15 hy @ 70 ma...	1.17	10 hy @ 250 ma...	2.47
12 hy @ 150 ma...	3.47	10 hy @ 200 ma.	1.98
30 hy @ 60 ma...	1.37	10/20 hy @ 85 ma	1.57
.05 hy @ 15 amps..	7.97	15 hy @ 125 ma.	1.47
.1 hy @ 5 amps....	6.97	15 hy @ 100 ma.	1.37
4 hy @ 600 ma...	5.97	3 hy @ 50 ma...	.27
200 hy @ 10 ma...	3.47	30 hy dual @ 20 ma	1.47
600 hy @ 1 ma...	3.17	3/30 hy @ 250 ma	3.47
325 hy @ 3 ma...	3.47	2 hy @ 175 ma...	1.49
3.5 hy @ 400 ma...	6.75	14 hy @ 40 ma...	6.75
6 hy @ 400 ma...	6.97	60 hy @ 50 ma...	6.97

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189 GREENWICH STREET . NEW YORK, N. Y.

WMOR—Supersonic Tone

(*Continued from page* 61)

tio. The pickup cartridges for lateral work are variable reluctance types with diamond styli. The high vertical compliance of these cartridges is a major factor in reducing surface noise.

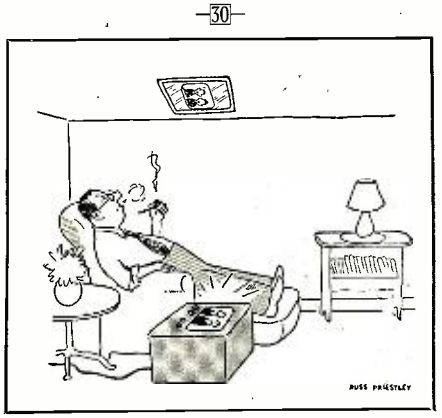
Almost all recording work is done on tape. A *Magnecorder* PT-6 and PT-7 are used for this, utilizing both 7½ and 15 inches-per-second tape speeds. With proper equalization, the recordings have a response above 15,000 c.p.s., using fast speed, and above 8000 c.p.s. with the low speed. When disc recordings are to be made, they are usually taken from tape.

The transmitter proper consists of a *G-E* ten kw. final amplifier using 5518's in a grounded-grid circuit. Two 7D21's provide 3 kw. of drive to the final. This may seem excessive at first, but a great deal of the IPA power goes "right on through," thus effectively increasing the apparent efficiency of the final. The antenna consists of a four-section *RCA* pylon, which is an evolution from a folded dipole.

Station WMOR is owned and operated by a group of ex-GI's, each of whom had the desire to own his own business. Pooling resources and capital, they formed a corporation, enlisting the cooperation of a few interested businessmen. Each was a specialist in his own field, and all felt that there was a market for what they had to offer, namely, good radio for the Chicago area.

A sample of true fidelity in the symphonic vein was given the Midwest this past summer when WMOR broadcast the entire series of open-air concerts at Grant Park. The line to the station was equalized to well beyond 15,000 c.p.s., and great care was taken over the strategic placement of microphones. Only one mike was used in the focus of the bandshell to pick up the entire seventy-five-piece orchestra. A noticeable improvement was discernible not only on receivers with wide-band amplifiers and coaxial speaker systems, but even in table model sets with small speakers. The programs were picked up off the air by other stations in outlying areas and rebroadcast to further increase the area served.

—30—



★ SPECIALS ★

ELECTROLYTIC CONDENSERS

New Stock—Not Surplus

D.Y. TYPE LUG TERM.

18c ea. 10 For $1.50

MFD.	VOLT
10	250
40	200
40	300
2x20	20
20+10	150
30+30	25
40+40	25
40	400
50	200
2x10	150
2x20	25
30+15	150
40+40	150
40+20	150
20	450
10	300
10	200
8	450
40	250
40	150
40/20	150
25/40	25/200
2x40	150

29c ea. 10 For $2.50

2x10	300
225	15
20/20	350/25
20/30	250
2x30	150
30+20	150
30/20	350/25
10/50/100	450/100/50
15—15/20	350/25
15—15/40	150/25
25—25/10	25/350
20—20/10	50/400
2x20	150
20/20	400/25
10—20/20	350/25
10—15/20	350/25
15—15/20	250/25
10—10/20	350/20
3x10	150
3x8	150
12	525
15	450
10	450
20	525
80	150
40+20+20	150
40/20	150/25
40/25	200/25
40/30	150
10/50/100	350/100/50
10/10—10	25/150—150
16	450
20	350
15	250

2x90/20	200/50	$.69
150—20/6	25/50	.49
120—60-20	150/25	.49
3x20	450	.59
2x20/20	450/25	.39
20—8/25	450/25	.49
40—20/20	150/25	.69
40+10+10	450	.89
40/40/25	475/400/50	.59
40/20/25	450/50	.69
40/40/16	450/400/350	.79
4x20	450	.98
2x30—15/20	400/25	.89
30—15—10/20	450/25	.79
3x10/10	450/25	.69
3x10/20	450/25	.69
80/40/150	400/50	.98
2x80/60	250	.65
150—50—25	150	.49
20—10/50	450/50	.49
2x20/20	400/25	.59
40—20/20	400/25	.59
40—40/25	400/25	.59
40—10/80	450/150	.69
40—40—10	450	.69
40—30—10	450	.79
3x15—30	300	.69
2x30/20x10	450	.98

MINICAPS PIGTAIL

MFD	VOLT	PRICE
30	450	$.49
30	300	.45
30	350	.48
40	450	.45
40	525	.60
16	350	.35
16	525	.45
16	450	.40
16	100	.24
20	25	.20
20	80	.25
20	450	.40
24	350	.30
8	400	.30
8	150	.15
10	150	.20
10	50	.15
4	50	.10
4	150	.14

DS TYPE CARDBOARD w/LONG PIGTAILS

MFD.	VOLT	PRICE
2x10	450	$.45
3x40	150	.45
20—20	150	.34
22—20	250	.45
30—30	150	.40
32—32	350	.49
30—50	150	.42
40—20	150	.42
32—32	250	.49
40—40	150	.42
32—16	450	.55
3x40/10	150	.70
80—40—30/100	150/25	1.29
8—8/25	450/75	1.10
30—20/20	450/25	1.10
20—16/10	200/25	.50
50—30	350	.55
2x50/20	150/25	.59
8	450	.35
16	450	.40
20	150	.18
20	450	.40

Write for List of Other Values

XMTR COILS AIR WOUND

80 MTR Bar Prong 100 w $1.19
40 MTR. 5 Prong 50w plug in socket.....$1.19
160 MTR 5 Prong 50w plug in socket.....$1.19
40 MTR 3 Prong Bar 100w $1.19
#1544 14.8-18MC. 500w $1.19
#154R 8.3-10 MC. 500w $1.19
#C538 2-3.5 MC 300w Fix. Link $1.19
#1735 2-3.5 MC. 300w Var. Link $1.49
#C390 5-7 MC. 300w Fix. Link $1.19
160 MTR Bar Type 100w $1.19

ROTARY BEAM COUPLER

RF Coupler 360° rotation 1 turn coupling link. Plastic case mount on side. Price.... **$2.95**

RECTIFIERS

KS 9020, 20 MA, Twenty 12V Discs, 1⅜" Dia, Two stacks, one of 5 other 15 discs for TG30. Price $3.49
Rect. in 7.1VAC—Out 2.4V @ 3A Cal. 61289 Dual Sel. Price $1.49
Rect. Full Wave in, 180 VAC. Out 120VDC. 4A. Price $3.49
Rect. 36V in/28V Out/1.5 Amp. $1.49
Rect. Dual Input 2.2V @ 1.5A: Out w/6.5V for SCR 593-BC728. Price $1.49

SOCKETS

8 Prong Cinch Steatite. 1⅛" C.toC. 49c
7 Png. Steatite, 1⅞" C.toC. 39c
5 Png. Wafer Socket, Mica Filled 17c
Socket for 705-715-7D21 Steatite w/ Lock 69c
7 Png. Wafer Min Tube ⅞" C.toC. 11c
8 Png. Octal Bake w/ Mnt. 1½" C toC. . 13c
8 Png. Octal Steatite w/Ret. Ring. 4 contacts 5c ea. 10 for 45c
Acorn Socket Steatite 5 for $1.00
Diheptal RCA 69c
8 Png. Loctal Amphenol w/Mnt. 1 5/16" C.toC. 39c

Precision Resistors

ohms	ohms	ohms
1.01	250	10000
3	430	12000
5	468	17000
5.05	800	17300
10.1	920	20000
18	1100	25000
43.5	1450	30000
50	1900	33000
75	2230	35000
82	4300	40000
120	5000	50000
125	7000	55000
128	7500	57000
150	8500	75000
200		

Each 25c, 10 for $2.00

84000	150000	250000
100000	170000	500000
120000	220000	

Each 35c, 10 for $3.25
1 Meg. ea. 70c
6.330 Meg, ...$1.00

METERS

4KVDC. Roller Smith w/Ext Resistance Bank 3½" Rd $5.95
50VAC A022 GE 3" Rd w/Stand $4.49

LIP MIKE

MC 419 .....49c

THROAT MIKE

T30Q 39c

ARC 3 COMPLETE AUDIO MODULATION X F M R PKG. T103 Carbon Mike to Grid. Price 95c
T102 6J5 to PP6L6 GRIDS (Modulation) $1.15
T104 MOD. XFMR PP 6L6 to 832 or 8298 Plates $1.49
COMPLETE KIT OF THREE w/CKT dia..... $2.98

COMMUNICATIONS EQUIPMENT COMPANY for your needs

T.V. Transformer, 7" or 9" scope. 3000v/5MA, 720vct/200MA. 6.4/8.7A. 6.4/.6A. 5/3A, 1.25/.3A. Price... **$6.95**

TOP TRANSFORMER BUYS!

Power Transformers—115v/50-60 cps input

Volts Out	Amp.	Filaments	Each
770V	.0025	2.5V/3A	$1.98
550VCT	.005	6.3V/.5, 2.5VCT/1.75	2.49
2x200V	.33	2x20V/.01	2.49
2x110VCT	.01	6.3V/10, 2.5VCT/7	2.75
2x110V	.010	6.3V/2.5, 2x2.5V/7	3.45
550VCT	.100	6.3V/1.8, 6.3V/.6	2.29
580VCT	.040	5VCT/3	2.95
700VCT	.017	5VCT/3A	2.25
2300V	.004	2.5V/2A	8.49
100VCT, 65V	.1	6.3VCT/10, 40V/.1, 18VCT/.1, 18-6/.1, 6.3V/.1	3.49
1500V	.160	2.5VCT/12, 30V/.01	6.95
1100VCT	.250	6.3V/.6	
Tapped @ 400V			6.95
78V	.300	6.3/2	1.79
825VCT	.190	5VCT/3A	3.95
800VCT	.150	5V/3, 2.5/2	3.95
2x300V	.042	55V/125, 45V/3.5	3.95
585	.086	5V/3, 6.3V/6	3.95
1080VCT	.055	6.3V/1.2, 6.3V/1.2	5.95
600VCT	.155	6.3VCT/5, 5VCT/3	3.95
1120V	.600	2x5VCT/6-2, 6.3VCT/3, 6.3V/.300	14.95
215VCT	.300	5VCT/	2.29

Plate Transformers—115V/50-60 cps input

Volts Out	Amp.	Each	Volts Out	Amp.	Each
65V	.500	$1.49	70V	1.	$1.95
500VCT & 650VCT	150-.015	3.00	100V	3.	1.95
2x150V	2x.940	4.25	1620VCT	.400	11.95
600VCT	.015	2.49	246VCT	.880	3.95
250VCT	.077	4.95	121V	1.5	2.25
690V	.450		126.5V	1.5	
1470VCT	1.2	24.00	132V	1.5	

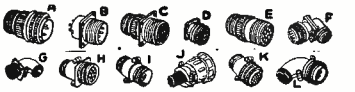
Filament Transformers—115V/50-60 cps input

Rating	Each	Rating	Each
2.5V/5A HV INS	$1.79	6.3VCT/1A, 5V/2A	$1.85
6.3V/2A, 78V.300	1.79	30VCT/.330, 34VCT/.380	1.95
36V/1.11	1.49	6.3V/2.5, 2x2.5/7	3.25
5VCT/20A	5.49	2x2.5VCT/6.5A	3.25
4V/16A, 2.5V/1.75 HV INS.	4.75	2.5V/1.75A, 5V/3A 6.5V/8A, 6.5V/.6A	3.85
5V/115A	12.95	10VCT/13A,10VCT/3.25A	6.95
7.2V/7, 6.4V/10, 6.4V/2\ 2x26.2V/2.5, 16V/1	5.95	5VCT/13.5A,2x5VCT/6.75 1.3V/.0091KVA	6.95 2.95
6.3VCT/20, 6.3V/1.8 6.3V/.6	5.25	6.3VCT/6A, 5V/2A 6.3VCT/2A, 6.3VCT/2	1.85 2.45
6.3VCT/1, 6.3VCT/7A	2.75	6.3V/1A, 6.3V/1A	1.95
6.3V/5A, 6.3V/1A	2.25	6.3V/2.5A, 2.5V/7A,	3.25
6.3VCT/3.2, 6.3VCT/1A	2.25	2.5V/7A	
5V/6A	2.25	6V/3A	1.10

SPECIAL TYPES

INPUT	OUTPUT	EACH
6,12, 24 or 115VDC or 30VAC	420VCT/85Ma, 6.3 V/3A. Univ Vibrator Kfmr	$2.49
230V 60 Cy	230V .05A	1.10
110/115/120/125 60 Cy	115V/78V .410/MA/.600 MA	1.59
210/220/230 60 Cy	13.5V/1.11 Amp	1.49
230V 60 Cy	2.5VCT/4A	1.49
230V 60 Cy	2.5V/6.5A	1.95
220/440V 60 Cy	200V/20A, 4x6.3V/.9A	2.95
220V 60 Cy	286VCT/290 MA	2.95
220V 60 Cy	260V/.03A, 100V/1A, 6.3V/4.2	2.95
45/78/90V	700VCT/75 MA, 40VCT/.1A, 15/10/15V/.1 Amp 1V to 10V Tapped	2.39
220V 60 Cy	2x40V/.05 MA, 2x5V/6A, 12.6V/1A	2.95
220V 60 Cy	24V/.6A, 5V/3A, 2x6.3V/1A	2.95
43/78/90/115/180/230	2.5V/6.5A, 2.5V/6.5A, 6.3V/4A	2.29
110/115/120/125	6/12/18/24/75/100/115V 150 MA	3.95
230V 60 Cy	5V/9A HV INS	2.49
200V 60 Cy	700VCT/.08A, 110VCT/.08A 24V/.08A, 6.3V/.3, 6.3VCT/1A 5V/3, 5V/5A, 2.7V/5A	4.25
230V 60 Cy	400V/.03A, 190V/.03A, 5V/2.5A 5V/2.5A, W/2-866 Sockets	4.25
50V 60 Cy	2x750V/.001A	1.95
6V & 12V	84V/9 MA,51V/3 MA,1.4V/.5 A Vibrator Transformer	1.95
230V 60 Cy	250V/.1A, 5V/2A, 5V/3A	4.95
220 & 440V	3x2.5V/5A, 2.5V/15A	5.95
230V & 115V	5VCT/7.5, 5VCT/7.5, 5VCT/15A	10.95
440 60 Cy 3 Phase	3 Phase 220V 30W or 220V & 6V Single Phase 60 Cy	5.95
230V 60 Cy	110V/200 MA, 33V/200 MA, 5V/ 10A2.5/1.4V/10A, 1500V/160 MA	5.95
95-130V 60 Cy	115V/3.6A, 40.9V/3.3A	10.95
220/440 60 Cy	115V/6.52A	12.95
220/440v 60 Cy	115/110/105V/7 Amp	13.95

AMPHENOL "AN" CONNECTORS



LARGE VARIETY AVAILABLE AT GREAT SAVINGS

Send your specs and let us quote

RATED CONCERNS SEND P.O.

BASIC 15 WATT AMPLIFIER

Pwr. Supply contains Trans. 600VCT/.155MA, 6.3V/5A, 5V/3A, 2—7 MFD 600V. Dual Choke. 10HY 200MA, 5T4 Tube, Socket. Price.....$8.49

BASIC 50 WATT AMPLIFIER

Pwr. Supply contains Trans. 880VCT/200MA. Dual 10HY 200MA Choke, 2—7MFD 600V, 5T4 Tube. Socket. Price.....$10.49

RUBBER COVERED CABLE

4½ ft. long w/red, blk & white Leads for Mike or Hdset.... **12c**
10 for $1.00

CABLE CLAMPS

Tinn. #1, 4, 6, 7, Locktype. Price 8c ea. 10 for **75c**

CABLE CLAMP ASSORTMENT KIT

Contains a few Rubber Covered Locking type and many different types. 50 for..... **98c**

Birtcher Tube Clamps

926C
926—16
926—B1
926—B2
926—B8
926B—16
926A—14
926C—19
926A
926—C1
926—A11
926—C15
926—C13
926B

13c ea. 100 for $12.00

XFMR TELEV PWR SUPPLY KITS

BASIC 3" and 5" T.V. PWR SUPPLY

Trans. 1080V/55Ma. 6.3V/1.2A, 6.3/1.2A. 2-.1 Mfd 2500V 2X2 Tube. Socket. 1-100000 ohm Resis. Price $7.49

BASIC 5" AND 7" TV PWR SUPPLY

Trans. 2300V/4Ma, 2.5/2A. 2-.1 Mfd 7500V Pyr. 2X2 Tube. Socket, 1-100-000 ohm Resis.....$9.50

TV TRANSFORMER

3000V/5Ma, 720VCT/200 Ma, 6.4V/8.7A, 6.4V/.6A, 5V/3A, 1.25/.3A Fil & Plate Voltage for 7" & 9" Tube $6.95

Basic Photoflash Condensers

6 Mfd 330VAC	
1200VDC Int.	$1.95
.5 Mfd 750VAC	
2500DC	1.75
1 Mfd 1500VDC	.89
1 Mfd 2000VDC	1.00
2 Mfd 1500VDC	1.00
10 Mfd 1000VDC	1.95
15 Mfd 1000VDC	2.25
3 Mfd 2200VDC	1.95
6 Mfd 1500VDC	2.15
45 Sec Time delay Relay 110V Input	1.95

932 PHOTO TUBE

Gas Phototube having S1 response, particularly sensitive to Red and Near Infrared Radiation. Can be used with incandescent light source. Send for Data. Price **75c**

1619—1619—1619

Octal Base Pentog Aversatile High Perveance Tube ..... New **21c**
5 for $1.00

DIAL LIGHTS

1½" Green Enclosed Type Chrome Finish. Min. bay base 49c
1" Red 115V Bulb Removable from front; Smooth Jewel bay base. Price.....79c
1" Red Shutter Type. 115V. Removable From Front; Smooth Jewel Candelabra Base. Price 89c

Heineman Ckt Bkrs. For AC DC Operation Amperes .010, 3, 7, 10, 50, 80, 100, 150. Ea. $1.45
Klixon 25A 98c
Dual 8 & 25 Amp.....$2.49
De Ion 35 Amp.....$3.75
HiGain Dyn Mike Xfmr UTC/ SuperElec 3wdg 600 CT&4000 ohms tapped 250&150 ohms. Fully Shielded Herm. Sld **59c**
2 for 98c; 10 for $4.50

COLLINS ART-13 FREQ. MULT. UNIT

2-18 Mc for two 1625 Tubes. Comp. Assy less Tubes & Coils w/ckt diag. Price **$8.49**

INTERPHONE CONTROL BOX

Permits Transfer of H.S. from Receiver. 4" x 4" WD x 2" D. Contains JK-33A, JK-34A. Toggle Sw. Lum. Tip. Pot, 50,000 Ohm. Term. Strip. A REAL BUY. PRICE...50c

FILTER CHOKES

5 HY 40 MA	3 for $0.99;	20 HY 50 MA	$0.79
30 HY 25 MA	.79;	11.5 HY 90 MA	1.39
25 HY .065A	1.00;	6 HY 150 MA	.99
8.5 HY 125 MA	1.49;	25 HY 75 MA	1.25
1.75 HY 100 MA	.59;	.030 HY 2A	1.39
30 HY 20 MA	.98;	5 HY 150 MA	1.45
15 HY 100 MA	1.39;	Dual 7 HY 75 MA,	
.2 HY 600 MA	1.95;	11 HY 60 MA	1.39
Swing 1.0/3.0 HY .225/.02 Amp, 1.75 HY 225 MA			2.25
.22 HY 600 MA .44 HY 400 MA			1.75
Dual 1.52 HY .167A	$1.95;	.100 HY 1.4A	$1.95
Dual 120 HY 17 MA	2.49;	.333 HY 1.12A	2.29
Dual 10 HY 150 MA	3.50;	.1 HY 1 Amp	3.95
3.5 HY 500 MA	4.95;	20 HY 300 MA	7.95
10 HY 500 MA	12.95;	10 HY 450 MA	12.45
Swing 9-20 HY .525/.075 MA			14.95
6 HY 150 MA	$1.50;	2.5 HY 130 MA	$1.25
.116 HY 150 MA	4.25;	.01 HY 2.5A	1.45
.35 HY 350 MA	7.25;	5 HY 200 MA	1.45
Dual 2.2 HY 550 MA	9.95;	Write for List of other.	

MICROWAVE WRITE FOR FLYERS OF SURPLUS PLUMBING AND ACCESSORIES

RADIO-RADAR SETS

SE (new)	SQ (used)	SO-3 (Incomp)
SF (new)	CPN-6 (unused)	QBG-1 (new)
SN (used)	APS-3 (used)	TBM (used)
SO-1 (used)	APS-15 (near comp)	RAK-7 (new)
SO-13 (used)		TBK-19 (new)

1.25-3-10 CM. Plumbing

WRITE FOR DATA OF MANY OTHERS

COMMUNICATIONS EQUIPMENT COMPANY

RADAR TELEVISION ELECTRONICS

CABLE ADDRESS: COMSUPCO
PHONE DIGBY 9-4124
131 LIBERTY ST. DEPT. N
NEW YORK 7, N.Y.

FM MICROWAVE RADIO SONAR

C.E.C. MONEY BACK GUARANTEE, $3 MIN. ORDER
F.O.B. N.Y.C. SEND MONEY ORDER OR CHECK, ONLY SHIPPING CHARGES SENT C.O.D.

Loudspeaker Enclosures

(*Continued from page* 38)

inch loudspeakers consisting of four rows of eight speakers occupies approximately only two feet by three and one-half feet of rectangular area. Wall space is often more available than floor space.

A common fallacy is the belief that loudspeaker efficiency at low frequencies requires a large cone. The size of the cone is principally related to power handling capacity. With 32 speakers driven by an average power of three watts, only a fraction of a watt is handled by each unit. A peak power of fifteen watts involves less than a half watt per speaker. Thirty-two is a convenient number for series parallel connection to obtain conventional impedances. The loudspeakers should all be connected in phase.

The phasing of speakers may be checked by applying a low voltage battery to each voice coil in turn and watching the movement of the cone. Each cone should move in the same direction for the same battery polarity.

General Considerations and Recapitulation

Reproducing middle frequencies is comparatively simple. A fair-sized flat baffle and a 12-inch loudspeaker will produce reasonably satisfactory results. The extreme low frequencies are limited by two factors. The one most commonly understood is the cancellation effect that takes place if the front and rear waveforms from the loudspeaker are not properly isolated. The other problem is the matter of matching the impedance of the loudspeaker to the air, creating an air load that is capable of accepting and transmitting the energy. Where space and cost are of no consequence, this is most effectively accomplished with a large exponential horn such as is commonly used in theater installations. The *Klipsch* corner cabinet is another solution that does not require as much space. Corner cabinets of simpler design, bass reflex cabinets, or a combination are the most satisfactory compromises. Large banks of small speaker units may also be used effectively.

High frequencies are limited by the ability of the cone to respond suitably, which is affected by the mass of the cone structure and other factors. For very wide range systems, it is necessary to use at least two speaker units, one specialized in low-frequency radiation, the other, in high-frequency distribution. High frequencies are also limited by the tendency to beam and by the fact that most wall surfaces absorb the high frequencies and reflect the middle and low frequencies.

There is one other limitation on high-frequency response that is not generally recognized as having importance. This is the fact that high frequencies are absorbed by the air to a greater extent than are sounds in the middle and low range. Under some conditions of humidity and temperature the absorption of high frequencies by the air may be as much as three decibels in fifteen feet. This means, percentage-wise, that the energy will be reduced by half at a distance fifteen feet from the loudspeaker in the region of ten thousand cycles.

Maximum power output from an individual loudspeaker unit is limited not only by the excursion of the cone and the non-linear suspensions and power handling capacity of the voice coil, but also by inherent distortion characteristics of the air. For very high-level operation in quite large or absorptive rooms, it is essential to use more than one radiating unit for optimum results. —30—

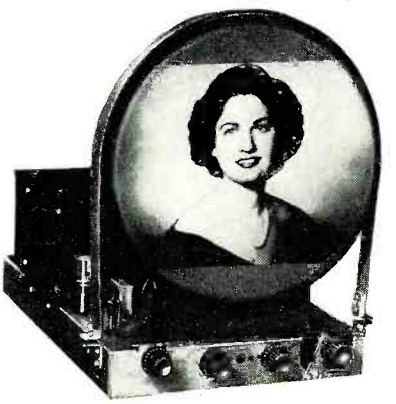
Wall mounted loudspeaker with frame and grill cloth to match wall.

Surprise TRADE-IN ALLOWANCES ON YOUR USED TEST and COMMUNICATION EQUIPMENT give you BIG SAVINGS ON: skyrider TELEVISION hallicrafters RECEIVERS

Now you can have the TV Set, TV Custom Chassis or Communication Receiver of your choice at the new low price made possible by a Walter Ashe "Surprise" Trade-In Allowance. For sensational savings simply tell us what factory-built Test or Communication equipment you want to trade in toward the purchase of fine new equipment manufactured by the maker of "The Radio Man's Radio." Get YOUR deal working right now. Wire, write, phone or use the handy coupon!

MODEL 513

A new history-making price for precision-built, big 61 sq. in. picture television. New, sleek, plastic cabinet. Rotary selector switch for instantaneous selection of any of the 12 pre-tuned channels. 19 tubes plus picture tube and 3 rectifiers. Shpg. Wt. 98 lbs. ONLY **$174.50**



MODEL 521 12½" Custom TV Chassis

The easy low cost way to complete TV enjoyment in your home. Custom installation chassis completely factory-wired and tested, ready to go. Same chassis unit as described in Model 518. With all tubes including picture tube. Shpg. Wt. 60 lbs. ONLY..... **$189.50**

Front panel assembly including safety glass and wood frame in unfinished oak veneer for Model 521. ONLY **$10.95**

MODEL 518

The best TV value on the market today; offering a 12½" tube with 92 sq. in. picture, comparable in price to that of many 10" sets elsewhere. All 12-channel rotary selector. New, simplified tuning. 17 tubes plus picture tube and 2 rectifiers. Shpg. Wt. 90 lbs. ONLY..... **$214.50**

hallicrafters MODEL S-40A Communication Receiver

Hallicrafters popular priced communication receiver. 540 KC. to 43 MC. 8 tubes plus rectifier. Internal speaker. Shpg. Wt. 33 lbs. ONLY..... **$79.95**

hallicrafters MODEL S-38A

"THE RADIO THAT AMAZES EVEN THE EXPERTS." Superior performance on all wave bands for all the family to enjoy. Has regular communication-type controls. Frequency range 540 KC. to 32 MC. Electrical band spread and BFO for CW reception. Shpg. Wt. 13½ lbs. ONLY..... **$39.95**

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(describe used equipment)
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ADDRESS _____
CITY _____ ZONE _____ STATE _____

Fixed Bias for Audio

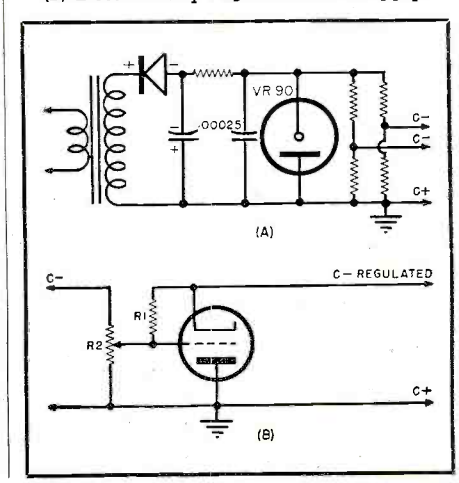
(*Continued from page 82*)

ulation and lower internal drop in voltage. If the power transformer has the bias tap mentioned previously, the filament transformer connected backward to step up filament voltage to 117 volts will be unnecessary. The bias tap is just as good a source of voltage, although the current rating of the power transformer must not be exceeded.

The second advantage offered by this circuit design is that of tube protection. The usual situation that occurs when a bias rectifier tube is used is that the main power rectifier warms up first and delivers full plate voltage to the output tubes before the cathode-type bias rectifier can deliver bias voltage. The resultant surge of plate current can badly damage tubes and transformers. The usual method for coping with this problem has been to provide a separate switch for the bias supply, so that it may be turned on first, or to provide a time-delay relay so that the main power supply will be able to supply no current until the bias supply is ready. Since a selenium rectifier will go into operation immediately, while any conceivable power rectifier must take a few moments to warm up, these precautions are entirely unnecessary.

It must be remembered, however, that a midget selenium rectifier of the type now used cannot be operated at more than about 130 volts peak back voltage. Therefore, it cannot be used similarly to the 6X5 in the illustrated "side rectifier circuit," which is connected across a high side of the high voltage winding to ground, or it will be destroyed. This circuit features the use of a gaseous voltage regulator tube to give practically ideal stability, filtering, and regulation to the bias voltage. A filter condenser may be substituted for the voltage regulator tube if such good regulation is not needed; this is perfectly permissible

Fig. 4. (A) Diagram of a selenium rectifier bias supply. The VR-90 tube can be replaced with a filter condenser if desired. (B) Electronically regulated bias supply.



in the bias supply for an amplifier which never draws appreciable grid current. This circuit is the property of the *Federal Telephone and Radio Corporation.*

Fig. 4B shows a familiar type of electronically regulated power supply adapted to the purpose of bias supply. Any tube of high transconductance, high perveance, and sufficiently low plate resistance is suitable. Tubes of the 2A3 family are good; the 6AS7 and 815 are capable of excellent control of large amounts of current. This circuit is not really necessary on any but high-power rigs, although it is flexible enough for any service of this type. Variations in output voltage are easily accomplished by adjusting R_2 which changes the grid bias on the control tube.

—30—

ELIMINATING BATTERY TROUBLES

ALMOST every ham who operates mobile has been faced with the problem of a run-down storage battery at some time. Even heavy duty generators and parallel batteries will not help if the operation is carried on with the motor turned off.

A novel method of preventing this occurrence in police cars was shown in the May, 1949, issue of the APCO Bulletin. The system was designed by E. W. Lindfeldt, Chief Radio Technician, Police Dept., Sacramento, Calif.

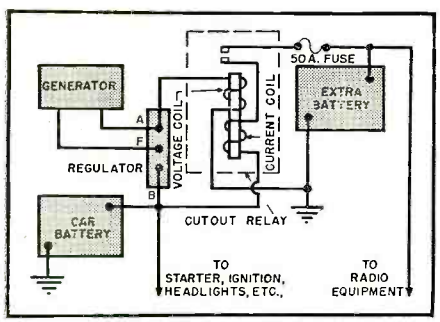


Fig. 1

With the system described, the extra battery operates the radio equipment, leaving the regular battery for starting the car, operating the lights, and carrying on its other regular functions. Thus it is possible to operate to your heart's content, subject to the capacity of the extra battery and still have a fully charged battery for starting the car. This feature will be readily appreciated, especially in winter time.

The means used to accomplish this is shown in the schematic diagram (Fig. 1). With the car engine running, the extra battery is automatically connected to the generator through an auxiliary cut-out relay connected to the regular voltage regulator. The extra battery is thus charged along with the regular car battery.

Mr. Lindfeldt has found that a 60-ampere generator is sufficiently large to keep both batteries charged in police work. With the limited operation of most hams, it is probable that the regular car generator will be sufficient. Standard size batteries have been found satisfactory for police work. —30—

The Beginning Amateur

(*Continued from page 67*)

and its only disadvantage is the need for a very heavy lead to the battery to carry the high-ampere load of the rig. It isn't as bad as it sounds, because it is a simple matter to parallel several lengths of No. 18 or 14 flexible lamp cord to handle even maximum loads with every little voltage drop. Additional wires for the microphone control, and aerial circuits can be installed at the same time. In most cars, these wires must be run under the car and brought up through holes in the trunk and driver's compartments. They must be very well protected because they will take a terrific beating from gravel, rain, mud, ice, and so on. The flexible armored cable commonly used for house wiring ("BX") is cheap and very good for this purpose.

One-handed push-to-talk operation is a "must" for mobile work. You can't juggle switches and a mike and expect to keep the car on the road at the same time.

Plate supply for the transmitter is much more of a problem than the transmitter itself. The r.f. and modulator elements of a mobile rig are no different from those of a fixed transmitter. The trick is to change six volts to several hundred volts. For transmitters of more than a couple of watts, there is no choice but a dynamotor, a rotating machine with two armature windings and one field winding.

Current from the car's battery, led into one winding through brushes and a commutator and also to the fixed field winding, makes the machine run as a motor. The other winding, being twirled past the magnetic field of the fixed winding, develops voltage of its own; this is led out from another set of brushes and a commutator at the other end of the shaft. Dynamotors are noted for their dependability and long life. They are far superior to vibrator power supplies for the relatively heavy current demands of transmitters. Some fine ones for mobile rigs are available as military surplus at very low prices.

Factory-made converters and transmitters for mobile operation are rather limited in number at the present time, but with the growth of interest in this activity, manufacturers are beginning to become aware of the possibilities of these units.

Whether you make your own or buy it ready made, a mobile rig is lots of fun. Try it once and you'll be convinced!

(To be continued)

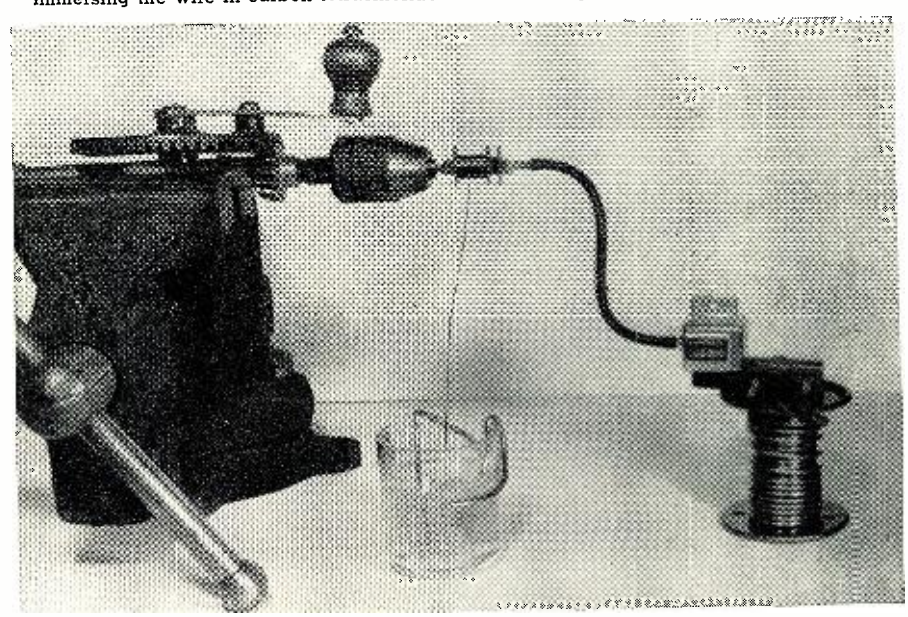
CARBON-TET AIDS COIL WINDING

THE EFFICACY of carbon tetrachloride in removing wax coating was shown recently when it was necessary to use a certain type of wire for a coil winding job.

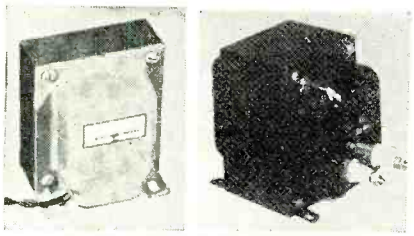
In winding a series of experimental high-impedance tape recording heads, the only suitable wire available for the audio coils was the fine wire in the transformer from which the pole-piece laminations were obtained. Thoroughly impregnated with wax, the wire broke frequently during the winding. A prolonged soaking in carbon-tet had merely cleared the wax from the first outside layers.

Suspending the wire bobbin in a small glass of carbon-tet solved the problem, since the wax was dissolved as the winding progressed and thousands of turns were wound without a single unintentional break. For recording turns, a surplus counter was coupled to the coil form by a short length of rubber tubing . . . . . A.C.P.

Immersing the wire in carbon tetrachloride before winding will remove unwanted wax.



NEW TRANSFORMERS And CHOKES



ALL FOLLOWING TRANSFORMERS 115 V.A.C. 60 CYCLE INPUT:

OUTPUT: 750-0-750 V.A.C. (600 V.D.C. after choke input filter at 250 MA.) Includes 6.3 V.A.C. winding at 5 amps and 5.0 V.A.C. winding at 4 amps. NH-106 ..... **$7.95**

OUTPUT: 625-0-625 V.A.C. (500 V.D.C. after choke input filter at 250 MA.) Includes 6.3 V.A.C. winding at 5 amps and 5.0 V.A.C. winding at 4 amps. NH-107 ..... **$7.35**

OUTPUT: 600-0-600 V.A.C. at 250 MA. 12 V.A.C. at 3 amps; 12 V.A.C. at 3 amps and 5 V.A.C. at 3 amps. Designed for Army surplus transmitters. NH-108 ..... **$6.90**

OUTPUT: 250-0-250 V.A.C. at 60 MA. 24 V.A.C. at .6 amps; 6.3 V.A.C. at .6 amps. Designed for Army surplus Receivers. NH-109 ..... **$3.00**

OUTPUT: 6.3 V.A.C. at 6 amps. NH-110.... **$2.25**

OUTPUT: 24 V.A.C. at 2 amps. NH-111.... **$2.25**

OUTPUT: 2.5 V.A.C. at 10 amps. center tapped and shielded. Open frame mounting insulated for continuous operation at 5,000 volts. NH-113.... **$4.20**

(ALL TRANSFORMERS ARE CASED)

CHOKES:

NH-115—8 Henries at 500 MA. filter choke, 5,000 volt insulation **$9.95**

NH-116—5-20 Henry 500 MA. swinging choke, 5,000 volt insulation **$9.95**

NH-117—8 Henries at 700 MA. filter choke, 7,500 volt insulation **$14.95**

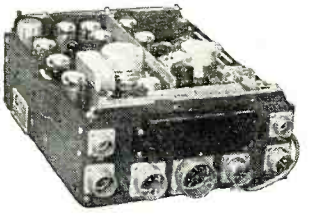
NH-118—5-20 Henries at 700 MA. swinging choke, 7,500 volt insulation..... **$14.95**

NH-121—15 Henries at 250 MA. filter choke, 1,500 volt insulation. **$4.95**

(ALL CHOKES ARE CASED)

ALL ABOVE ITEMS BRAND NEW—NOT SURPLUS!

BC-645-A TRANSCEIVER For Citizens Band



• 15 Tube Transceiver ideal for conversion to 460 MC. Citizens Band. Frequency coverage 435 to 500 MC. Complete conversion instructions for Citizens Band furnished. Price, NEW and BOXED..... **$16.95**

DYNAMOTOR PE-101 for BC-645-A—13 or 26 volt input; required voltage output..... $2.95

TRANSFORMER for BC-645-A—110 volt 60 cycle input; output 400 volt 150 MA after filter. 12, 9, and 6 V. AC. 4 amps. and 5 V. 3 amps. No. NH-645..... $6.95

CHOKE—15 Hy. 150 MA. No. NH-646..... $2.95

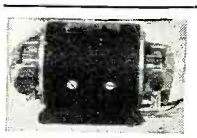
TRANSFORMERS—110 Volt 60 Cycle Primaries:

Sec. 12 V. 1 amp.	**$1.50**
Sec. 24 V. 1 amp.	**1.95**
Sec. 24 V. 2 amps.	**2.25**
Sec. 24 V. .5 amp.	**1.50**
Sec. 36 VAC. 2.5 amps.	**2.95**
Sec. 14-14 or 28 V. 7½ or 15 amps	**4.95**

CONDENSER ASS'Y.

5 GANG with vernier tuning. 25 MMFD. to 450 MMFD. each section. Size: 7½"x3½"x3½". Price **$2.95**

CONDENSER—3 Gang. 25 MMFD. to 450 MMFD. ea. section. Size: 6"x3¼"3". Price **$1.95**



MOBILE DYNAMOTOR

680 Volts 210 MA. output at 12 VDC input. 6VDC input; 300 Volt 150 MA output. As illustrated. Size: 7" x 4".

No. DM-680—Price **$7.95**

DYNAMOTOR—9 VDC input; output 450 V. 60 MA. 6VDC input; output 275 V. 50 MA. with Blower.

No. DM-9450—Price **$3.95**

DYNAMOTORS AND INVERTERS:

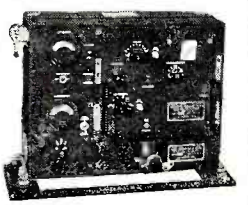
Write today telling us your requirements—or send for list of stock available of the following numbers: DM—20-32-33-40-42; PE—73-94-98; BD—77-86-93; PE—206-218-115; MG—149-149F-153-153F; D—401-402-104, etc.

SELSYN TRANSMITTER AND INDICATOR SYSTEM

Ideal as radio beam position indicator for Ham, Television, or Commercial use. Complete with 5 inch 1-82 Indicator, Autosyn Trans., 12 Volt 60 cycle Transformer, and wiring instructions.

Prices: NEW ....$9.95 USED **$7.95**
PL-118 PLUG
f/1-82: .....$1.00 Autosyn Trans.: ...$2.95

BC-223 TRANSMITTER



30 Watt Transmitter with crystal oscillator control on four preselected channels—also master oscillator. Frequency coverage 2000 KC. to 5250 KC. by use of three plug in coils. Five tube operation, 801 oscillator, 801 power amplifier, two 46 modulators, and one 46 speech amplifier. Price with TU-17 Tuning Unit, 2000 to 3000 KC. and cable from transmitter to dynamotor.

Prices: NEW .....$24.95 USED **$19.95**

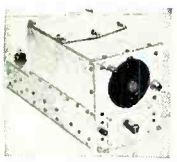
ADDITIONAL TUNING UNITS:

		NEW:	USED:
TU-17	2000 to 3000 KC.	$3 50	**$2.50**
TU-18	3000 to 4500 KC.	3.50	**2.50**
TU-25	4500 to 5200 KC.	3.50	**2.50**

CABLE only for Transmitter to Power Supply for BC-223 Transmitter. Price..... **$1.75**

PE-125 POWER SUPPLY for BC-223 Transmitter. Operates from 12 or 24 Volts and supplies 500 volts at 150 MA. Prices: NEW....$9.95 USED.... **$7.95**

COMMAND RECEIVERS—TRANSMITTERS—And Accessories:



		USED
BC-453	Receiver 190-550 KC.	**$12.95**
BC-455	Receiver 6—9.1 MC.	**7.95**
BC-454	Receiver 3—6 MC.	**6.95**
DUAL or TRIPLE RECEIVER RACK.....		**1.50**
BC-450	Triple Con. BOX.....	**1.95**

TRANSFORMER—F/Comm. Rec. —110 V. 60 cycle input; output 250-0-250 VAC. 60 MA.; 24 VAC. .6 A. & 6.3 VAC .6 A. No. NH-109 ..... **NEW: $3.00**

DYNAMOTOR—Can be used on 6 VDC. to supply 240 V. 50 MA. f/Comm. Rec. Mobile operation. USA/0515 ..... **2.95**

		USED	NEW
BC-459	Transmitter 7—9 MC.	$12.95	
BC-457	Transmitter 4—5.3 MC.	7.95	**$ 9.95**
BC-458	Transmitter 5.3—7 MC.	5.95	**8.95**
T-18	Transmitter 2.1—3 MC.	8.95	
T-20	Transmitter 4—5.3 MC.		**9.95**
T-23	Transmitter 100—156 MC.		**29.95**
DUAL TRANSMITTER RACK.....			**1.50**
BC-451	Trans. Control Box		**1.50**
BC-442	Antenna Relay Box with Cond.		**2.95**
BC-456	Transmitter Modulator Re-issue.....		**2.50**

TRANSFORMER—F/Comm. Trans.—110 V. 60 cycle input; output 600-0-600 VAC. 250 MA.; 12 VAC. 3 A. & 12 VAC. 3 A & 5 VAC. 3 A. No. NH-108..... NEW: **$6.90**

CHOKE—15 Hy., 250 MA. No. NH-121..... NEW: **4.95**

SELSYN SIZE V—No. C-7828—110 Volt AC. 60 cycle. Can be used to turn small antennas or for position indicator systems. Size 3½" x 5½". Price per Pair **$5.95**

SELSYNS 2JIG1—WITH CAPS—Can be used as position indicator for antennas. 110 Volt 60 cycle. Instructions furnished. Normally operates from 57.5 V. 400 cycle. Price per Pair: $3.00. Price—Caps only..... **50c** Ea.

EXTRA SPECIAL:

CO-213 CABLE—Seven conductor No. 20 AWG., with two cond. separately shielded within the outer shield for all 7 conductors. Insulated, rubber covered. 35 Ft. length..... **$1.25**

WHIP ANTENNA EQUIPMENT

MP-22 MAST BASE—(Ill.) mounting with spring action and 4" x 6" mounting bracket. Insulated at top to receive mast sections listed below. Price **$2.95**

MP-47 MAST BASE—has heavy coil spring and large base insulator, used with BC-610 Transmitters, etc. **$5.95**

MP-48 MAST Base—has heavy coil spring and insulated at top, requires 1⅜" mounting hole. Price **$2.95**

MP-37 MAST BASE—has heavy coil spring and 8" insulator at bottom, requires 2" mounting hole **$3.95**

MP-57 MAST BASE—same as MP-37 but has 5" insulator **$3.95**

MP-132 MAST BASE—has 1" dia. heavy coil spring, 2" insulator at bottom. Requires 1" mounting hole. Overall base length 11½". Price..... **$3.95**

MAST SECTIONS FOR ABOVE BASES:

Tubular steel, copper coated, painted, 3 foot sections, screw-in type. MS-53 can be used to make any length, with MS-52-51-50-49 for taper. Price—any section ..... **50c** Ea.

FL-8A FILTER—1200 CPS..... $1.95

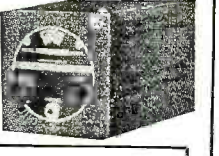
BLOWER—110 Volt 60 Cycle, 4" intake, 2" outlet. Approx. 100 cu. ft. dis. Motor size: 3" x 3". 1750 RPM.

Prices: NEW **$6.95**
Motor only **3.95**

MISCELLANEOUS:

Cable f/BC-375 w/PL-59 ea. end.....	$1.75
Cable f/BC-375 w/PL-61 ea. end.....	1.75
Cable f/BC-375 w/PL-64 ea. end.....	1.75
Tuning Unit f/BC-375 TU-6-8-10-26..... Each	3.95
FT-151 Mounting f/BC-375-191.....	1.50
GN-45 Generator	5.00
Leg & Seat Ass'y. f/hand generators.....	2.75
Crank for hand generators..... Each	.75
BC-357 Marker Beacon (used).....	2.95
BC-301 Marker Beacon, less tube.....	1.95
BC-347 Amplifier, Used, less tube.....	.79
RG-8U Coaxial Cable..... Per Ft.	.05
Cable—4 Conductor, shielded, 50 Ft. length.....	2.00
Coaxial Cable—125 OHM cotton covered, 50 Ft....	1.00
HS-17 Head Phone & Chest Set used w/EE-8 for extensions..... Prices: NEW $3.95; USED	2.95
HS-33 Headset, Low imp. (used).....	1.25
TS-13 Handset	3.95
T-17 Microphone..... USED: 98c; NEW	1.49
T-30 Throat Mic. Used..... 6 for	1.00

BC-1206 RECEIVER
SETCHELL-CARLSON



200—400 KC. 5 Tubes. Operates from 24-28 Volt DC. IF Freq. 135 KC. Size: 4" x 4" x 6". Price: LN **$7.95**

FT-237 MOUNTING BASE f/BC-604 & 603's. & f/BC-684 & 683's. Prices: NEW $9.95; USED..... **$7.00**

INVITATION—IF YOU ARE NEAR LIMA, STOP IN TO SEE OUR LARGE VARIETY OF SURPLUS RADIO EQUIPMENT AVAILABLE IN OUR BRAND NEW SALES ROOM!

Limited Supply . . . MARK II B19 Transmitter and Receiver 15-Tube Sets

2—8 MC., 240 MC., AND INTERCOMMUNICATING! IDEAL FOR MOBILE AND STATIONARY USE!

Set Transmits and Receives 2 to 8 MC. Phone, C W and M C W 25 Watt Master Oscillator Control. Transmits and Receives 240 MC Phone. Also Intercommunicating Set. Complete with 15 Tubes, Headset, Micro., Antennas, Control Box, 12/24 Volt Power Supply, and instructions, Ready to operate. Set size: 27"x10 x13¼". Prices: NEW $59.50; USED (Tested)..... **$39.50**

Also Available—All Parts and Accessories for B19 Mark II Sets!

Address DEPT. RN • Minimum Order $2.00 • Prices F.O.B., Lima • 25% Deposit on C.U.D. Orders

FAIR RADIO SALES

132 SOUTH MAIN ST.
LIMA, OHIO

What's New in Radio

(*Continued from page 97*)

F-222 West Fourth St., Covington, Ky.

Although it is primarily built for prospecting, the "Keleket" Model K-802 may be connected to a p.a. system for classroom use. Two flashlight batteries operate the unit through the

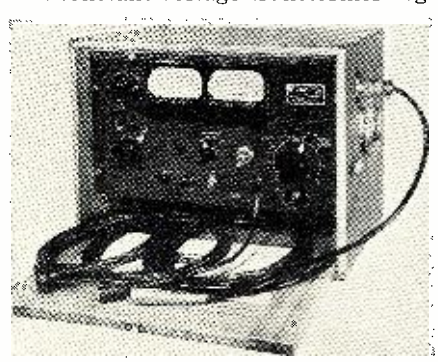
power supply that furnishes high voltage for the Geiger tube. No separate probe is necessary with the unit.

As it responds to both beta and gamma rays, this locator is especially suitable for uranium prospectors, as that particular material often emits both beta and gamma radiation. Lightweight and durable, the plastic case may be carried in the hand, hooked on the belt, or even in the pocket.

INSULATION TESTER

Speed in operation with complete safety are features of the portable insulation tester designed by the *Radio Frequency Laboratories, Inc.,* Boonton, New Jersey. It provides complete facilities for taking insulation resistance and dielectric absorption measurements on cables, transformers, rotating machinery, condensers, etc.

A constant voltage transformer reg-



ulates voltage to within one-half of 1% on this RFL Model 184C, which has four voltage ranges with continuously variable d.c. voltages up to 10 kv. It operates from a 115 v. 60 cycle line and consumes a maximum of 65 w.

Resistance of .1 to 50,000 megohms may be read directly on a megohmmeter scale at open circuit voltages of .5, 1, 5, and 10 kv. They may also be calculated in ranges of .3 to 20,000 megohms from a voltmeter and microammeter connected to read resistance at any desired test voltage operating from

OUTSTANDING VALUES NOW AVAILABLE

3-SPEED PHONOGRAPH

Plays 33⅓ RPM, 45 RPM, 78 RPM, Records. Single Arm Operation. This fine record player comes with an Astatic three-play arm, a Alliance 3-speed motor, 3 tube amplifier, 5″ Speaker. Built in an attractive, sturdy carrying case. Fine parts and construction give large set performance.

Only **$18.95**

Lots of three—**$18.29** each

Single speed 78 RPM Phonograph in same case.....**$15.49**

Single speed 33⅓ RPM Phonograph in same case.....**$15.49**

SUPER 25 WATT HI-FI AMPLIFIER KIT

Including all parts, schematic and layout diagrams, enabling you to easily build this fine, deluxe amplifier.

FEATURES:

- Ready punched chassis
- Multi-impedance output transformer 2-4-8-16-500 ohms for use with any PM speaker
- 2 mike inputs, 1 phono input
- Push pull phase inverter driver for low hum and distortion
- Hum level 65 DB below rated output
- Separate bass and treble control
- 110-120 volt AC operation, on fuse UL approved line cord
- 6 tubes: 2—6SJ7, 6SC7, 2—6L6G, 5Y3
- Attractive, well-constructed steel chassis and cover. Baked hammerloid finish
- Indirect lighted panel
- Frequency Response 20-17000

Nowhere can an amplifier of comparable features be had for twice the price. This amplifier, designed from the famous Clark Amplifier, will fill 90% of all sound uses.

$24.95 COMPLETE WITH TUBES

CLARK 15 WATT AMPLIFIER KIT

Another popular Clark kit. All first line parts to make an exceptionally fine unit.

• 6 tubes—2—6SQ7, 2—6V6, 1—6SN7, 1—5Y3GT. • Mike and phono input • Separate treble and bass controls. • Heavy steel chassis and cover. • Frequency response 30-17000 CPS+1DB. • Output impedances 4-8-16-500. • Hum level 65 DB below rated output. **$18.95**

MOTOROLA MODEL VT-71

New—Standard Guarantee—with fine tuning knob. Attractive Mahogany cabinet. Reception on all 13 channels. Can be used with an indoor antenna in good signal areas. Compact. Table model. 7″ tube. Size 9¼″x16⅜″. Weight 26½ lbs. Formerly **$189.95**

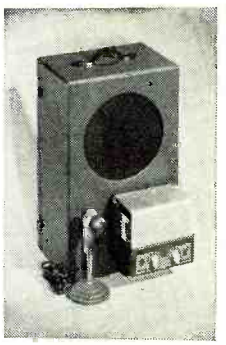
NOW ONLY **$92.50**

(plus $1.50 excise tax.)

150 WATT SOLDERING IRON

⅜″ plug-in type tip. Removed by set screw. Perfect for general soldering work. Handle stays cool. UL approved cord. Price...**$2.29**

10 WATT AMPLIFIER SYSTEM



An amazing value! including: •10 watt high quality amplifier. Tubes: 6L6, 5Y3, 6SL7. Mike and phono input. Attractive maroon and grey, all-steel cabinet. •Hi-Gain crystal mike with table stand. •Attractive heavy-duty carrying case. •Heavy Alnico V. 12″ P.M. speaker, with matching transformer.

This amplifier system is just the thing for all medium and small gatherings. It gives excellent performance on music and speech.

Only **$29.95** Complete

12″ PM Heavy Alnico V Magnet.....**$4.59**
Crystal Mike with Switch and Stand. 15 feet of Mike cable.....**$5.95**
10 Watt Amplifier Only.....**$15.49**

P.M. SPEAKERS

All Alnico V—All First Line Speakers.

FULLY GUARANTEED

3″ P.M.	Square Frame.....	**$0.79**
4″ P.M.	Square Frame.....	**.95**
5″ P.M.	Round Frame.....	**.95**
6″ P.M.	Round Frame.....	**1.39**
6″ P.M.	Pin Cushion Frame.....	**1.49**
7″ P.M.	For Auto Replacement.....	**2.49**
8″ P.M.	Round Frame.....	**2.29**
10″ P.M.	Round Frame.....	**3.49**
12″ P.M.	Round Frame.....	**4.59**

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Cut out handy order form, place quantity in front of item desired, mail to us. We shall give your order our prompt attention.

_____ 1. ICA 96″ side cowl antenna—Chrome finish, all mounting hardware, insulators, and lead in. Each **$1.29** 10 for **$11.90**

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_____ 4. Line cord—Molded Rubber Plug. Each **15c**.....10 for **$1.29**

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100 ft. Hanks.....**$0.59**
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_____ 6. Presto 16″ Professional Recording Discs—Metal Base.
Each **99c**—10 for **$8.90**

_____ 7. 6″ PM Speaker 1 oz. Alnico V.....Each **$1.19**

_____ 8. Single Conductor Shielded Mike Cable.....50 ft. **$1.75**

_____ 9. Universal 8 Watt Output Transformer—¾″ Strap type mounting..... **.49**

_____ 10. Appliance Cord, 3000 cycle, UL Approved. 100 ft. roll.....**$1.98**

_____ 11. Record Carrying Case—Attractive—Well Built—Covered in Brown Leatherette and Alligator Leatherette. 25 Record case **$1.29**
50 Record case **1.89**

_____ 12. Bakelite Plug in Coil Forms.
4 Prong 3″ Length 5 Prong 2⅛″ Length
4 Prong 2¼″ Length 6 Prong 2¼″ Length
Each **19c**—10 for **$1.50**

_____ 13. 2-tube Phono Oscillator—Using 12SN7 and 6U5—Complete with tubes **$3.19**

_____ 14. VM Dual Speed Changers—In Original cartons:
Model 800-D3.....**$19.17**
Model 801-D—with base..... **21.25**

_____ 15. Bat Handle Switches—1 ¾x¾ Mount Plate—Screw Terminals H & H 5A—125V.
SPST **25c** DPDT **32c**

QUANTITIES ARE LIMITED—ORDER NOW!!

Radio Parts Company, 614 RANDOLPH ST., CHICAGO 6, ILL.

zero volts to 10 kv. The alternate method may be selected by means of one switch, and brass handles on the unit facilitate handling in the field.

CIRCUIT TESTER

All low resistance circuits of 50 ohms and under may be checked instantly by means of a small tester that fits into the pocket and is called the "Cord Visual Circuit Tester." The device has been introduced by the *Gits Molding Corporation,* 4600 W. Huron St., Chicago 44, Ill., and is the result of a wartime development used by inspectors.

With this unit the electrician, repair man, or amateur can tell immediately whether the circuit is open or closed on such appliances as pilot lights, fuses, flash bulbs, radio tube elements,

speaker voice coils, transformer and coil windings, and so forth. The tester utilizes penlite battery cells and is so small as to resemble a flashlight. A test prod about one inch long is fastened next to a tiny bulb, so that when the prod is applied to the circuit, the bulb lights up to indicate "good."

NUCLEONIC MODEL RD-1A

A comparatively low-cost, completely portable radiation detector operated with standard radio batteries has been introduced by the *Nucleonic Corporation of America,* 499 Union St., Brooklyn 31, N. Y.

Presence of radiation is indicated by means of clicks or by the rate of light flashes of a neon bulb. Small in size, 2¾ by 4½ by 5¾ inches, and weighing only 2 pounds, the instrument may be clipped onto the belt for greater freedom.

Extreme sensitivity of the *NCA* radiation detector and its simplicity

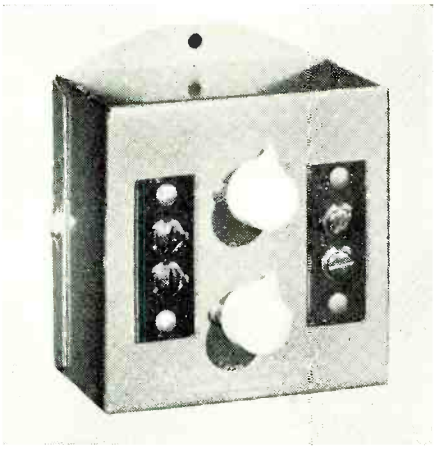
make it especially suitable for prospectors of uranium or other radioactive substances.

TELEVISION CLARIFIER

Precision Electronics, Inc., 643 Milwaukee Ave., Chicago 22, Ill., has recently announced that they are producing a TV Clarifier to eliminate her-

ringbone patterns, tears, waves, and other picture effects and distortions produced by FM, amateurs, short-wave, or electrical apparatus.

In addition to those applications, the



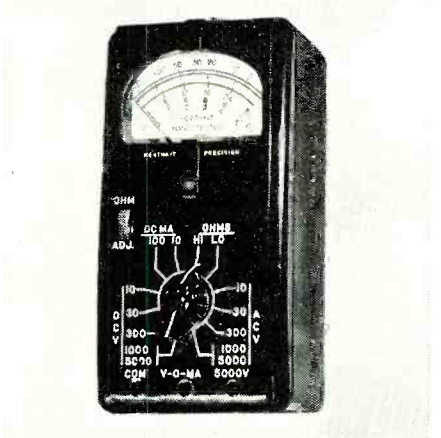
Clarifier is effective when installed between a.c. outlets and receivers as a trap for interference.

The device consists of two variable condensers in parallel with fixed inductance and is inserted between the antenna and receiver.

VOLTOHMMETER KIT

One of the newer products developed by the *Heath Company*, of Benton Harbor, Michigan, is a "Handitester Kit" with a 3-inch built-in meter that operates on a.c. or d.c., having ranges of 10, 30, 300, 1000, and 5000 volts. Ohm ranges are 0 to 3000 and 300,000, while the milliampere ranges cover 10 ma. and 100 ma.

Parts are housed in a pocket-size



bakelite case, in which the 400 microampere meter movement is already mounted.

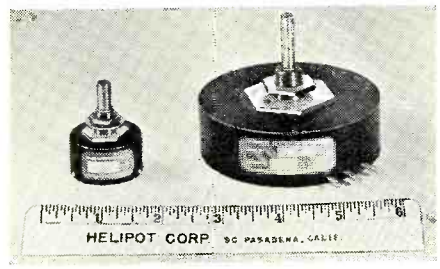
PRECISION POTS

A culmination of nearly two years of laboratory research and experiment is the line of precision linear potentiometers, models "F" and "G" being produced by the *Helipot Corp.*, 916 Meridian Ave., South Pasadena, Calif.

These instruments are single-turn pots with continuous rotation; the smaller of the two models is adapted for transmitting and aircraft applications, while the larger is designed and

engineered for various computer systems.

Models "F" and "G" will be avail-



able in the standard forms or they can be custom-built on special order in any version to which they are applicable.

* * *

CURRENT INDICATOR

A miniature device for service technicians that will indicate load current of motors and other a.c. operated electrical devices has been introduced by *Industrial Devices, Inc.,* Edgewater, New Jersey.

This unit, called the Mini-Amp, is less than 2 by 2 by 1 inch thick and has an opening in the center through which pass the current-carrying lines. Accuracy is held within 5% and does not depend on the kind of insulation, line voltage, or manner in which wire turns are made through the center.

—30—

Intercom For The Home

(*Continued from page* 51)

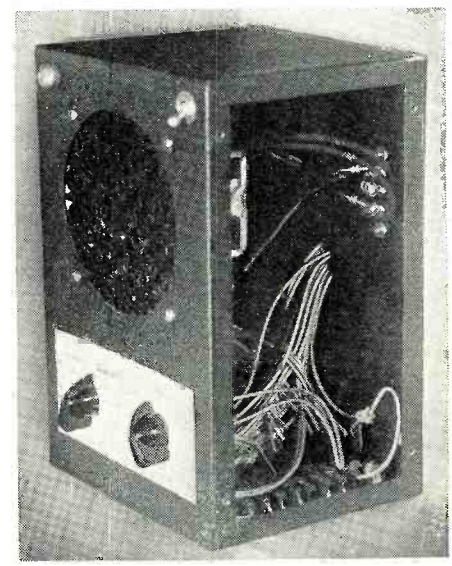
in the open was used in this setup, which has a 30-foot cable run from the basement master to the upstairs master.

Reversing the input transformer primary leads and changing the placement of the amplifier input and output ground returns in the kitchen box should clear up any difficulties. Shielded "In" and "Out" leads may be utilized, if desired, and should be used for longer cable runs. In such a case the shields can be used for the ground lead, "G."

The cellarway is the most logical place to run the cables; therefore, the locations of the amplifier and kitchen box should be chosen with this in mind. The cable run from the kitchen box to the upstairs hall box presents the real problem. In this installation, the cable goes from the kitchen box up through the cellarway ceiling. It comes through on the second-floor stairway landing, which is one step below second-floor level. Then it goes behind the floor shoes for six feet and comes up between the wall separating the hall and bathroom.

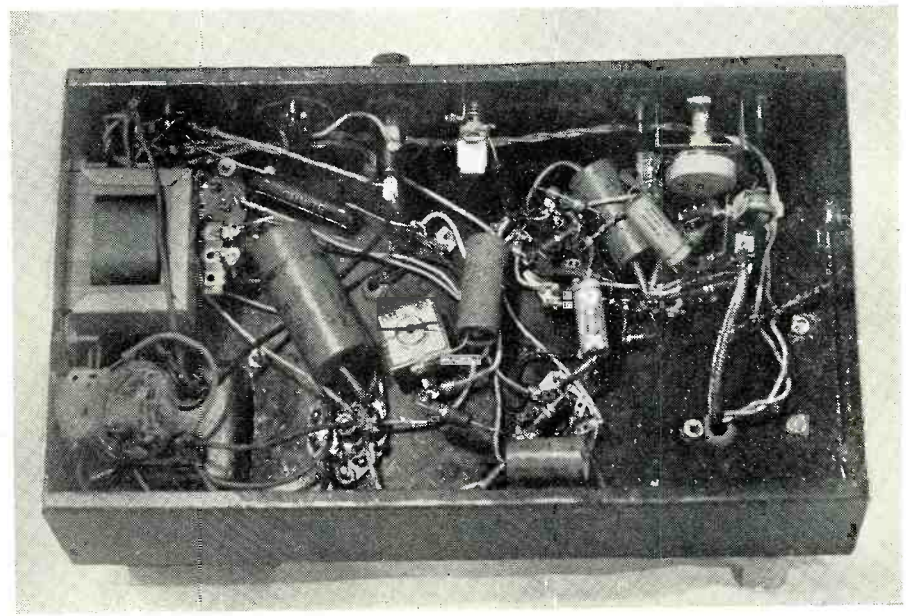
This intercom has given four years of excellent service. The reader should have no difficulty in bringing the convenience of this intercom system into his home.

—30—



Kitchen master unit with the side panel removed to show terminal strip mounting.

Under-chassis view of amplifier showing parts arrangement and wiring.



Horn-Type Transducer

(*Continued from page* 56)

space forms a coupling chamber of constantly diminishing cross section.

Fig. 1 shows the method of introducing the tweeter horn into the basic unit and facing the low-frequency driver into the sound chamber. The enclosed back space is ample to allow for back wave release ports which reinforce the low and middle range, thus eliminating dead spots near floor level. Note how the back wave emerges from the space between the sloping sides of the transducer and the wall. This back wave reflex principle is encountered in the *Jensen* "bass reflex" baffles now available.

A photograph of the completed unit is shown in Fig. 1. It does not show a recently-designed plastic extension of the exponential flare.

This extension increases the efficiency of the integral space transducer without adding to its apparent height. It is also possible to lengthen this plastic extension under conditions where greater control may prove desirable.

It is now evident that the tri-rigid construction of this horn has resulted in a unit of light weight, yet immense strength. The over-all appearance is neat, compact, and of pleasing modern form. This is a long cry from the past, when instruments resembling gigantic cow horns protruded into the apartments of sound enthusiasts who wanted the best, but who found it necessary to sacrifice appearance and comfort for their personal idiosyncrasies.

Upon hearing one of these horns, a person becomes keenly aware of the amazing possibilities in sound reproduction. Even the elusive transient sounds are present in true perspective, with little of the distortion so common to direct radiator loudspeakers mounted in conventional baffles.

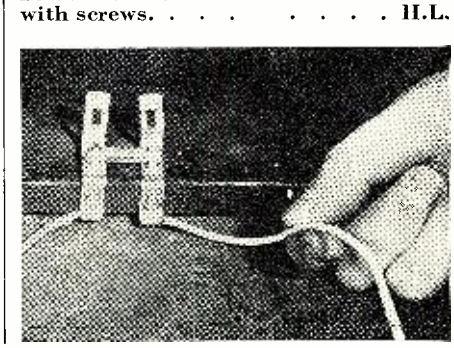
—30—

GLASS FUSE HOLDER

IT IS often desirable to insert a small glass type fuse in a circuit used for experimental purposes.

Battery clips from discarded "B" batteries may be bent and arranged so that the inside sections of the clips will hold the fuse as illustrated.

The opposite ends of the clips may be drilled and fastened to a wood base with screws. . . . . H.L.



Wide-Range Amplifier

(*Continued from page 48*)

across the high voltage, or the plate voltage of the output tube may be dropped slightly. At any rate, if the circuit components are followed closely, the current should be very nearly 150 milliamperes.

Although they are not shown on the diagram, one megohm resistors are shunted from each grid to ground on the 6AS7G. These resistors may or may not be needed. In this amplifier there was a tendency to oscillate at some supersonic frequency, and adding the resistors eliminated this trouble, their value being primarily that they have no effect on the frequency response. A low-voltage meter should be connected across the plates of the tube and the slider on R_{38} adjusted for zero reading, balancing the plate current. This will take care of the adjustments for this stage.

The test curves were taken with a standard audio oscillator, using an oscilloscope and an output meter. Maximum output without visible distortion was just less than 10 watts. With the tone controls disconnected, output was flat to a fraction of a decibel from the limits of 20 to 20,000 cycles of the audio oscillator. The tone control curves were taken with a .04 μfd. condenser at C_{26} as recommended by the control manufacturers. This later was changed to .03 μfd. to increase the frequency point where treble boost begins as well as the treble cut. This reduced somewhat the noticeable increase in loudness with treble boost.

Output response through the phono input was also taken. The variations are for constant output with varying input. Incidentally, all the curves were made with the output running around 5 watts. The curve as shown through the phono input follows quite closely the desired response. To this must be added a slight droop of the pickup cartridge caused by the 10,000 ohm resistor across the input. Disconnecting C_{13} resulted in the second curve. The relatively high grid impedance, plus the high mu triode, causes an attenuation to occur through capacity effects. The second curve may be preferable to some; however, the 6 db. per-octave de-emphasis is satisfactory for most records. The tone controls provide sufficient variations so that most records can be made to sound right.

The operation of the dynamic noise suppressor is rather interesting. The circuit is a slight modification of the original circuit described by C. G. McProud. With the control turned to maximum suppression position, screen and plate voltages are 32 and 18 volts respectively, measured by a vacuum tube voltmeter having an input resistance of 15 megohms. With the control turned to the other extreme, the contact potential developed by the 6SL7GT offers bias, decreasing the

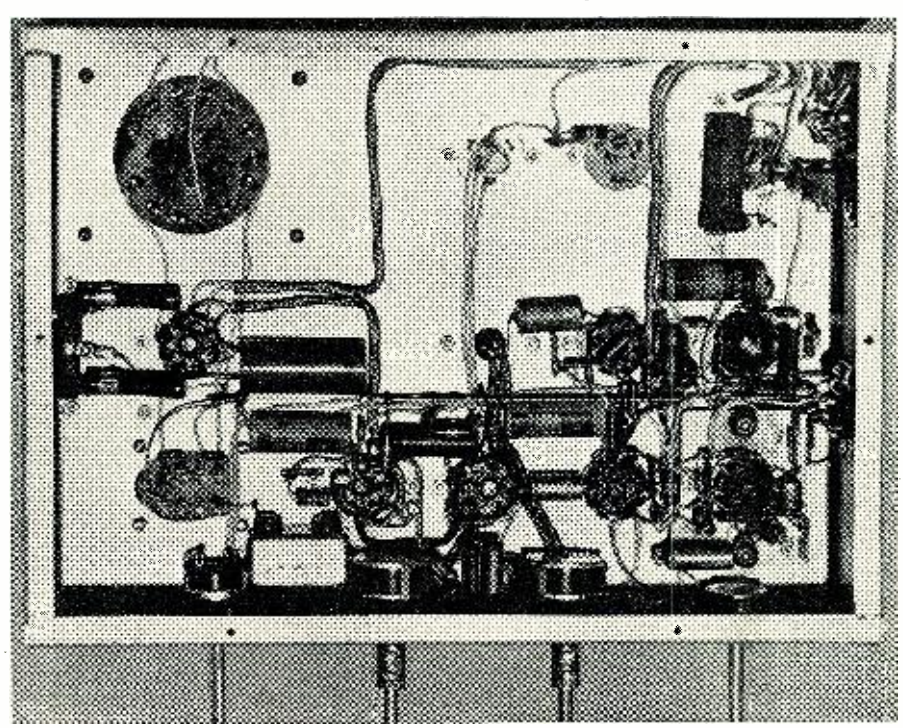
plate current; the voltage rises to 50 which consequently raises the cut-off frequency. A section of a single pole, double throw switch is utilized so that further turning the control switches in negative bias taken from the heater string. This, in effect, switches the reactance tube out of the circuit, which was found desirable at times. This final circuit was found satisfactory with a *Pickering* cartridge; suppressor action was sufficient on various records. Tests on a *Universal* frequency record showed a droop beginning at around 3000 cycles and down about 6 db. at 4000 with suppression full on. Turning the control, allowing the rectified voltage to act on the reactance tube grid, raises the cut-off frequency somewhat and at the same time allows dynamic action to take place.

With a constant level signal of varying frequency, the rectified voltage measured at the plate of the 6SL7GT (at the high end of the suppression control) reached a maximum at 4000 cycles, with the reactance tube disconnected. This is the desired response for the side amplifier. The highest possible fundamental tone of any musical instrument runs close to this value, allowing the harmonics of this fundamental to pass through. High-frequency signals above this frequency as well as frequencies below this 4000 cycle point do not have nearly the same effect on the reactance tube. This provides for the reactance tube's staying "closed" on hiss and other high-frequency noise, as well as during the periods when there are no high-frequency notes to mask the hiss. The action of the suppressor can be observed by connecting a vacuum tube voltmeter to the plate of the 12SG7. The plate voltage will swing up to the plate supply voltage on high-frequency passages, depending on the actual setting of the suppressor control.

Due to the lower output of the *G-E* cartridge with circuit values as shown, the side amplifier did not give enough amplification for sufficient range of dynamic action. On low level records with the control turned up for maximum action, it was felt the action was insufficient. Adding C_{17}, shown as dotted lines on the diagram, increased the gain somewhat without altering its response characteristics. Further, the 12SG7 is replaced by a 12SH7, the latter having a higher grid sensitivity than the former. The relatively high value of R_5 in the screen lead allows for some variable mu characteristic introduced to the 12SH7 so that abrupt cut-off does not occur. The values as shown for the resistors are satisfactory for the 12SH7. Measured voltages were 36 for the screen and 18 for the plate. With the control turned for maximum sensitivity, the contact potential raised the plate voltage to 100, due to the higher grid sensitivity of this tube. On subjective testing of scratchy records on both 12SH7 and 12SG7, the greatest apparent reduction of scratch seemed to occur with plate voltage varying from 150 to full-supply voltage. Variations that occurred below this value did not have as much effect.

The screen voltage on both tube types has considerable effect on the plate voltage. Reducing screen voltage increases the measured plate voltage as well as the grid sensitivity of the tube. Raising the screen voltage lowers the plate voltage, and there is also a point where further increasing the screen voltage and dropping the plate results in an increased cut-off frequency which brings about the re-

Under-chassis view of the home-built, wide-range phono amplifier.



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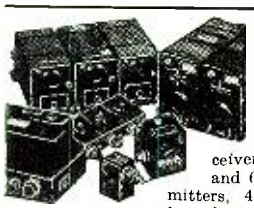
10-tube, xtal controlled rcvr, 7-tube xmtr. Makes ideal 2-meter, 2-way mobile rig. 100-156 mc. With Dynamotor, control box, all plugs and tubes. Excellent condition.... **$59.50**
Antenna for SCR-522....$2.95



SCR-274-N COMMAND SET

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Each..... **88¢**

CARBON HANDMIKE

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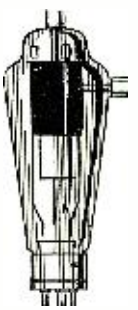

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$11.95 each While They Last!

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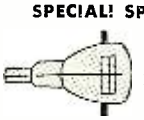
SPECIAL! SPERTI R-F Vacuum Switch



Famed Collins Xmtr Antenna Switch. 9200 peak volts. 8 amperes. BRAND NEW! Only..... **$3.49**

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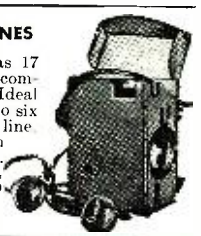

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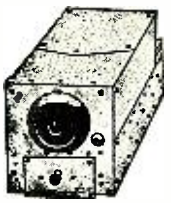
ARMY AIRCRAFT RECEIVER—BC-946-B



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BC-458—XMTR	Used	6.95	New	9.95
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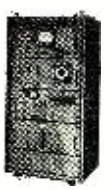
RG-182-A Complete I.F.F. Equipment



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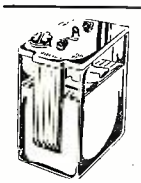

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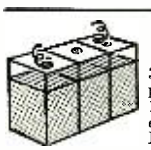
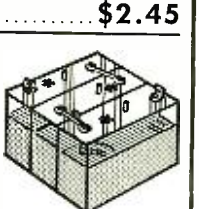


WILLARD MIDGET 6-V STORAGE BATTERY

3 amp hour rating. Transparent plastic case. Brand new. 3⅝"x 1 13/16"x2⅜" high. Uses standard electrolyte.
Each..... **$2.45**

WILLARD 6-VOLT STORAGE BATTERY



3 cells @ 2 volts each. 15 amp hour rating. Transparent plastic case. Uses standard electrolyte listed below. Brand new! 7 1/16"x 6⅞"x4⅛" high..... **$4.95**

1-QUART BOTTLE BATTERY ELECTROLYTE

Made by Willard, for above storage batteries, 1 qt. sufficient for two 2-volt cells. Hermetically sealed. SPECIAL. Per qt. bottle.. **$1.25**

verse effect. The values of plate and screen voltage are satisfactory. It was found best not to drop the plate voltage much below 20. The value of C_7 was satisfactory for both *G-E* and *Pickering* cartridges on listening test, though there is some difference between the inductance of the two.

Relative simplicity and the few parts required make the suppressor well worth incorporating. For some that do not desire dynamic effect, the side amplifier may be omitted and a d.c. bias applied to the control, which will result in a variable cut-off control that can be located remotely from the input terminals.

Subjective tests on the amplifier as a whole were very satisfactory. The 6AS7G tube, with its low plate resistance, contributes greatly to this test. While excellent results may be obtained with beam power tubes with large inverse feedback, the simplicity of using low impedance triodes for home construction use is an advantage.

It should be mentioned here that a wide-range amplifier requires associated components of equal quality to realize the full benefits on high fidelity. Turntable rumble that was scarcely noticeable on a previous amplifier became quite apparent, and this can become quite serious with bass boosting. The magnitude at a few cycles may be sufficient to overload the amplifier while having little audible effect other than the intermodulation of the desired frequencies. With a high-quality magnetic pickup this amplifier is capable of reproducing with full justice the full range of recorded frequencies. Full appreciation may be realized on high quality FM broadcasting. —30—

IMPROVEMENTS ON EARLY TELEVISION SETS

By WILBUR J. HANTZ

SOME television receivers currently manufactured have incorporated in them a means by which the operator may select a linear rectangle or larger round, close-up picture. Of course, the outer edges of the pictures are missing, but this does not detract from the over-all effect, or cause attention to be directed from the center. This same improvement can be effected in some of the earlier receivers without much difficulty or cost.

To enlarge the picture height and width without introducing a great deal of distortion, the vertical and horizontal oscillator sweep amplitudes must be changed accordingly. This can best be understood by considering a circuit of a typical multivibrator horizontal sweep oscillator of a small receiver, using a 7JP4 kinescope.

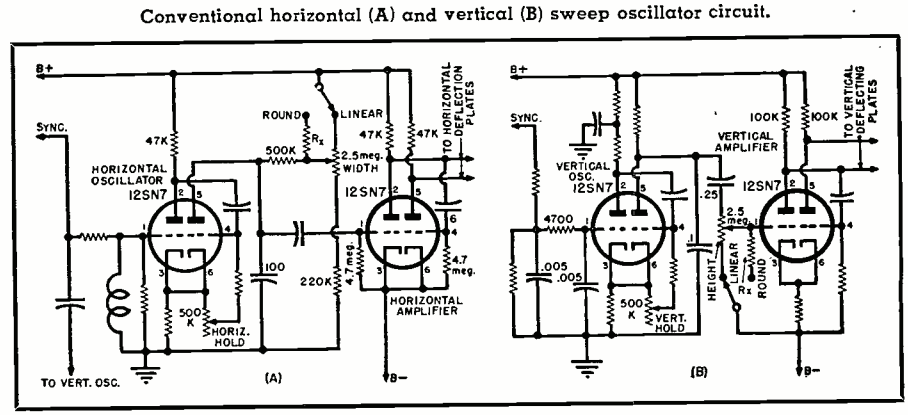
A 12SN7GT is used as the oscillator and discharge, followed by another 12SN7 as the horizontal amplifier. The 2.5 meg. width control functions as a voltage divider supplying one plate of the 12SN7 discharge section, and it controls the amplitude of the sawtooth output.

In the vertical sweep oscillator circuit, a second pair of 12SN7's is used similarly, only the 2.5 meg. height control is connected as a gain control in the grid of the vertical amplifier.

There are several methods that can be employed to obtain this effect, but only the simplest will be given here. Use a double pole, double throw switch and two resistors. Since the amplitude of the horizontal oscillator output depends upon the value of the width control, we can arrange to switch a resistor in here of the proper value, which is found by turning on the receiver, letting it warm up thoroughly, then turning the width and height controls until the picture completely covers the kinescope tube. Now turn the set off, and with an ohmmeter measure the amount of resistance left in the "B+" end of the width control. This is the value that will be switched in here in place of one-half of the control.

In the vertical oscillator section, measure the amount of resistance left in the low or ground end of the height control and the grid of the 12SN7 vertical amplifier. This is also the resistance value to be used here. The exact amount of resistance used varies in different makes of sets. If enough vertical sweep amplitude cannot be obtained with the control turned all the way, it may be necessary to switch this resistor in series with the ground end of the control. These changes will not affect the regular functions of the controls, because when the regular linear picture is used, the added resistors are switched out of the circuit. —30—

Conventional horizontal (A) and vertical (B) sweep oscillator circuit.



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4A6G 6A3 6C4 6F8GT 6SD7GT 10 12A
14X7 39/44 47 50 71A 112A 182B

FREE! $20.00 List Value Cornell-Dubilier, Mallory, Aerovox, Sprague, Solar. Filter Condensers—ten fast moving filters FREE with each 100 tubes.

183 25S 25Z6GT 482B 483 1A4 1A4P
1A6 1B5 1D5GT 1D7 1D8GT 1F4
1F5G 1G4GT 1G6GT 1H4G 1H6GT 1J6G

29c ea.

39c ea.

1C5 1C6 1L4 1R5 1S4 1S5 1U5 2A5 2A7 3S4 5U4G 5W4GT 5X4G
5Y3GT 5Y4G 5Z3 6AC4 6AC5 6AC5GT 6AG5 6AK5 6AL5 6AL6 6AQ5 6AT6 6AU6 6A8G 6A8GT 6B6 6BA6 6BD6 6BE6
6BH6 6BJ6 6C5 6C8G 6D6 6F5GT 6F6GT 6G6 6H6 6H6GT 6J5 6J5GT 6J6 6J7G 6J7GT 6K6GT 6K7GT 6K8GT
6P5GT 6SA7GT 6SC7GT 6SG7 6SG7GT 6SH7 6SJ7 6SJ7GT 6SL7GT 6SK7GT 6SN7GT 6SQ7GT 6SR7 6U6G 6U6GT 6U7G 6U7GT 6V6GT
6W4 6X4 6X5GT 6Z4 12A8GT 12AT6 12AU6 12AU7 12AX7 12BA6 12BA7 12BE6 12F5GT 12H6 12J5GT 12J7GT 12K7GT 12K8GT
12S8GT 12SA7GT 12SF5 12SF7 12SG7 12SH7GT 12SJ7 12SJ7GT 12SK7GT 12SN7GT 12SQ7GT 12SR7GT 2050 2051 24A 25L6GT 25X6 30
VT-52 31 32 33 34 35 35B5 35C5 35W4 35Z4GT 35Z5GT 35Z6GT 36 37 38 39 46 50B5

39c ea.

50Y6 51 53 57 58 75 76 77 78 80 84/6Z4 85 89

49c ea.

0Z4 1A5GT 1A7GT 1C7G 1H5GT 1LA4
1LE3 1N5GT 1P5GT 1Q5GT 1T5GT 1V 1C5GT 2A3 2B7 5V4
5Z4 6AC7 6AV6 6B4G 6BA7 6B8 6C6 6D8 6D8G 6F5
6F8G 6K7G 6R7 6SF5GT 6Q7GT 6T7G 6T8 6U7 6W7G 6Y6G
6Z7G 7A4 7A7 7B6 7E5 7E6 7E7 7F7 7G7 7H7
7J7 7L7 7N7 7Q7 7S7 7T7 7W7 10Y 12A7 12AT7 12C8
12J5 12Q7GT 12SL7 12Z3 14N7 19T8 20 32L7GT 35/51 35L6GT 36

49c ea.

40 41 42 43 50L6GT 53 117Z3 VR150 XXL 7A4

59c ea.

1B3 1AB5 1AD5 1LA6
1LB4 1LC5 1LC6 1LH4
1LN5 2C34 2E24 2V3G
2X2 25Z5 35Z3 3LF4
3Q5GT 50A5 6A7 6B7
6BF6 6DG6G 6J8G 6L6G
6L6 6S7G 6SU7GT 6U5
7C4 12A6 12BF6 14H7
45 70L7GT 81 83
117Z6GT 807 9001 XXB

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Less than 50 tubes, 5c per tube extra.
Individually boxed—Standard factory guarantee.

50L6, 35Z5, 12SK7 12SQ7, 12SA7 All-American Five ..... 5 tubes for $1.95

3S4, 1R5 1S5, 1T4 Battery Tube Special .. 4 tubes for $1.29

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Best quality Alnico 5 PM Speakers.

	10 or more Each	Price Each
5"- 95c -	$1.05	
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6"	$1.49	$1.59
8"	2.95	3.25
10"	4.25	4.50
12"	4.95	5.95

IF TRANSFORMERS

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Regular size ..... ea. 29c
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Standard replacement crystal cartridge. Each $1.39

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½ meg. with switch — long shaft	29c	35c
2 meg. for battery sets—DPST switch, long shaft	29c	35c
½ meg., 1 meg., or 2 meg., long shaft, less switch	15c	19c

BY-PASS CONDENSERS

100 Condensers assorted in package $5.95

.001 mfd. 600 V. ..... ea. 6c
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.005 mfd. 600 V. ..... ea. 6c
.01 ..... ea. 7c
.02 ..... ea. 7c
.05 ..... ea. 8c
.1 ..... ea. 9c

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.2 mfd. ..... ea. 6c
.25 mfd. ..... ea. 10c
.5 mfd. ..... ea. 15c

BUFFER CONDENSERS

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15c ea.

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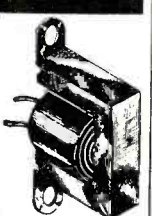

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For 6V6 6F6, 3Q5, etc. ..... 45c ea.

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1 box of 10 bulbs 54c

No. 40 6-8 V .15 Amps.	No. 46 6-8 V .25 Amps.
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15—450 V ..... ea. 29c
20—450 V ..... ea. 39c
30—450 V ..... ea. 49c
30—450 V with 20-20—25V ..... ea. 29c
8-8—450 V ..... ea. 39c
10-10—450 V ..... ea. 43c
20-20—450 V ..... ea. 49c

150 Working Volts

15-15—150 V ..... ea. 29c
20-20—150 V ..... ea. 29c
20-20-20—150 V ..... ea. 39c
30-30—150 V ..... ea. 39c
40-20—150 V ..... ea. 39c
40-30—150 V-30-20-25 V ..... ea. 39c
40-40—150 V ..... ea. 39c
40-40—150 V-25-25V ea. 39c
50-30—150 V ..... ea. 39c
50-50—150 V ..... ea. 39c
60-60—150 V ..... ea. 39c
15—150 V ..... ea. 21c
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Technical BOOKS

"FUNDAMENTALS OF WRITING FOR RADIO," by Rome Cowgill. Published by *Rinehart & Company, Inc.*, New York, N. Y. 300 pages. Price $3.50.

Proceeding on the theory that the average beginning student tries to understand the techniques of writing for broadcasting before he is quite sure of himself as a writer, the author has included a few chapters of writing hints before entering into the technical aspects of sound effects, transitions, continuity, and dialogue.

Some choice radio drama scripts have been included as examples of good radio continuity. These show how, with the aid of sound effects, music transitions, and other technical tricks, the realistic effects heard every day are produced. The last chapter is devoted to some hints on marketing radio scripts, bracing words of advice and encouragement on free-lance work.

Providing with his own work an excellent example of the soundness of his theories, Mr. Cowgill writes most interestingly and presents his material in understandable form without "talking down" to the reader. After studying this book, with the aid of the exercises given at the end of every chapter, no student could fail to consider that he has received all the help it is possible to communicate by means of such a text.

* * *

"COMMUNICATION CIRCUITS," Third Edition. By Lawrence A. Ware and Henry R. Reed. Published by *John Wiley & Sons, Inc.*, New York 16, New York. 403 pages. Price $5.00.

In line with recent communications developments, the authors of this third edition have applied each problem at hand, whenever possible, to the high-frequency range and present a good deal of information on microwave transmission by means of rectangular and cylindrical wave guides and coaxial cable.

For some portions of the text, a rather advanced knowledge of mathematics is required, and for these problems, special material has been provided in the back of the book for assignment according to need. For the book itself as a whole, however, a knowledge of calculus and the elements of a.c. theory is essential.

A considerable amount of material has been added to this revised text, Chapter 1 having been almost completely rewritten. A change has also been made in certain treatments to conform with procedures growing out of World War II. Portions on impedance matching have been extended, and many new problems have been devised. An Appendix comprising fifty pages presents much helpful practice work including a study of Maxwell's

Equations in relation to wave guides and coaxial cable.

Primarily, the book is designed to lead the electrical engineering student into the elements of hyper-frequency theory as a background for more advanced work. Reference suggestions are given for the benefit of those who wish to progress further. As the text deals with communication circuits from low voice frequencies through the microwave region, it will serve excellently as introductory material for any field of communication contemplated by the student.

* * *

"TV PICTURE PROJECTION AND ENLARGEMENT," by Allan Lytel. Published by *John F. Rider Publisher, Inc.,* New York 13, N. Y. 192 pages. Price $3.30.

In this up-to-date publication the author offers some valuable material that is quite different from that usually prepared on television subjects. The book undertakes to instruct on only one aspect of TV receivers, the optical systems employed, with special emphasis on the projection types. No circuits are included, but the thorough treatment given to the basic principles and theory of operation of lenses and optics should prove very helpful to the serious student.

For example, the first chapters concentrate on the properties of light, reflection, and mirrors and the rules and principles of refraction and lenses as a preliminary to the study of television pictures and projection systems. Following chapters on the television picture discuss the many ways of viewing the picture, providing descriptions of magnifiers used with the direct-view types of receivers. Subsequently, direct-view systems are contrasted with projection TV, and a long chapter describes commercial applications of the modified Schmidt projection system. This is followed by a study of refractive projection.

Questions at the end of each chapter drill the reader on the material covered therein, so that no aspect will be overlooked or misunderstood. An extensive bibliography and well-formulated index conclude this authoritative work. —30—

"I haven't a 275,000 ohm resistor, Ed, but if you put these in series you'll have it on the head!"

AFCA NEWS

This Association is a patriotic non-profit organization, with chapters in most of the larger cities, dedicated to developing and maintaining efficient personnel, commissioned, enlisted, civilian, for the supply (including design and development), installation, maintenance and operation of communications and electronic equipment for Army, Navy, and Air Force and their supporting civilian activities. It publishes a magazine "SIGNALS" at its national headquarters in Washington. Every American interested in any way in communications is eligible and invited to join. Dues are $5.00 per year. Application should be submitted to the secretary at 1624 Eye St., N. W., Washington 6, D. C., who will furnish details upon request.

Executive Committee Meeting

AFCA President Fred R. Lack of *Western Electric* presided at the Executive Committee meeting at national headquarters on September 14th. Col. Rex. B. Corput of the Office of the Chief Signal Officer and Col. T. J. Tully of Fort Monmouth were also present to participate in the discussion of general plans for the 1950 annual meeting of the association in New York City and Fort Monmouth, N. J.

Honor Roll

The Council voted in June to follow the lead of several professional societies and establish an honor roll for the purpose of perpetuating the names of distinguished pioneers and members now deceased of the association. Not more than one name may be added each year to this list. Elected by the Council were:

Maj. Gen. C. M. Saltzman, former Chief Signal Officer, who, with Brig. Gen. J. J. Carty, also named, founded the American Signal Corps Association after World War I; Brig. Gen. J. J. Carty, distinguished industrialist, with the *AT&T Co.* and reserve officer; and Maj. Gen. George S. Gibbs, former Chief Signal Officer, later president of *Postal Telegraph Co.*, and charter life member of the association.

Membership

1st lieutenants and lieutenants jg. and below are now eligible for the $3.00 associate membership. Student membership at $2.00 is now available for USMA, USNA, and technical school students for one year after graduation, as well as while in undergraduate status.

Naval Communications Chief

Rear Admiral John R. Redman, new Chief of Naval Communications, has been made an honorary life member of the association. This is in accordance with the policy established by the board of directors last spring of extending honorary life memberships to each of the three Chiefs of Communications upon appointment.

* * *

AFCA CHAPTER NOTES

Baltimore

The first fall meeting was held on September 14th at Fort George G. Meade, Md. After the business meeting and dinner at the Battalion Mess, 51st Signal Operation Battalion, visits were made to the Communication Center, Military Amateur Radio Station and Photographic Laboratory and Library. A display of tactical equipment of the 51st Signal Operation Battalion, including the modern AN/MSC-1, Mobile Signal Communication Center, rounded out the evening's activities.

Pittsburgh

The annual election of officers took place at the September 13th meeting held in the *Bell Telephone* auditorium. The program included a round-table discussion of the types of meetings desired during the year and the objectives to be accomplished.

The new officers of the chapter are: President—Edward J. Staubitz, *Blaw-Knox Co.;* 1st vice-president—Donald L. Chaffee, *Copperweld Steel Co.;* 2nd vice-president—Eugene C. Stern, *Bell Telephone Co.;* treasurer—Charles A. McKenney, Jr., *Peoples First National Bank & Trust Co.;* asst. treasurer—Hobart H. Drake, Jr., *Rust Engineering Corp.;* secretary—Sylvester C. Stoehr, Jr. *Bell Telephone Co.*

Southern Chapters

Mr. W. H. Mansfield of the *Southern Bell T & T Co.*, AFCA's area representative for the southeastern area, arranged a series of demonstration-lectures on "Micro-Radio Waves in Civil and Military Communication" by Dr. J. O. Perrine, assistant vice-president of the *American Telephone & Telegraph Co.* Dr. Perrine appeared before the following chapters: South Carolina on August 31st; Augusta-Camp Gordon on September 1st; Atlanta on September 6th; and Louisiana on September 8th.

Following a simple theme of "waves," Dr. Perrine, a *Bell System* research physicist for more than a quarter of a century, in a series of dramatic demonstrations built up a visual conception of radio waves and their application in communication, television and radar. Ultra-high frequency radio waves illuminated lights

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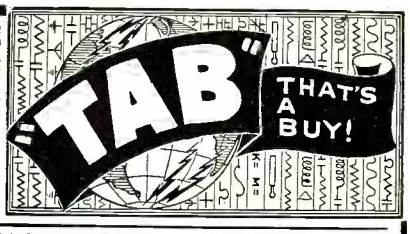
W/Flash Lamp $26.98



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OB2	1.69	2B7	.85	5C22	29.95	6K8G	.85	12A7	.96	48	1.49
OB3/VR90	.67	2B22/GL559	.73	5C30/C5B	9.95	6L5G	.98	12AGT	.56	50	1.49
OC3/VR105	.75	2C22/1642	.81	5D21	25.95	6L6	.98	12AH7GT	.84	EF50	.40
OD3/VR150	.49	2C22/7193	.18	5J23	14.25	6L7	.83	12AT6	.45	50B5	.54
OZ4	.87	2C26	.25	5J29	17.39	6N7GT	.90	12AT7	.79	50C5	.59
C1A	9.95	2C34/RK34	.55	5J30	49.27	6P5G	.75	12AU6	.59	50L6	.56
O1A	.45	2C39	18.00	5R4GY	1.12	6Q7	.75	12AU7	.69	53A	.89
1A3	.59	2C40	2.89	5T4	.96	6R7G	1.05	12AX7	.89	57	.47
1A4	1.26	2C43/464A	8.91	5U4G	.52	6S7G	.81	12BA6	.55	RK65	22.95
1A5GT	.70	2C44	1.69	5V4	.95	6S8GT	.79	12BA7	.89	FG67	12.75
1A6	1.26	2C51	7.98	5W4	.74	6SA7GT	.45	12BD6	.59	HY69	2.29
1A7GT	.59	2D21	.90	5X4G	.71	6SB7Y	.81	12BE6	.45	70L7GT	1.15
1B3/8016	.81	2E5	.98	5Y3GT	.38	6SC7	.65	12BH7	.59	75	.65
1B21/471A	2.95	2E22	1.34	5Z3	.81	6SF5	.55	12BY7	.45	76	.45
1B22	4.50	2E24	2.98	5Z4	.88	6SF7	.78	12DE8	.75	77	.45
1B23	9.00	2E25/HY65	2.98	C6A	8.35	6SG7	.63	12DQ6	.85	78	.45
1B24	4.85	2J21	11.98	6A3	.98	6SH7	.38	12E6	.75	80	.36
1B26	4.50	2J21A	11.98	6A4	1.29	6SJ7GT	.55	12H6	.34	81	1.29
1B27	4.75	2J22	29.95	6A6	1.02	6SK7GT	.55	12J5GT	.35	FG81A	4.45
1B29	3.39	2J25	98.00	6A7	.75	6SL7GT	.55	12J7GT	.78	82	.85
1B32	2.24	2J26	8.89	6AB7/1853	.84	6SN7GT	.55	12K8	.75	83	.59
1B37	45.00	2J27	8.85	6AC7	1.05	6SN7GTA	.89	12K7GT	.55	83V	1.05
1B38	37.00	2J31	9.95	6AD6	.75	6SN7WGT	.89	12SA7GT	.55	84/6Z4	.57
1B40	29.95	2J32	39.95	6AD7	.81	6SQ7GT	.47	12SK7GT	.55	85	.57
1B41	29.95	2J33	14.50	6AE7	1.17	6SR7	.56	12SK7M	.52	89	.35
1B53	49.95	2J34	23.90	6AF6G	.87	6SS7	.63	12SL7GT	.63	VR92	.23
1B54	49.95	2J37	17.25	6AG5	.72	6T7G	1.19	12SN7GT	.54	FG104	14.98
1B56	49.95	2J38	13.89	6AG7	1.08	6T8	.98	12SQ7GT	.54	FG105	10.75
1B60	29.95	2J39	34.00	6AH6	.98	6U5/6G5	.72	12SR7GT	.37	HY114B	.81
1C5	.86	2J47	39.95	6AJ5	.73	6U6GT	.69	12X3	.90	HY115/145	.80
1C6	1.26	2J48	45.00	6AK5	.78	6U7G	.54	12Z3	.72	HY116/145	.80
1C7G	1.27	2J49	24.00	6AK6	.81	6V6GT	.92	14B6	.81	117N7GT	1.36
1D5GP	1.25	2J50	40.00	6AL5	.59	6V6GTY	.59	14R7	.85	117Z3	.49
1E5	1.03	2J53	40.00	6AL7	1.00	6V6GTY	.90	15E	1.44	117Z6GT	.77
1E7G	1.17	2J56	81.00	6AQ5	.52	6W7G	.87	15R	.75	117Z6GT	1.49
1F4G	1.05	2J61	39.00	6AS5	.59	6X4	.49	FG17	2.87	F127A	16.95
1F7GV	1.55	2J62	39.00	6AS6	1.98	6X5GT	.55	RK18	.98	19T8	.98
1G4GT	1.05	2K23	24.50	6AS7G	4.40	6Y6	.87	19	1.49	20	1.17
1G6GT	.67	2K28	24.89	6AT6	.45	6Z7G	1.23	19T8	.98	PJ21	4.98
1H4G	.87	2K29	24.95	6AV6	.53	6ZY5G	.67	VT127A/	WL534	REL21	4.85
1H5G	.65	2K39	54.00	6AV6	.43	7A4/XXL	.57	CV147	7.90	RX21	3.20
1H6G	1.27	2V3G	1.05	6B4G	.96	7A5	.57	J151	.98	VT158	9.85
1J6	.98	3A4	.27	6B7	.89	7A6	.69	FG166	49.00	FG172	29.50
1L4	.49	3A4	.36	6B8G	1.05	7A7	.56	FG172	29.50	FG190	12.98
1LA4GT	1.05	3A5	1.20	6BA6	.49	7A8	.69	25L6GT	.55	205B/VT2	1.98
1LB4	1.05	3B7/1291	.95	6BE6	.59	7AG7	.85	25Y5	1.08	211/VT4C	.45
1LC6	.85	3B22	2.68	6BF6	.59	7B4	.55	25Z5	.46	RX215	9.95
1LE3GT	1.49	3B24	1.85	6BG6G	1.49	7B5	.70	25Z6GT	.55	WE215A	.25
1LH4	1.05	3B25	4.95	6BH6	.79	7B6	.60	FG27A	9.50	GL227A	2.98
1LN5	.75	3B28	5.89	6BJ6	.59	7B8	.70	28D7	.36	231	1.20
1N5GT	.69	3C23	2.48	6C4	.24	7C4/1203A	.36	30	.36	250TH	18.49
1P5GT	.69	3C31/C1B	1.98	6C5	.47	7C5	.54	31	.36	250TL	18.90
1P24	.85	3C45	24.95	6C6G	.55	7C6	.69	32	.89	282B	4.98
1Q5GT	.96	3D6/1299	.85	6C8G	1.05	7C7	.65	FG32	4.98	304TH	5.95
1Q26	75.00	3D21A	1.37	6C21	23.95	7C23	69.95	32L7GT	.95	304TL	1.39
1R4/1294	.98	3D22	7.49	6D6	.45	7E5/1201	.89	FG33	8.49	307A/RK75	3.80
1R5	.99	3E29/829B	4.89	6E5	.81	7E6	.69	35A5	.65	316A	.38
1S4	.49	3Q4	.54	6E6	1.05	7E7	.85	35B5	.59	323A	19.50
1S5	.54	3Q5	.89	6F6G	.59	7F7	.85	35C5	.60	327A	2.90
1S21/GL34	3.75	3S4	.79	6F7	1.00	7F8	1.03	35L6GT	.54	350	1.23
1T4	.69	3V4	1.04	6F8G	1.40	7H7	.65	35W4	.35	350B	1.98
1T5GT	1.05	4A1	1.29	6G6G	1.05	7K7	1.05	35Y4	.55	371A	.41
1U4	.69	4B27/201	2.49	6H6	.43	7L7	.86	35Z5GT	.54	C376	2.98
1U5	.69	4B31	18.95	6H6GT	.38	7N7	.85	REL36/6J4	.75	380A	.79
1V	.54	4C33	81.00	6J5	4.75	7Q7	.72	37	.36	388A	.40
1Z2	1.98	4C35	22.95	6J4	5.75	7S7	.98	38	.34	393A	3.80
2A3	1.25	4D32	7.98	6J5GT	.48	7T7/7G7	1.03	39/44	.25	394A	3.80
2A4G	1.08	4J31	95.00	6J6	.78	7V7	1.04	CRC40	.54	FP400	7.98
2A5	.86	4J32	95.00	6J7	.75	7Y4	.54	41	.50	417A	19.95
2A6	1.05	4J42/700A	29.85	6K5GT	.86			43	.57	GL434	3.45

446A/2C40	$1.17	872A	$1.49	7BP7	$ 4.65						
446B	1.80	874	.55	7CP1	12.95						
450TH	17.75	876	.36	7HP7	5.95						
450TL	39.95	878	1.95	9GP7	12.35						
GL451	1.90	884/6Q5G	1.35	9LP7	2.21						
460/HF200	11.98	885	.95	10BP4	19.75						
WL468	7.49	920	2.70	10FP4	24.50						
RH507	9.98	922	1.19	10HP7	12.49						
527	7.49	923	.85	12GP1	49.98						
530	4.90	927/CE25	1.26	12GP7	12.80						
531	1.80	930	.75	12JP4	34.75						
WL531	1.95	931A	3.95	12KP4	34.75						
GL534/		954	.14	12LP4	34.00						
1S21	1.95	955	.16	12QP4	49.98						
544	4.98	956	.27	16AP4	55.00						
GL546	1.65	957	.20	902	3.75						
550P1	19.95	958	.25	905	3.89						
575A/975	12.75	SD968	4.98	910/3AP1	4.75						
601B	.19	991	.25	912	89.98						
KU610	9.50	1000UHF	59.95	914	45.00						
HY615	.27	1605	.18	**TUNGAR BULBS**							
WL619	20.00	1609	5.98	12X825	$ 2.25						
KU627	7.49	1613/6F6X	.55	16X897	2.49						
631P1/SN4	3.98	1614	1.42	20X672	2.95						
WL632A	7.49	1616	.89	189048GE	3.45						
701A	3.50	1619	.18	199698	2.95						
702A/702B	3.20	1620	4.95	289881	2.50						
703A	3.75	1622	1.75	859483	3.98						
704A	1.08	1624	1.69	**BALLAST**							
705A/8021	1.05	1625	.37	1P1	$ .49						
707B	7.98	1626	.35	6-11	.49						
710A/8011	.65	1629	.26	7H12	.49						
713A	1.49	1632	.89	9-3	.49						
715B	7.29	1633	.97	10-4B	.49						
717A	.51	1635	.90	13-4	.49						
721A	1.89	1641/RK60	.68	20-4	.49						
722A/287A	9.95	2050	.63	K49-A	.36						
723A	6.95	2051	.42	K55B	.36						
723A/B	14.95	UX6653	.69	M55B	.39						
724A/B	3.90	8012A	1.45	L82A	.49						
725A	9.36	8013A	2.50	K80B	.36						
726A	6.98	8020	1.90	WL121A	2.65						
726C	29.98	9001	.34	C376	2.98						
730A	10.90	9002	.35	ZB583	1.98						
803	4.75	9003	.35	**MAGA PILOTS**							
804	6.90	9004	.27	44 Box 10	$ .50						
805	3.80	9005	.90	49 Box 10	.60						
807	1.10	9006	.18	55 Box 10	.50						
808	1.35	**C-RAY TUBES**		6.4 Each	.07						
809	2.40	2AP1	$ 3.79	S6/T4 Ea.	.15						
810	6.45	2AP1A	4.85	100W/90V	.25						
811	1.67	3AP1	4.75	313/28V	.15						
812	2.60	3BP1	2.98	323/3V	.10						
813	6.25	3BP1A	7.98	Sylvania S6/							
814	2.61	3CP1	2.65	6W/120V	.15						
815	1.39	3CP1-S1	1.95	Wstghs C7/							
816	.99	3DP1	1.87	7W/120V	.09						
826	.42	3EP1	2.75	Dialco type							
SD828	3.98	3FP1	1.49	Bull' s Eye Pilot							
829B	7.29	3FP7	.98	Lite Complete							
832	3.98	3GP1	4.95	w/S6 115V bulb							
832A	4.20	3HP7	3.49	or neon bulb							
836	.95	4AP10	5.90	chrome 2/78c							
837	2.35	5BP1	1.85	**NEON BULBS**							
838	2.75	5BP4	2.75	NE2/100for	$3.98						
842	2.75	5CP1	1.75	NE16/991	.25						
843	.39	5CP7	7.50	NE31/1¼W	.24						
845	4.15	5FP7	6.49	NE32	.35						
851	14.95	5FP14	1.26	NE51/NE20	.07						
860	18.50	5HP1	18.50	**TEL Slide Lamps**							
861	10.26	5JP1	4.95	6, 12, 24, 48							
864	.45	5JP2	11.95	55V Each	$0.18						
865	.95	5JP7	10.95	Tube&Gtd	1.5c						
866A	.99	5LP1	18.00	**Open Fil & B'kage**							
868/PJ23	1.90	5LP3	18.00	**C'R Tubes Gtd**							
869	30.00	5LP7	18.00	**Only Via R'Exp**							
		5MP1	3.95								

115V/60 CYC AC TRANSFORMERS
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2240vct/.5a,12v/14.25a,19.2v-18.3v-17.5v@ 7a 2.5v/10a,30v/.05a, Autoformer on Pri.. $19.98
1700vct/110ma,6.3v/12a,5v/3a 4.98
1550vct/150ma,6.3v/4a,5v/3a 8.98
1320v&375vct/110ma,5v/3a,2.5v/3.25a, 6.3v/2.75a 7.25
1000vct/200ma,90v bias,6.3v/5a, 5v/6a, 18v/.55a 6.95
1000vct/150ma,300v bias,6.3v/5a,5v/3a, 2x6.3v/.65a,6.3v/1.25a 4.50
1000vct/45ma,750vct/80ma&360vct/55ma 3x5v 3a,6.3vct/1a,5vct/300ma 4.95
900v/3ma,6.3v/2a,2.5v/3a 4.49
840vct/110ma,530vct/21ma,2x5v/3a, 6.3vct/3a 3.98
770vct/70ma,6.3vct/2.5a,5v/2a 3.49
770vct/2.5ma,2.5v/3a 3.95
700vct/120ma,115v/100ma,2x6.3v/1a,5v/2a 2.98
700vct 85ma,5v/2a,6.3v/7.5a,6.3v/3a ... 3.95
700v/1ma,2x5.3v/50maDC,2.5v/2a 6.3v/3a,2.5v/3a 3.49
650vct/175ma,5v/3a,6.3v/2.1a 3.29
580vct/50ma,5v/3a,6.3vct/2a 2.89
5?0v/150ma,5v/3a,12v/4a 3.11
550vct/275ma,5v/3a,6.3v/6a 3.98
480v/80ma,6.2v/4a,5v/3a 1.89
420vct/85ma,6.3v/1.9a, also pri6-12-24-115vdc&230vac $2.39; 2/4.39; 10/.. 19.98
370v/75ma,6.3v/2.1a 2.49
225vct/750ma,6.3v/4.15a,5v/3a 3.89
220v/50ma,5v/6.5a,6.3v/2a,6.3v/1a 2.39

PLATE TRANSFORMERS

10800vct or 2400vctDblr/95ma $19.95
7500vor15000Dblr/35ma 18.95
5000v/10ma(or2x2's) Csd 7.95
3000v 10ma,Csd HiVins 4.50
1800v/4ma,USN Csd Altec/GE HiVins 3.29
1200vct/300ma, 18v/1a Csd HiVins 6.95
490v&355v/325ma 4.98
2x330vct/10ma (or660vct/10ma)CsdHiVins .98

FILAMENT TRANSFORMERS

10.2vct/10a,12.2vct/.7a,6.4vct/.9a,6.4vct/1.8a,6.4v/.9a,6.4v/1.8a,6.4v/.6a 5.29
4x6.3v/4a, 3x5v/4a 4.50
6.4v/12a, 6.4v/10.6a, 3x5v/3a,2.5v/1.75a, Usable as Autoformer 4.98
12.6v/3.5a, 10.6v/1.25a 2.98
6.3v/6a, 6.3vct/3a 2.98
6.3vct/2.5a,6.3vct/1a 2.29
2x5v/.065 RVApri (for 872A fil's 7.95
5v/3a, 2.5v/10a 3.98
2.5v/1.75a, 4v/16a, 20KVins 4.95
5vct/10a/100-120Vinpt or 10vct/10a/200-240Vinpt 5.98
5v/5a/110Vinpt or 10v/5a/220Vinpt 3.25
2.5vct/20a/100to120Vin or 5vct/20a/200 to 240Vinpt 7.98
2.5v 10a 10KV (for 866's) 3.95

12.6vct/2a	$1.49	6.3vct/1a	$1.19
7.5vct/12a	3.29	6.3/.6a 5v/115a	12.95
6.3vct/4agudto 6.5a	1.69	5vct/60a	7.95
6.3vct/2a	1.39	2.5v/2a (for2x2)	.69

PULSE XFMR—Pri & 3 SecWndgs—Imped Ratio 50-1000ohms Electrostatic Shield, Permalloy Core WECo Pri 4000v. Sec17500V $14.98
TV Video RAYTH UX7307 ..... $1.98
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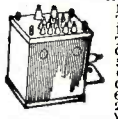
G-E Autosyn/Selsyn ServoControl Xfmr Type 20G12 Inpt115V/400cyc 1hp. Sec0phase210to 360V $1.49

TV PWR SUPPLY XFMR



HI-VOLTAGE for CR Tubes 5" to 20" & Plate: Volts for ALL Tubes & ALL Fil's, Complete w/data for 5000 to 20000 Volt Circuits: also Full Wave Outpt 300VDC/275Ma & 6.4V/10.3A, 5.4V/8A, 2.5V/3A, Inpt 105-125 VAC/50-400cyc Hypersil Core Oil Impreg.W.E. for USN Special **$9.95**
Ideal CRT Xfmr 1800V Dblr Ckt; 115 vac Inpt; Outpt—1000V/35ma:2x2.5V/2 amps ea. Sec.4KV ins. Sig. C Specif. Herm Sld. Two 2x2 tubes & All Filter Parts & Data **$5.98**

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Modulation Stancor USN H'Sld PPprll 807's toPP807'sRF 2000ohm Load240 Watt0k $4.95
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UTC LVM-11 line autoformer 30 Watt $2.98
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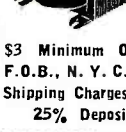
CARTER"MAGMOTORS" Perm Magnets Extremely Hi-Efficiency Compact 5½ x 3¾ x 2½". Lo-temp rise.

XMTG "MAGMOTOR" Inpt: 5.5VDC/ Outpt: 400V/150Ma int, 57½% eff, **$4.00** RPM, 4¾ lbs, net, ONLY **$5.98**
RCVNG "MAGMOTOR" Inpt: 6VDC Outpt: 250V/100Ma cont, 52% eff, 4800 RPM,4½lbs net, ONLY.. **$4.98**
BOTH UNITS ABOVE, SPECIAL **$12.49**



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15-29Hy/150ma Swinging Cased $2.95
12Hy/300ma $3.95
3Hy/40ma, 6.3 for $1.00
15Hy/400ma or 20 HY/300ma/12KV ins $7.95

$3 Minimum Order. F.O.B., N. Y. C. Add Shipping Charges and 25% Deposit

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Best Buy—5 Ma DC Tuning Meter. G-E. 2½"dia,BkltCsd SPECIAL..98c

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0-30A,2¼" IntWECo&WStg.. 2.98
0-35A Int. Shunt WECo 2.98
0-60A, 2¼" Int.Shunt, WECo.. 3.49
0-120A, 2½" w/ExtShunt WECo & Wstg 3.98
0-240A, 2½" Less Shunt 2.49
0-240A,2½",w/Ext.Shunt,Wstg. 3.98
0-300A, 3" Less Shunt,WECo... 4.49
30-0-30A, 2⅜",Weston 203P& Wstg 4.98
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60-0-60A, 2½", w/ExtShunt,WE &Wstg. 3.98
120-0-120A, 2½" w/ExtShunt, WECo&Wstg. 3.98
480-0-480A, 2½"Wstg.LessShunt 3.49

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0-500V, 3½" WECO. 1000ohms V/AN B'Csd 4.95
0-2KV, 2¼" GE Ext. Resistor. 7.89
0-10KV, 3¼",1ma basic, Ext. Resistor Weston B'Csd. 10.95
0-20KV, 3½" 0-1 ma basic B'Csd Meter w 20Ke 2%Meg. Sprague Precision Resistor.... 14.98
DB METER, 10+6 DB. 3½" Sq. Wstghs B'Csd $9.98
0-120Ma, 3½" WESTON JAN Accy to 65 Mc's 12.95
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KIT 866A's & Xformer, 2.5KV/60cyc Outpt 2.5 VCT/10A 10KV Insul & Sckts & Tubes **$5.95**
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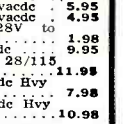

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40 CFM/28vacdc .$3.49
100 CFM/12vacdc 5.95
100 CFM/28vacdc 4.95
Xfmr or 28V to 115vac 1.98
550 CFM/28vacdc 9.95
250 CFM plus 28/115 vac Xfmr 11.98
100 CFM/115vacdc Hvy Dty 7.98
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2x5mfd (10mfd) OILMITE to W.E. specif KS8976 rated 400WVDC —65 to +65° Cent GTD Usable 600WVDC "TAB" SPECIAL 2 for 98c.
Dual .1mfd/2000WV Common term off Ground TOBE Mfr.....$1.08; 2 for $2
1mf/500wvGE..... 4 for 98c
5mf/500wv Bckts 98c

OIL CNDSRS—NEW—Famous Makes

Mfd	WVDC	Each	Mfd	WVDC	Each
.00025	25000	$4.95	1	3600	$ 3.25
.0016	15000	4.98	1	4000	3.75
.002	7000	.98	1	7500	7.98
.0075	7000	1.29	1	25000	95.00
.025	1500	.59	2	1000/330AC	.65
.03	7500	1.98	2	1500	1.69
.05	1500	.39	2	2000	1.98
.05	4000	1.89	2	3000	3.98
.1	1000	.39	2	6000	9.98
.1	1500	.59	2	5500	10.98
2x.1	1500	.79	2	12500	19.98
.1	2000	.89	3	2000	3.49
.1	3000	1.90	4	600	.55
.1	7500	2.89	4	1000/330AC	.87
.2	5000	2.25	4	1500	2.39
.25	1000	.59	4	2000	3.98
.25	2500	.74	4	3000	5.95
.5	1500	.98	4	5000	16.00
.5	3000	2.49	5	600	.90
.65	12500	14.89	5	1000	1.98
1	1000	.45	5	1500	2.49
1	1500	1.09	5	2000	4.98
1	2000	1.27	8	2000	8.98

THAT'S A BUY **"TAB"** THAT'S A BUY

DEPT. 11RN SIX CHURCH ST. NEW YORK 6, N.Y., U.S.A. CORNER CHURCH & LIBERTY STS. ROOM 200

held in space, and were reflected, bent, and focused.

South Carolina

Some 250 members and guests attended the August 31st meeting at the Columbia Hotel, Columbia, which featured Dr. J. O. Perrine's lecture on "Micro-Radio Waves in Civil and Military Communications." The audience included a large delegation from the Charleston Navy Yard, as well as Army personnel from Fort Jackson and representatives of the industry.

Officers elected to lead the chapter during its first year are: President—Fred M. Fister, South Carolina, Chief Engineer, *Southern Bell T & T Co.;* 1st vice-president—Capt. Joseph B. Berkley, USN, Charleston Naval Shipyard; 2nd vice-president—Maj. Theodore A. Brunner, Post Signal Officer, Fort Jackson; secretary—John A. Norman, Division Construction Supervisor, *Southern Bell T & T Co.;* treasurer—Albert L. Ragsdale, Professor of Physics, University of South Carolina.

—30—

DISC JOCKEYING AT THE PLAZA

AN engineer's dream come true is the radio room of the Terrace Plaza Hotel in Cincinnati, Ohio, which keeps in operation throughout the day six radios, plus a seventh emergency hookup. From 8:30 a. m. until 12:30 a. m., these six radios supply programs from Stations WLW, WSAI, WKRC, WCPO, WCKY, and the hotel's own recorded show, all of which may be tuned in by the guests by means of the six pushbuttons provided in each room.

What makes the three men who staff the radio room very proud is the fact that the Terrace Plaza's own recorded broadcast is the one most often tuned in. One of the reasons for the popularity of the hotel's program can be summed up in the words "Extension 385." Guests who want a certain song broadcast at a definite time of the day, say as a "happy birthday" greeting in honor of a friend or "mood music" timed for romance, may dial 385, and the request is granted cheerfully.

Specially selected programs of music are used as a background for the many activities occurring there. Bright and airy music is selected for the breakfast hours, while more subdued selections and light opera herald lunch and dinner time. Vocals are seldom used, and bebop, swing, and hill billy numbers are out. George Gershwin's "Rhapsody in Blue" and "Concerto in F" are popular request numbers. Frequently a guest will call up to learn the name of a song being played and ask that it be repeated.

Three turntables are used to keep the recorded program going. Two are radio station types and one is a big automatic changer holding 100 records, that will play for 14 hours. There is no end to the variations possible with this arrangement. One turntable can be used for skating music outside, from early fall through spring, the second for the regular program, and the third for a special transcription to any location desired.

The seventh radio in this extensively equipped studio is used for emergency messages, and when it is broadcasting, every speaker in the hotel picks it up, even those that may be turned off at the time; the special message also cuts into any programs that may be on.

As impressive as the radio system may be, the plans for television facilities seem even more so. All the 19th floor rooms are wired for television, though guests now must supply their own sets. Later the hotel will have some available for rent. Plans are under way so that the Terrace Plaza will be able to present television shows on a channel received only in the hotel, emanating from the *Crosley* TV studio located on the seventh floor. When television can be controlled from a central station, the remaining rooms will be wired for it.

—30—

Herman Knott (right), head of the radio room staff at the Terrace Plaza, with an assistant, Everet Fredy, prepares one of the hotel's recorded musical programs.

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BI-MONTHLY

RADIO-TV STANDARD & SURPLUS EQUIPMENT

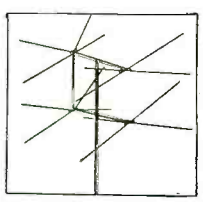
Write for your FREE copies NOW!

Just drop us a card to get the Bulletin regularly. It gives you the real low-down on the latest competitive prices on surplus gear, plus special buys in nationally known standard AM FM TV and electronic parts. IMMEDIATE SHIPMENT! MONEY-BACK GUARANTEE!

Typical Values Below:

CATALOGUES GET OUT OF DATE TOO FAST! USE R&M BULLETIN AS YOUR BUYING GUIDE.

TV CONICAL ANTENNA



STANDARD—$9.95

DELUXE—$13.29

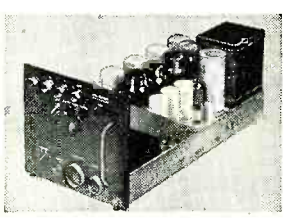
Unsurpassed in Performance! Conical stacked array and reflectors; all bands; less mast for 72 or 300 ohm; good up to 125 miles.

160 METER RECEIVER

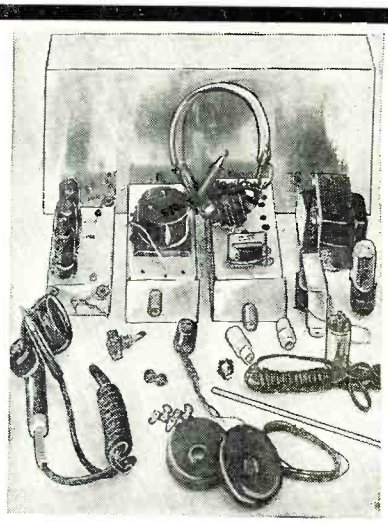
HI-VOLTAGE POWER SUPPLY FOR 110 VAC—60 CYCLES OPERATION

$14.95

with these desirable features:



4 channels on 160 meters . . . Select your day-and-nite freqs. by easy switching; 150 mil, 300 VDC .01% regulated power supply; two hi-voltage scope supplies, both 1350 VDC 2 mils, which combine to produce 2700 VDC at 2 mils; converts in 45 minutes. By presetting the 4 channels you're prepared to receive on the old favorite 160 meters. Moreover, you'll have a power supply from 200 to 325 VDC at 150 Ma, continuously variable, with extremely low ripple content, .01% voltage regulation electronic control. Conversion is simple—consists of adding a pot for receiver gain control, a small audio output transformer and one half-watt resistor. Complete, simple instructions furnished with each set.



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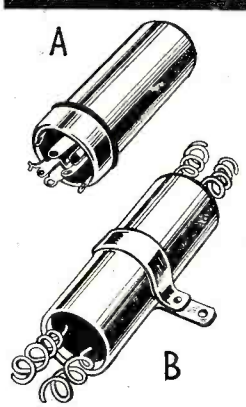
COMPLETE KIT Nothing Else to Buy **$49.95**

Here's a sensational R&M offering—a compact kit for complete citizen frequency coverage on both AM and FM. Major components are pre-wired. Simple, easy-to-follow instructions and diagrams are furnished with each unit. Transmitting and receiving antennas are included. Operates on 110 VAC—60 cy. Useful for businessmen, doctors, sportsmen, boat owners, experimenters, hams, and first aid crews.



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FRESH STOCK • MONEY-BACK GUARANTEE

Type	Mfd.	Voltage DC Working	Dimensions (Diam. x length)	Price (each)
A	40	450	1" x3"	45c
A	40-40-20	150	1 3/8x2 1/8	69c
	200	10		
A	80-40	150	1 x3	55c
	20	25		
A	40-20-10	150	1 3/8x2	49c
A	80-40-30	150	1 3/8x2	66c
	100	25		
A	40-40	150	1 x2	43c
B	20-40-20	150	1 x3	39c
B	20-30-40	150	1 1/4x2 1/2	45c
B	4	450	1/2x1 3/4	19c
B	40-40-40-10	150	1 1/8x2 7/8	69c

Many more varieties not listed. Write for complete listing of condensers, resistors, transformers, speakers, etc. Any condenser order of $10 or more shipped prepaid.

TERMS: F. O. B. Arlington, Va. Under $10—cash with order. Over $10—25% deposit; balance C. O. D.

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International Short-Wave

(*Continued from page* 69)

ing SWL's who have v.h.f. interest.

* * *

This Month's Schedules

Algeria—Radio Algerie noted on 9.57 to 1800 closedown; should be using winter channel of 11.835 soon? (Slutter, Pa.)

Andorra—Radio Andorra, 5.980, heard in Australia 1700 with French news and musical program. (Sanderson)

Anglo-Egyptian Sudan—"Omdurman Calling" heard on 9.750 on Fridays beginning with "Colonel Bogey March" at 1230 followed by call, "Good evening, everybody. This is the Sudan broadcasting from Omdurman on 30.5 and 49 meters short-wave and on a medium-wavelength of 524 meters." News in *English,* then musical program to 1300. Pearce, England, who reports this transmission, says: "I cannot hear anything of the 49-m. channel; letter states the station broadcasts on 6.122 and 9.770 s.w. and on 572.5 kc. m.w.; is reported heard in England on 5.940, but I cannot confirm."

The daily 2315-2345 Arabic transmission on about 9.750 is again being heard in the United States. (Bellington, N. Y., Stark, Texas, and others)

Angola—CR6RL, 9.47, Luanda, logged in New York 1545-1600 sign-off; played classical and tango music; off with "A Portugesa"; signal only fair with some CWQRM; all-Portuguese. (Bellington)

Radio Clube de Benguela, CR6RB, 9.165, R6 with classical orchestral music 1330 on a recent Friday; has classical music at this time one day a week; off 1400 with "A Portugesa." (Pearce, England) Sent verification and listed schedule of 0615-0700, 1230-1400 on 9.165 and 7.041; card is a pretty one with picture of elephant. (Fellers, Japan)

CR6RG, *"Radio Diamang,"* 8.242, Dundo, heard weak a few times 1330-1430, through severe CWQRM; best during last half hour of transmission; programs are nice, consisting of music with many well-known melodies; verifies both by QSL card and letter; on Sundays has a broadcast 0300-0400 and *not* at 1330-1430. (Albinsson, Sweden)

"Radio Clube de Bie," 7.550, Silva Porta, heard to 1500. (Nattugglan, Sweden)

Argentina—LRS, 11.88, noted with excellent level, little QRM, at 1835 ending news bulletin; continued in *English* with *SRI* (International) programs. Mesquita e Sousa, Portugal, notes that this one verified from *Radio Splendide,* Ayacucho 1556, Buenos Aires, Argentina.

LRS, 11.88, and LRY, 9.451, are both heard in Sweden around 1900-2100; sometimes fade badly. (Gimby)

Australia—VLA4, 11.85, is a great improvement over VLA8, 11.76, which it replaced for the 1643-1815 beam to

Eastern North America; only interference is a slight heterodyne from Chile underneath VLA4. (Bellington, Osterman, N. Y., and others) This one is heard fair in Britain. (Pearce)

Austria—KZCA, Salzburg (U. S. Zone), heard on 9.535 around 0740-0800 when this call is given—"Blue Danube Network, Station KZCA, Salzburg." *Radio Vararlberg* (Dornbirn?) in the French Zone, 6.005, often is heard in Britain around 1600-1700 with invariable heterodyne; this station transmits the American-recorded religious program, "Bringing Christ to the Nations," in *English*, each Wednesday 1700. (Short-Wave News, London)

Rot-Weiss-Rot, 9.565, Salzburg, heard 0030 with "early morning music"; details and schedules 0056, followed by news in German 0100; more music 0115. *Radio Wien*, 11.785, Vienna, R6-7 signing on 0040 *daily* with church bells and recording of Handel's "Largo." (Pearce, England)

Balearic Islands—Radio Menorca, Mahon, heard 1330-1530, much QRM and CWQRM; frequency now appears 7.495-7.500, is well on the low side of EAJ43, Tenerife, Canary Islands. (Pearce, England) QRA is ERM, Delegacion Insular del Frente de Juventudes, Mahon, Islas Baleares, Espana (Spain). (DX Radio, Sweden)

Bechuanaland—Via airmail, Ridgeway, South Africa, writes—"As far as I know, Bechuanaland has but one station, ZNB, Mafeking, 5.90. Schedule is now 1200-1430; ZNB is a postoffice transmitter; formerly had a mid-day session but this has not been heard lately. Relays news from SABC, Johannesburg, at 1200 and then plays recordings to closedown."

Belgium—Ruyselede, 17.845, heard a recent Sunday 1115 to sign-off 1225, relaying soccer scores to Leopoldville in French; no announcement at sign-off, but from time to time said, "Allo, Leopoldville." (McPheeters, N. Y.)

Brazil—ZYS8, Manaos, now on 4.805 where is free of interference; heard in Australia opening 0500. (Simpson via *Radio Australia*)

Radio Nacional, Rio de Janeiro, was to have a new outlet on 6.155 shortly, may be on by now? (Osterman, N. Y.)

British Guiana—ZFY, about 5.985, Georgetown, is fair level evenings. (Slutter, Pa.)

British New Guinea—Officials of VLT7, 9.52, say program 0230-0300 is in *Pidgin English* (at times also uses Motu), and that bagpipes are used on VLT7 because the natives like the bagpipe tunes; asks for further reports. (Bellington, N. Y.)

Bulgaria—Radio Sofia, 7.671, news is radiated 1520, 1645; announces, "This is *Radio Sofia*, calling in the Anglo-American Service of the Bulgarian Broadcasting System." After the news, requests reports from listeners which says will be acknowledged over the air and QSL'd by card also. (Patrick, England) Heard with poor signal in Pa. around 2315 with setting-up exercises, still going 2345. (Hankins) Saturday sign-on is 2325, other days 2255.

Burma—Rangoon, 6.035, has news yet 1000, good signal. (Fellers, Japan.)

Canada—Cushen, N. Z., says VED, 8.265, Edmonton, Alberta, beamed to Yukon and Northwest Territories, is now scheduled 0900-0200 Monday-Saturday and 1000-0200 Sunday. *(Radio Australia.)*

CBNX, 5.970, St. John's, Newfoundland, heard with news 0530, then music, fair signal. (Osterman, McPheeters, N. Y.)

CJCX, 6.010, Sydney, Nova Scotia, good signal in New York 1700. (Leinbach) CHNX, 6.130, is asking for reports to P.O. Box 400, Halifax, Nova Scotia, Canada. (Slutter, Pa.). Heard in Puerto Rico signing off 2315. (Novomestky)

CBLX, 15.090, Montreal, is located at Vercheres and operates *daily* 0700-2400; power 7.5 kw. CBRX, 6.160, Vancouver, British Columbia, lists power as 150 watts. (Hubbard, N. C.)

Canary Islands—EAJ43, *Radio Club de Tenerife,* 7.518, strong 1600-1700 (will be 1700-1800 soon when goes on winter schedule). (Pearce, England.) Is heard best in Sweden during the last half hour. (Albinsson.) Albinsson lists frequency as 7.540-7.550.

Ceylon—Radio Ceylon, 15.12, excellent in East 0600 with BBC news; also good 0700 when relays BBC's "Half-Hour in English for People in the Far East."

The 21.62 channel heard 0500 in Australia with news, then dance program. (Sanderson)

Verified by letter signed by J. F. Mudie; now using 21.62 directed to Malaya and Netherlands East Indies with 7.5 kw., and 15.12 beamed to North China-Japan with 100 kw.; schedule appears 0325-1205 on both; this is "basic schedule," so there may be other (unlisted) items. (Osterman, N. Y.)

Chile—CE1180, 12.003, Santiago, heard in Sweden 1800-2100, usually through heavy CWQRM. (Gimby)

China—At the time this was being compiled, Chungking, 11.913, was audible but weak in West Virginia 0800 with news; appeared to be jammed by unmodulated carrier in addition to suffering usual severe CWQRM. The 15.17 channel—which should have news yet 0600—has not been audible here lately. The 11.913 channel has been heard in California by Raith at 1000 on a Sunday with news and then music dedicated to listeners.

Recently, a *new* station has been heard on 9.74 from 0520 sign-on to sign-off around 1005; all-native as far as heard; starts with march similar to that used by BEA8 (Nanking, 9.73, Communist-controlled outlet), followed by three chimes, then woman talks most of the time; location unknown; signal averages fair. (Balbi, Calif.) Also reported by Dilg, Calif., who says this definitely is *not* BEA8 which is heard just *below* the *new* one, but it may be Hankow (moved from approximately 11.495?).

BCAF verified from Major C. Y. Chen, Director BCAF, Taipei, Formosa; stated the 8.990 channel has been suspended and the station is back on 11.680; transmitter is a Wilcox 960 obtained from U. S. war surplus, output is about 3.5 kw.; schedule is 1700-1800, 2155-2400, 0330-0930 on 910 kc. and 11.680. (Cushen, N. Z., and Sanderson, Australia.) Heard 0515 with Western music, news in Chinese. (Sanderson)

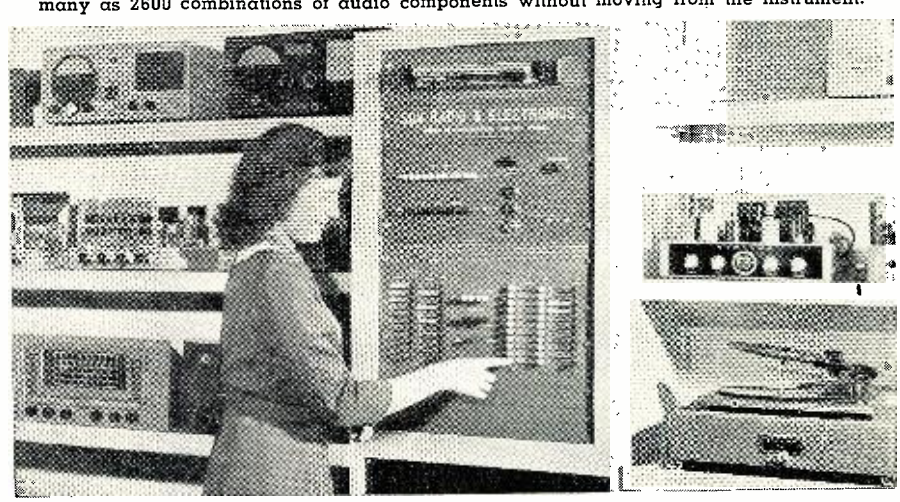
BEF8, 15.17, Chungking, heard 0500 with "Back to the Bible" session, news, and music. North China, 7.50, heard 0530 with Chinese news (slow speed), then music. Nanking, 9.73, heard 2005 with Chinese news and music (this may have been transposed, if so meant 0505). (Sanderson, Australia)

Communist-controlled stations continue to carry *English* news 0830 on announced 10.26 (Peiping), 9.73 (Nanking relay), 9.04, 7.50, 7.10, 5.98 (Nanking relay), and BCB 680 kc., all heard well in Tokyo. (Fellers, Japan)

A station heard mornings on about 11.685 to 11.700 (old Shanghai frequency) is believed to be Shanghai; does *not* take the Peiping *(English)* news 0830; heard to *after* 1000. (Dilg, Calif.)

A Chinese station has recently been

Recently installed in Sun Radio's Sound-TV Studio is a self-service, push-button panel permitting the customer to compare ordinary and high-fidelity sound reproduction in as many as 2600 combinations of audio components without moving from the instrument.



heard mornings on about 11.492; definitely is *not* Hankow and is Nationalist-controlled; heard from *before* 0800 and until around 0900; has played American recordings at times. (Dilg, Calif.)

Colombia—HJCX, 6.027, Bogota, "La Voz de Colombia," good signal from 2200; all-Spanish. (Osterman, N. Y.) HJEX, 6.054, Cali, heard identifying 2100; all-Spanish. (Leinbach, N. Y.) HJDE, 6.145, "La Voz de Antioquia," Medellin, has schedule of 0900-2200; heard 1930 to sign-off; *no English noted.* (Novomestky, Puerto Rico)

Radio Nacional de Colombia seems to have taken over *Radio Manizales,* 6.225; goes to at least 2200 (this is *not* HJCF, 6.240, Bogota). (Stark, Texas.)

Kane, Pa., comments—"HJKD, Emisora Nuevo Mundo," is one of the stations in the QRM crazy-quilt on 6.000, but is in clear late evenings.

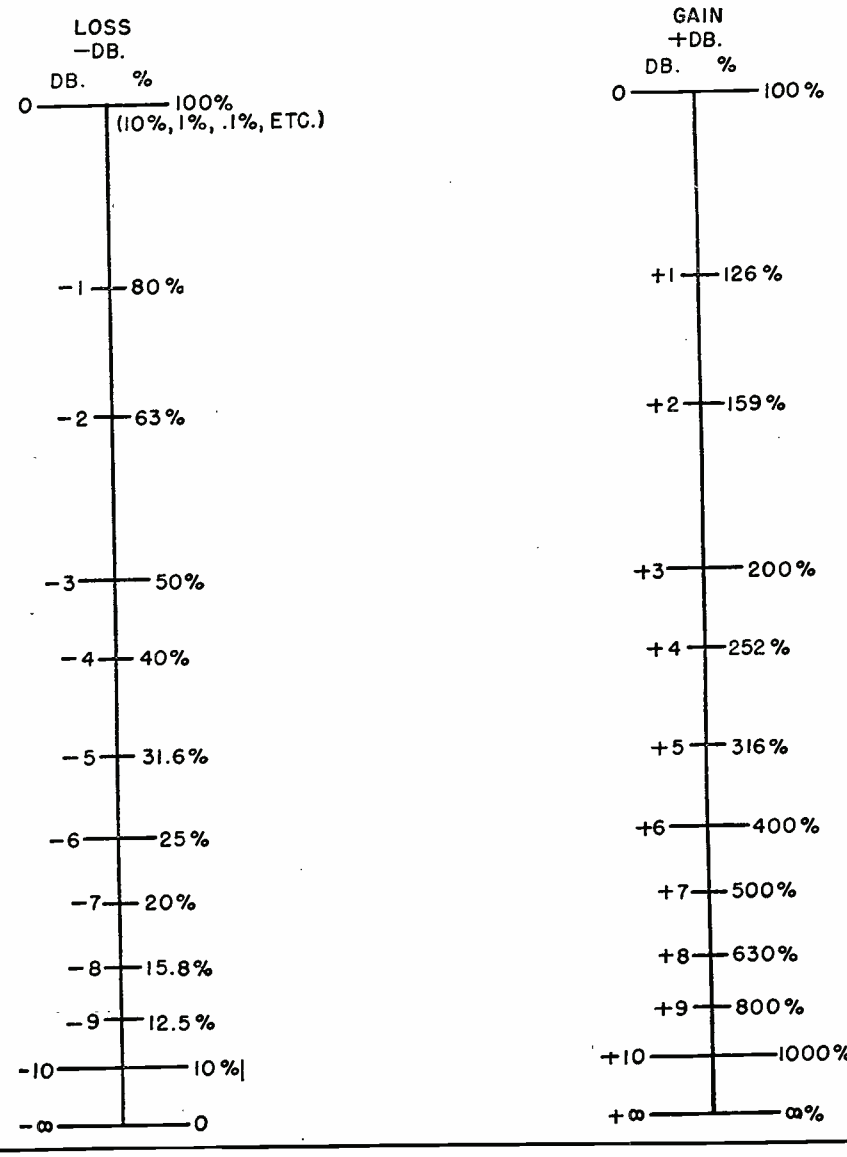
Cuba—COBZ, 9.035, Havana, noted with Spanish-*English* lesson Saturdays 1800. (Bellington, N. Y.)

DECIBEL TO PERCENTAGE CONVERSION

By GEORGE P. KEARSE

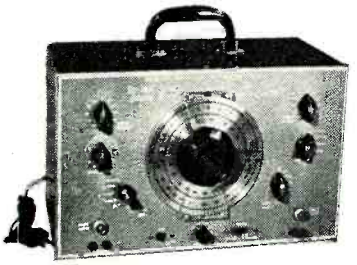
Senior Eng., American Phenolic Corp.

This chart indicates the percentage gain or loss corresponding to the decibel gain or loss of an audio or radio frequency network. For example, if a network has a loss of 7 db., the output of the network will be 20% of the input. Similarly, if an amplifier has a gain of 9 db., the output will be 800% of the input.



MARKER SWEEP

TEE VEE MODEL TV 75



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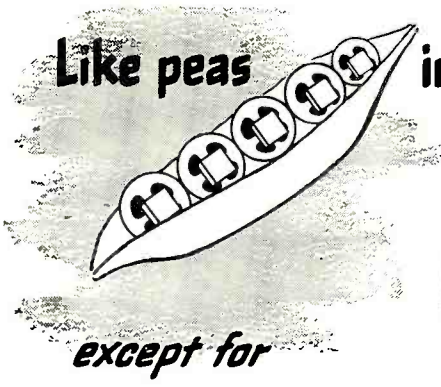

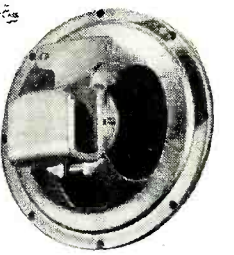

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OUR PRICE ..... Ready to operate... Set **29.95**

BC 605. INTERPHONE AMPS.

Ideal for Home Intercom., Office to Office, Airplane Intercommunication, etc. Complete with Tubes. Diagram and Case. Uses DM34 Dynamotor.
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110 V. 60 Cy. A.C. 850 V. TC; 6.3 V. @ 4 Amp.; 6.3 V. @ 3 Amp.; 5 V. @ 3 Amp.; Conservatively rated at 148 Mil; Tested at 250 Mil; But will handle more.
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Contains an R. F. Meter, Thermo-couple, sensitive relay and a 50 MMFD. 5000 volt vacuum condenser.
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Uncharged ..... each **1.05**
Complete Set of three with Box and Connections to make a 6 Volt. 20 Amp. Hrs. Battery. Uncharged ..... set **3.95**

20 TO 28 MC FM RECEIVER BC-603

For 11 meters; can be tuned to 10 meters with slight modification; super-het, BFO, squelch; 10 pushbuttons and manual tuning. Makes 10 meter converter or IF strip for 88-108 MC wide-band FM; with all tubes, speaker, case, diagram.
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110 V. 60 Cy., AC.
Similar to type 5 ..... pair **5.95**
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Complete with rubber ear cups and cord with a P1.55 Plug. High. Imp. ..... pair **1.25**

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BA 33	1½ Volt	25c
BA 37	Walkie Talkie, 1½ V.	50c
BA 38	Walkie Talkie, 103½	1.00
BA 40	90 V.—1½ V.	50c
BA 41	60 V., 25½ V., 4½ V.	50c
BA 48	90 V., 1½ V.	50c
BA 59	45 Volt	50c
BA 70	90 V., 60 V., 4½ V.	50c
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RHC, *Cadena Azul*, Havana, COCY, 11.740, opens 0628, closes 0100, usually makes closing announcement in *English* as well as Spanish; *Radio Progresso*, COBC, 9.380, opens 0630 and is believed to leave the air 0100, *no English noted; Radio Salas*, COBZ, 9.026, opens 0700, closes down 0100, *no English noted.* (Novomestky, Puerto Rico)

Curacao—PJC2, 5.010, Willemstad, heard in Dutch 2030-2100. good signal in New York. (McPheeters.) PJC1, 2.315, heard signing off 2315 with Dutch National Anthem. (Novomestky, Puerto Rico)

Cyprus—Sharq-al-Adna, Limassol, heard in Britain 1330-1400 in parallel on 9.650, 6.135, 6.790; program chiefly Arabic music. (Short-Wave News, London)

Czechoslovakia—Prague has *English* daily 1245 on 11.84, 1445 and 1645 on 9.55; this is in addition to the *English* portion of the *daily* North American beam on 11.84, when *English* starts off the broadcast. On 9.55, Prague begins a period in Spanish at 1800, identifies in that language as *"Radio Praga."* (Ormond, N. C.)

Denmark—OZF, 9.52, signs on to North America *daily* 2100 and signs off around 2215-2230, news 2145. (Driver, Ohio.) Copenhagen now plays the Danish National Anthem regularly at sign-on; melody is believed to be "Kong Christian Stod Ved Hφjen Mast" ("King Christian Stood Beside the Mast"). This is *not* the tuning signal but is the tune played *after* the Town Hall chimes are rung. The melody played regularly at sign-off is a Scandinavian song, "There Is a Beautiful Land." There are three Danish recordings that have been played frequently during the Copenhagen broadcasts—"The Champagne Gallop," "The Rooster Dance" from Carl Nielsen's "Masquerade," and "The King Christian IX March." (Worris, N. Y.)

Dominican Republic — HI4T/HI2T, "La Voz Dominicana," 5.970, 9.735, are scheduled to open daily at 0700; usually operate in parallel but lately HI4T has been coming on the air later in the day; closing time is believed 2400. At around 0645 will come on with the first seven notes of the Dominican National Anthem which phrase is repeated to 0700; these notes are played on a piano. (Novomestky, Puerto Rico)

Finland—The *Finnish Radio* is making extensive plans to cover the 1952 winter Olympic Games to be held in Finland. The name of the Finnish National Anthem (which is played on 15.19 at the end of the *daily* 2200-2400 transmission) is "Maamme Laulu" ("Our Land"); the opening announcement of this transmission in Finnish is "Tama Suomen Yleisradio. Tama Suomen Yleisradio." (Each "A" in "Tama" has an umlaut.) During this transmission on OIX4, 15.19, the first part has been devoted to programs in Finnish (dramas and concerts), and at 2320 they "anthem," announce "Finlands Rundradio! Finlands Rundradio!" and begin a program in Swedish

which continues to 2400 sign-off when they again "anthem." (Worris, N. Y.)

French Indo-China—According to a letter received by Kensy, Germany, from *Radio Chambodge,* Phnom-Penh, this station is operating on 6.090 with 1 kw. at 2200-0030, 1030-1600, 1800-1900; reports from listeners are welcomed. (Swedish DX broadcast)

Radio Saigon, 11.78. is heard in South Africa at 0900 with *English;* the 6.165 outlet carries an entirely different program (in French). (Ridgeway)

The Broadcaster, Perth, Western Australia, says Hanoi can be heard *daily* to closing 0830 on 8.640; on Sunday the closing time is 0645, the last 15 minutes being in French; says Viet Nam on 12.000 can be picked up daily 1915-0030, 0730-0830. Says *Radio Hue* in the province of Annam is being received on 7.210, having a power of 1 kw.; schedule is daily 1800-2000, 2200-0100, 0500-1030; reports should be sent to P. O. Box 65, Hue, Annam, Fr. Indo-China. Fried, Michigan, comments that this is a Viet Nam Republic outlet.

French Morocco—Radio Rabat, 6.006. heard 1430 with Arabic music; signals suffer CWQRM; again logged 1600 with announcement in French, "Ici *Radio Maroc,*" followed by recordings, chiefly of French origin. (Patrick, England)

French West Africa—Kensy, Germany, received a letter from *Radio Bamako* which has an output of 2 kw. on 15.030. Is operated by the Government and *is on the air irregularly;* programs consist of meteorological reports, Government and industrial news, and now and then some music. (Swedish DX broadcast.) Is listed FGJ9, 15.025, 350 watts, and as "inactive."

Radio Dakar noted back on 11.895 after having been "missing" for a short time; heard again to 1800 closedown. (Stark, Texas)

Germany—Munich relays of the "Voice of America" are scheduled—Munich III, 6.080, 1015-1700 to Europe; Munich IV, 7.250, 1015-1715 to Europe; Munich II, 9.540, 1015-1700 to Europe; Munich IV, 11.870, 1015-1045, and Munich I, 11.870, 1230-1715 both to Europe; Munich I, 15.280, 1100-1200 to Middle East. (Legge, N. Y.)

Nordh, Stockholm, says he has been hearing a *new* German station on about 6.072 around 1640-1650; announces in German as *Mitteldeutcher Rundfunk Sender,* Heidelberg.

A newcomer to the *ISW Department,* Leary, Indiana, reports DHT, Germany, on 15.860-15.870 with newscast for recording to America 1600-1615, good level.

Radio Stuttgart, 6.050, 10 kw., is on the air Mondays, Wednesdays, Fridays 0430-0745 and 0355-1700; Tuesdays and Thursdays 0430-0730 and 0855-1700; on Saturdays 0430-1700, and on Sundays 2300-1700. (Swedish DX broadcast)

Greece—Bluman, Israel, reports that Macronesio moved from 7.040 to 7.105. Transmitter heard 1200-1500 on 6.530-6.550 is *not* a Communist outlet

but is a *new* Greek State Transmitter; name sounds like Chios; heard by Skoog in Sweden to 1625 on a Sunday. (Swedish DX broadcast)

Guatemala—TG2, 6.621, Guatemala City, *"Radio Morse,"* listed 1 kw., still heard 2115 tune-in and still going 2325; verified by nice card; all-Spanish. (Driver, Ohio.) TGLA, 6.295, noted recently on *before* 1915; used to go to 2205. Another Guatemalan outlet is being heard on about 6.230 (listed 6.234) with call TGJA, *Emisora Nuevo Mundo;* leaves the air 2200. (Stark, Texas)

Hawaii—Honolulu relays of "Voice of America" broadcasts are scheduled —KRHO, 15.250, 0400-0915 to East Asia; KRHO, 17.800, 0215-0345 (Tue.-Sat.) to Philippines-E. Indies (UN); KRHK, 17.800, 0400-0915 to Philippines-E. Indies; KRHO, 17.800, 1700-1900 to Philippines. (Legge, N. Y.) The "Amateur DX Radio" program is carried on 15.250 on Sundays 0800-0815; forecasts reception conditions. (Ferguson, N. C.) This program is carried also on other "Voice of America" stations (and relays) to the Far East.

Holland—Hilversum sent these current schedules—on PGD, 6.025, PCJ, 15.220, PHI, 17.775-21.480, *English* 0500-0600 (except Sun.); Dutch 0400-0600 (Sun.), 0430-0500 (first and third Mons.); Happy Station Program, 0330-0500 (Tues.), multiple languages; Dutch 0715-0830 (daily), 0830-0900 (daily but *not* on PCJ), 0900-1015 (except Sun.), 0900-1030 (Sun.); in Bahasa Indonesian 0830-0900 (daily on PCJ *only*); *English* 1015-1030 (except Sun.); Happy Station Program, 1030-1200 (Sun. and Wed.), multiple languages.

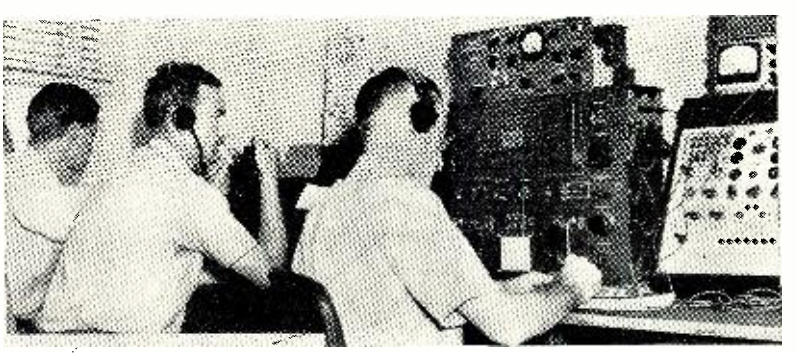
On PGD, 6.025, PCJ, 9.590, and PHI, 11.730, *English* 1230-1330 (except Sun.); Dutch 1230-1540 (Sun.), 1330-1600 (except Sun. and Wed.), 1330-1530 (Wed.), Happy Station Program, 1600-1730 (Sun. and Wed.), multiple languages; Spanish 1730-1830 (except Sun.); Dutch 1745-2130 (Sun.), 1830-2100 (except Sun.); Spanish 2100-2130 (except Sun.); *English* 2130-2230 (except Sun. and Wed.), 2130-2200 (Wed.); Happy Station Program, 2200-2330 (Sun. and Wed.), multiple languages. (Worris, N. Y.)

Hungary—An English news bulletin is broadcast daily 1720 from both 6.247 and 9.820 channels of *Radio Budapest,* best on 9.247 in Britain. (Patrick)

India—VUD, 17.74 (may have meant 17.84?) is being heard on West Coast from 0630 to around 1100, with strong signal to 1030; also heard at 1930 to sign-off 2014, fair to weak. (Balbi)

AIR noted recently on 15.16 in parallel with 11.89 in the Indonesian period 1845-1900; 19-m. outlet was much the weaker. (Bellington, N. Y.)

The Indian Listener is now published weekly instead of fortnightly. It now "invites correspondence from readers on articles published and talks, discussions, and so on reproduced in the journal. Letters should be in *English,* brief and to the point, and should be addressed to the Editor, The Indian Listener, Curzon Road Barracks, New Delhi, India." First issue of *The Indian Listener* was back in December of 1935. and contained programs of only three stations—Bombay, Calcutta, and Delhi with one transmitter each. AIR now divides its services into (1) Regional Short-Wave Service, (2) National Home Service, and (3) Services for Overseas Listeners. The *Listener* recently carried excerpts from letters of AIR listeners in such widely separated areas as Norway, England, Sweden, Scotland, Germany, Persian Gulf, New Zealand, United States (Illinois), Saudi Arabia, Burma,



↑Radio hams handled a large part of the communications at this year's National Air Races. These operators, shown at one of the three control points, also served as a maintenance and repair group for the $15,000 worth of radio equipment owned and, in many cases, operated by amateurs.

← The parking and servicing of some 3000 visiting transient aircraft by the Civil Air Patrol at the Labor Day races was accomplished safely and rapidly with the assistance of mobile radio equipment loaned by the hams, creating an orderly operation out of what would have been chaos.

and Austria. These were from reports on "experimental services only," it was stated. Format and content of the journal continue to improve greatly.

Indonesia—By this time, YDC, 15.15, should be using the *new* 100 kw. transmitter at Batavia; watch for this one during the daily *English* beam 0600-0700.

Makassar, Celebes, around 11.085, is usually fair to good here in West Virginia at 0600.

A station heard mornings on approximately 9.685 is believed to be *Radio Sario*, Menado, Celebes, which has been shifting about in recent weeks. (Stark, Texas)

YD12, 4.366, Soerabaja, heard in dual with YD13, 7.298, mornings; latter is good signal. (Dilg, Calif.)

Israel—Kol-Yisrael, 9.000, Tel-Aviv, is widely reported in East with fair to excellent signals from 2245 sign-on (may sign on 2345 on Fridays). Heard very weak on West Coast by Dilg.

The experimental transmitter previously reported on 11.82 has moved to 9.000. (Bluman, Israel, via ISWC, London)

Kol-Yisrael will soon inaugurate an overseas service, using 7.5 kw. until the *new* 50 kw. transmitter—now under construction—is completed. Initially, there will be daily programs in *English* and Hebrew beamed to North America, as well as an expansion of the existing Middle East programs in Arabic, Turkish, and Persian. The 7.5 kw. transmitter has tested on 11.82, 9.000, and may also use any of 11.935, 15.415, 17.880, and 21.465 channels. Reports are welcomed by *Kol-Yisrael*, particularly from listeners in North America. (Bluman, Israel, via *Radio Australia*.) QRA for reports is Kol-Yisrael, Technical Dept., Hakirya, Israel. (Swedish DX broadcast)

Italy—Test transmissions by *Radio Italiana* in *English* and Italian have been heard in Stockholm on about 15.620 at 1345-1445. (Swedish DX broadcast)

Rome continues to use 15.12 (replacing 9.63) in the daily 1930-2055 transmission to North America, with 11.81

(*Continued on page* 180)

Equalizing Phono Pickups

(*Continued from page 65*)

ciples, equalizers have been constructed for various commercial pressings. In every case, standard half-watt, 10 per-cent tolerance resistors were used, and the required condensers were built up from the miniature paper condensers now made by several manufacturers. Equalizer characteristics attained with such components are generally sufficiently close for all practical purposes. The characteristics can be checked with a signal generator of low internal impedance by placing a condenser of the same value as the cartridge capacitance in series with the equalizer input; the signal voltage should then be varied with frequency to correspond to the open-circuit output of the crystal cartridge.

With compact components of the type mentioned, the entire equalizer is conveniently inserted into a small shield can and potted in microcrystalline or ceresin wax. The cans in which 35 mm. photographic film cartridges are sold make excellent shields for this purpose. A series of such equalizers arranged on a rotary selector switch makes a compact and convenient means for correcting the various characteristics followed in commercial pressings.

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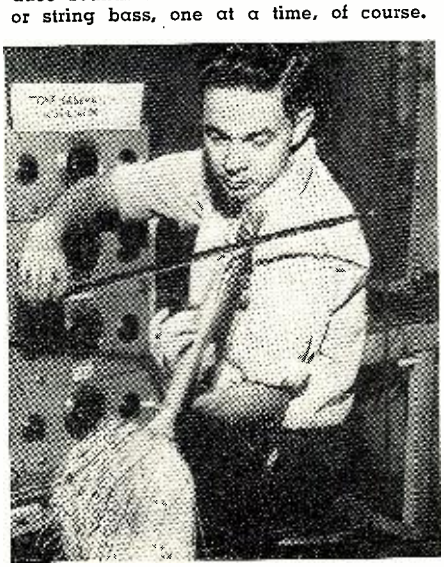
—30—

Roderick Gordon tries out his recent invention, an electronic fiddle, which can produce sounds like an oboe, clarinet, cello, or string bass, one at a time, of course.



Amplifier Design

(*Continued from page 41*)

of multi-element tubes. "Class AB_1" 6L6's under these conditions may undergo a twenty-five per-cent decrease in screen voltage under maximum drive, with a consequent loss of output and reduction in gain.

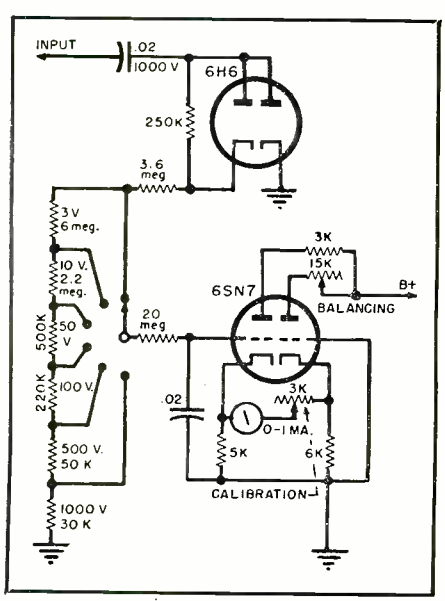
A good method for stabilizing amplifier operation is to use a small separate power supply for the screen grids, driver tubes, and fixed bias. As current requirements in this application are usually small, excellent regulation and very good decoupling may be obtained from the plate supply where wide current variations may occur. This is especially desirable in systems where it is wished to combine high gain with high output. The added cost is usually reasonable, as the only additional components required are a small power transformer, rectifier tube, and filter condenser.

Another method of screen stabilization is the use of voltage regulator tubes. A combination of tubes having a voltage equal to the screen requirements should be used.

Although the intermodulation measuring technique may be applied to any type of power amplifier, the preceding discussion has been concerned primarily with multi-element, or "beam power," tube amplifiers. Triode amplifiers have the advantage of low output impedance and tolerance to load variations as well as somewhat greater simplicity. Disadvantages are lower output and higher grid voltage drive. In general, the notes regarding fixed bias, voltage regulation, and decoupling hold for both types of amplifiers; however, the multi-element tube amplifier was selected for emphasis as being the most representative and popular of the various amplifier designs.

—30—

Schematic diagram of v.t.v.m.



In Estimating—Look for Hidden Labor Costs

By HAROLD J. ASHE
Tax Counselor

Chamber of Commerce reports "hidden wages" run about 15% of employer's total payroll.

NOW THAT highly competitive charges are returning to the radio and television service trade, a good many shop owners may need to take another long, hard look at their estimating methods, flat-rate charges, and service call rates and, in some instances, radically alter them.

There is considerable evidence to support the belief that the wide variation in service charges by different shops may be due less to cut-throating (although this is always with us) than a failure upon the part of many shop owners to consider all of the cost factors entering into servicing in homes or in shops. While shop owners can not be expected to understand the intricacies of cost accounting, some show a positive genius for ignoring the most fundamental service costs.

Not long ago the United States Chamber of Commerce underscored a situation which, we believe, has been given too little consideration by radio service shop operators. The Chamber, in a survey of private employers, has come up with startling evidence that there is a "hidden payroll" running close to 15 per-cent of the average employer's payroll. In 1947, this study points out, the typical worker received from his employer benefits totaling more than $424, over and above his wages.

That is, in addition to the basic or generally recognized wage, the employer also bears additional wage costs in the form of old age and survivor's insurance, unemployment insurance, workmen's compensation, paid holidays, vacations with pay, year-end and Christmas bonuses, and numerous other benefits.

Quite by coincidence this 15 percent national average for all industries and trades approximates very closely the amount of hidden wages for the typical radio service shop. Is the shop owner recovering this $424 additional wage in his service charges, or is it coming out of his own pocket in decreased profits?

It is the injection of this relatively new factor of large hidden wages that brings about serious discrepancies in estimating and determining flat-rate charges and points up the need for overhauling estimating techniques and pricing structures. A time was, not so long ago, when the hidden labor costs were nominal and constituted only a small part of the shop owner's overhead and might, without harm, be lumped in as general overhead. Now, these hidden labor costs, if not treated as part of the cost of labor and so identified, loom large in the overhead aggregate.

Careful estimating and pricing now insistently demand that itemized social security, workmen's compensation, and unemployment insurance taxes be added to the basic wage in determining the over-all wage factor. These extra labor charges should not be lumped under general overhead which, properly, should be a catch-all only for such costs as cannot be accurately charged directly to specific jobs.

However, with social security, unemployment insurance, and workmen's compensation now constituting only part of the present hidden labor costs, it would seem equally imperative to also charge other hidden labor costs directly to labor in estimating and pricing. Once the shop owner knows what his other hidden labor costs are running him, he can use a percentage formula to arrive at a dollars and cents figure on his wage factor.

Because the labor factor is a variable, no matter how slight, it is a basic accounting and estimating error to add any of the hidden labor costs to the job by a percentage formula of the *material and labor costs*. It can be pinned down and be expressed more accurately by using the percentage formula directly to labor only.

With all hidden labor costs running from 12 to 15 per-cent of the payroll, there is grave danger in lumping any part of these hidden labor costs into the catch-all of general overhead. If on a job where material is high in relation to labor, having hidden labor costs in the overhead will over-state the hidden labor costs in the estimate or price. Contrary-wise, if the labor factor is high in relation to materials, and hidden labor costs are in the overhead, there will not be enough of an overhead charge to recover the outlay for hidden labor costs.

In one case, the estimate or price may be unjustifiably high, and the shop may lose the job or, if it does get

it, gain a dissatisfied customer; on the other hand, it may be too low, and the job will be done at a loss.

While the shop owner is mindful of social security, workmen's compensation, and unemployment insurance taxes because they are tied directly to the payroll week by week, he is less likely to be aware of the heavy drain on his business traceable to the so-called fringe benefits. These may include, by union agreement, as many as six or seven paid holidays a year, as well as voluntarily given paid vacations for older workers and, perhaps, distribution of Christmas bonuses or year-end gifts. In addition, an increasing number of shops are covering their regular employees with life and sickness insurance and pay all or part of the premiums. All of these added costs are part and parcel of hidden labor costs.

Assume a service technician is paid $2.00 an hour, and, to simplify this illustration, assume he is employed steadily throughout the year. Thus, he is employed 40 hours a week, 52 weeks a year, for a total wage of $4,160. During the year he is paid for 2,080 hours. However, he gets paid for six holidays a year, so there are 48 hours (better than a week) in which he does no productive labor, but draws full pay. So, in fact, the basic wage in relation to productive hours is better than $2.04¾ an hour for each of the 2032 hours worked during the year, or two per-cent greater than appears to be the basic wage.

While this added two per-cent may not appear to be considerable in relation to either the total payroll or the total volume of business, if it is not recovered from or charged to the jobs it will decrease profits.

If one week's vacation with pay is given, this boosts the basic wage for productive work still further, as does the payment of insurance premiums on life and sickness policies. Even a modest cash bonus at year-end of $25 can increase the basic wage by one-half of one per-cent. And so it goes.

From this, it can be seen that today even those shops which pay only for such hidden benefits as are required by law or union agreement have a hidden labor cost burden of upwards of 10 or 12 per-cent.

In fact, where paid holidays are in union agreements or are voluntarily given, the shop operator pays hidden benefits on hidden benefits, pyramiding the costs. That is, he pays hidden benefits in wages for time not worked, and then he pays workmen's compensation, social security, and unemployment insurance on such wages.

To ensure the likelihood that such hidden labor cost be recovered, the shrewd shop owner might very well weigh the advisability of directly relating such hidden labor costs to the basic labor wage in establishing rates for service calls, estimating repair jobs, and revising his flat-rate charges. —30—

Mac's Service Shop

(*Continued from page 68*)

paper where some lodge, group of factory workers, political group, etc., is going to have a gathering, I immediately get in touch with the chairman of the committee on arrangements and suggest I furnish him with a good sound installation. Another good source is the list of park reservations that I get from the park superintendent. I write to the party who has made the reservation for a family reunion, picnic, home-coming, etc., to see if he could use an amplifier. A lot of them can, now that you mention it!

"The whole idea is to keep alert to the need for amplifying equipment. Last summer, for example, I loaded my equipment into the truck and drove out to the county fair. Practically every carnival outfit on the midway had an amplifier of one sort or another, and just about half of them were prospects for either sales or service. I sold three complete amplifiers out there and got at least a dozen service jobs."

"Well, how about the service end? Do you need much special equipment?"

"A really well-equipped radio service shop needs very little extra equipment. You must have a good, low-distortion, variable frequency audio oscillator; you should have an up-to-date amplifier service manual; and it is very convenient to have a distortion analyzer and an output power meter. This last item is very handy because it has built-in load resistors that will match every power amplifier output impedance. With it attached to the output and with a 400 cycle signal input, you can instantly see the effect of replacing a weak tube, etc. What is more, you can do your checking of the amplifier in silence. However, you can still use the v.t.v.m., scope, and an assortment of husky loading resistors to the same end."

"What do you do to give an amplifier a complete check?"

Mac reached up and pulled a red-jacketed book from the shelf.

"Here is the sound man's most up-to-date *'bible,'"* he said. "Take it home and read it. It is Read's *'The Recording and Reproduction of Sound.'"* He says—and I agree with him—that the following tests should be made in this order:

1. Tube checking
2. A.f. signal tracing
3. Static voltage and current measurements
4. Gain measurement
5. Frequency response check
6. Distortion check
7. Check for feedback
8. Impedance measurement
9. Power output measurement
10. Hum and noise level checks

"After you have been through an amplifier with that fine tooth comb,

you are certain to know any faults, either inherent or acquired, that it may have."

"I know that a gain measurement is made by comparing the input and output voltages of a signal passing through an amplifier," Barney said; "but how do you measure accurately the input voltage? It seems to me that when you are working on a high-gain amplifier, any input voltage that would give a substantial reading on a v.t.v.m. would be overloading the output stages."

Mac opened a cabinet drawer and took out a little black box with a switch-knob and some pin-jacks on the front and a diagram of the contents, as is shown in Fig. 1, on the back.

"This is a millivolter," he explained. "As you can see here on the diagram, it is nothing more than a tapped resistance voltage divider. Precision resistors are used, and their values are such that when exactly one volt is applied from the audio oscillator, as measured with the v.t.v.m., you can take out one volt, 100 millivolts, 10 millivolts, 1 millivolt, or .1 millivolt. This is assuming, of course, that you are working into a high impedance, as you almost invariably are in the case of an amplifier."

"Do you use the same kind of parts in the amplifiers that you do in receivers?"

"The same kind, yes; but you select more rugged units. Higher voltage condensers, higher wattage resistors, huskier transformers—in fact, you simply keep in mind that the amplifier must stand up under long periods of continuous duty under conditions that are not always of the best, and you keep in mind that the dynamic current and voltage peaks are much higher than are ordinarily encountered in radio service, and then you allow for these factors in your selection of parts."

"But now I have talked myself awake, and we had better get back to work; but just to button up the subject, I might add that the service technician has an advantage over most sound men in that he can service and even actually build much of the equipment he needs. He is in a good position to get business, for people are accustomed to bringing him their electronic problems. If he does not try to bite off too much, he can operate both enterprises so that they do not interfere with each other and yet bring in an income that is substantially greater than he could get from either by itself."

"And he has a fine alibi to give his wife when he comes in early in the morning!" Barney suggested slyly. "He can just say he is a little dizzy from riding the gain."

—30—

AUDIO NOISE IN INTERCARRIER TV RECEIVERS

By MATTHEW MANDL

AUDIO noise characterized by a buzzing sound in the Intercarrier type of television receivers is more often the result of improperly set controls than it is the fault of a bad part or misalignment. In the Intercarrier system, both the video and sound intermediate frequencies ride through the same amplifier stages preceding the picture detector. At the picture detector, both these i.f. signals mix again by converter action to give a 4.5 mc. frequency. The latter is then channeled to the FM sound detector, while the regular picture i.f. is demodulated and sent, via the video amplifier stages, to the picture tube.

With this type of receiver there is a possibility that the picture signal, which is amplitude modulated, may be superimposed on the 4.5 mc. sound frequency to such an extent that the FM detector will be incapable of removing this sufficiently. This is a result of excessive modulation of the video portion of the carrier, and can be controlled only at the transmitter. When this happens, a pronounced audio buzz is heard from the loudspeaker. Manufacturers, however, reduce this possibility to a minimum by properly balancing video and sound gain through the amplifier stages preceding the detector, and for this reason no trouble should be encountered during normal operation of such a receiver.

If, however, the contrast control is set too high, or the fine tuning adjustment is incorrectly set for best reception of a station, the audio buzz may become noticeable. Many a service call can be avoided if this fact is brought to the customer's attention at the time the set is purchased.

When proper adjustment of contrast and fine tuning fail to eliminate the audio noise, one or more of the following circuits will have to be serviced:

1. Local oscillator. If the local oscillator is misaligned it will be impossible to properly tune in a station by use of the fine tuning control. Since most receivers have provisions for getting at the oscillator controls by removing the channel-indicating escutcheon and associated knobs, adjustment for each individual station may be made without chassis removal.

2. I.f. stages. Improper i.f. alignment will also increase the audio noise beyond the point where it can be eliminated by the front panel controls. Alignment of TV intermediate frequency stages, however, should not be attempted without the manufacturer's service notes and properly calibrated equipment.

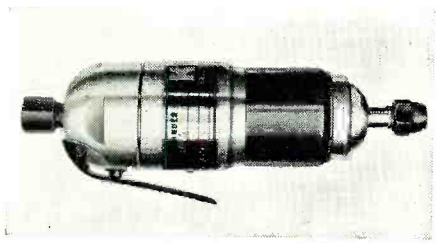
3. FM detector. If the sound detector is not aligned correctly, it may also result in audio buzzing. Component parts should also be checked, for this can, of course, seriously contribute to poor performance. A common fault is a defect in the electrolytic condenser across the output of a ratio detector. This condenser, ranging in value from 4 μfd. on up, is essential in suppressing amplitude modulation, and any decrease in value or other defect will immediately be evidenced by an increase in noise output.

—30—

NEW TOOLS AND GADGETS

HIGH SPEED GRINDER

Keller Tool Company, Grand Haven, Michigan, has designed a pneumatic grinder to take all wheels of ½ inch diameter and smaller. This Model 30 A-7 tool will grind in close quarters or where intricate designs permit the use of only small grinding wheels as,



for instance, in touching up dies and similar tedious jobs.

This tool, which attains 75,000 r.p.m., has a housing that fits into the hand comfortably, and an inverted throttle lever provides convenient operating control. The standard spindle collet will accommodate mounting grinding wheels with ⅛ inch diameter shanks. Optional equipment includes spindles with 3/16 or ¼ inch capacity collet chucks.

PLASTIC STORAGE TRAYS

A metal shelf rack and plastic tray combination has been introduced by the *Andrew Technical Service,* 4747 N. Damen Ave., Chicago 25, Ill., providing an orderly and efficient method for storing the small tools, screws, bolts, electronic parts, etc., used by service technicians.

Complete units of trays and racks or the trays alone may be purchased. A

complete unit consists of a steel shelf section, 34½ by 14¾ by 11⅝ inches in size, equipped with as many as 56 plastic trays. Four removable partitions come with each tray and two of these will make five compartments for the tray.

Two sizes are available in the trays: 11⅜ by 2 by 2¾ inches and 11⅜ by

3¾ by 2¾ inches. They are of transparent molded Polystyrene, with an index card slot and finger pull at the front. A card may be placed at the back of the partition also for identification of contents.

PORTABLE SANDING KIT

Electric drills may now be used for sanding and polishing operations in addition to their regular applications with the aid of a kit offered by *Portable Electric Tools, Inc.,* 320 West 83rd St., Chicago 20, Ill. This consists of an adapter with a ¼ inch shank that will fit any make of electric drill, plus one molded-rubber sanding disc, two gar-

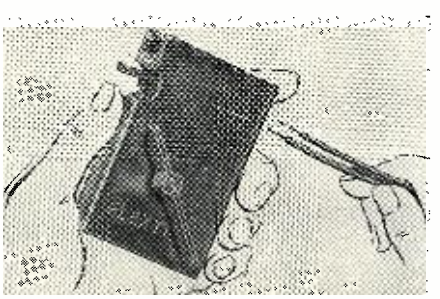
net abrasive discs, and one lambs wool polishing bonnet.

The kits are available in two sizes: the SP 40 comes with a four-inch disc, while the SP 50 is supplied with a five-inch disc. Complete details on the Model 50 sanding kit will be sent by the firm on request.

WIRE STRIPPER

Electro-Steel Products, Inc., 112-14 N. Seventh St., Philadelphia 6, Pa., has introduced a Flextron 300 ohm lead-in stripper that accomplishes the necessary work in only one operation.

The unique feature of the device is its simplicity; whereas most strippers



require three separate operations, the Flextron necessitates just the insertion of the wire and the job is done.

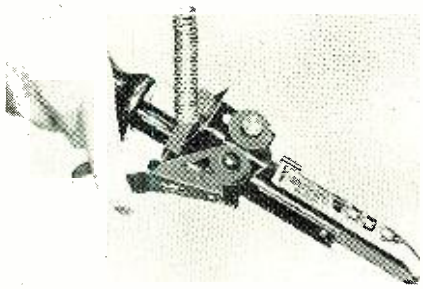
AUTOMATIC SOLDERING IRON

Designed to fit any standard electric soldering iron from 75 watts to 250 watts, the "Solder-Matic," distributed by the *Stern Corporation,* 436-A Fourth Ave., Pittsburgh, Pa., will automatically feed solder to the tip of the iron.

More than six feet of solder, 1/16 to

3/16 inches in diameter, can be held in the device, and just a slight pressure on the trigger of the attachment brings the solder right to the tip of the iron in the exact quantity needed for any job.

A Home Craftsman Model, consist-



ing of an Underwriters Approved 85 watt electric soldering iron, the attachment, and six feet of solder, has been made available as a unit, although the "Solder-Matic" device itself should find wider use in factories, electrical shops, and like industries.

HANDY SCREW HOLDER

Designed to handle very small screws and screws that must be placed in hard-to-reach spots, a new screw holder made by the *Handy Industries,* Dept. 232, 141 Jackson Blvd.. Chicago 4, Ill., has recently been introduced.

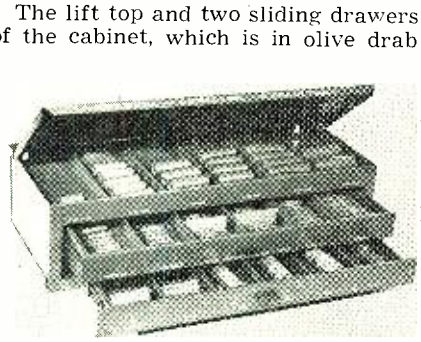
The holders come in a set of three sizes, consisting of a 10, 7 and 4½ inch holder, and in widths of 3/16 and ⅛ inch.

Although the hardened tips of the tools are not intended to serve as a screwdriver, they are quite strong enough to get it started and well on the way.

CONDENSER CABINET

As a no-cost feature of its new condenser kit, *Cornell-Dubilier Electric Corp.,* South Plainsfield, New Jersey, is offering a three-drawer metal cabinet, 5 by 8 by 20 inches in size, complete with an assortment of twenty condensers.

The lift top and two sliding drawers of the cabinet, which is in olive drab



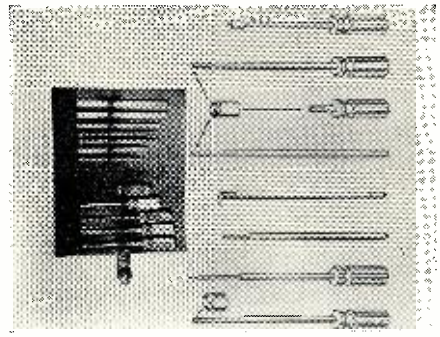
baked porcelainized finish, permit the whole to be hung on a wall within easy reach. The drawers have compartments for additional stock, as well as for the condensers originally provided.

ALIGNMENT TOOLS

The *Walter L. Schott Co.,* 9306 Santa Monica Blvd., Beverly Hills, California, has introduced a new line of TV-FM alignment tools for radio and television service technicians, including all

of those needed for present-day sets and most of the 1950 models.

These tools are entirely new in design and construction and are made of



a new plastic that is unbreakable and yet very flexible. The inserts are made of tempered steel, chemically welded to the shafts, while the handles are made of plastic to facilitate precision alignment.

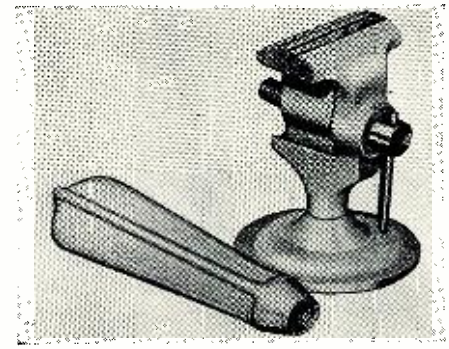
Although the tools are available in pocket-size leatherette kits or on a Masonite wall rack for the shop, they may also be purchased individually and separately.

TWO-WAY VISE

Besnel Products, Inc., 3525 Auburn St., Rockford, Ill., has designed a two-way device that may be either bench mounted or held while operating by means of the cast aluminum handle. When bench mounted, it measures 3 inches in height, and with the handle attached it is 6½ inches long.

The vise is of 40-E cast aluminum, and although light in weight, it is strong and durable. One jaw face is double-V notched to hold pins securely for filing, grinding, sawing, etc., and both jaws open to ⅞ inch.

It is an ideal tool for general home



use and is also an item that should be popular with hobbyists, radio and television technicians, pattern makers, tool and die makers, jewelers, and others who work with small pieces of metal, wood, and plastic. —30—

PHILCO BUILT-IN TV ANTENNA

A BUILT-IN electronic aerial system that provides good reception when used in reasonably strong signal areas has been designed by *Philco*. The antenna system, illustrated in the accompanying photographs, has four main elements, as follows:

The antenna itself is made of two sections of aluminum foil which are attached to the under side of the top rear of the TV cabinet and which will receive signals from all of the present twelve channels with frequencies from 54 to 88 mc. and 174 to 216 mc.

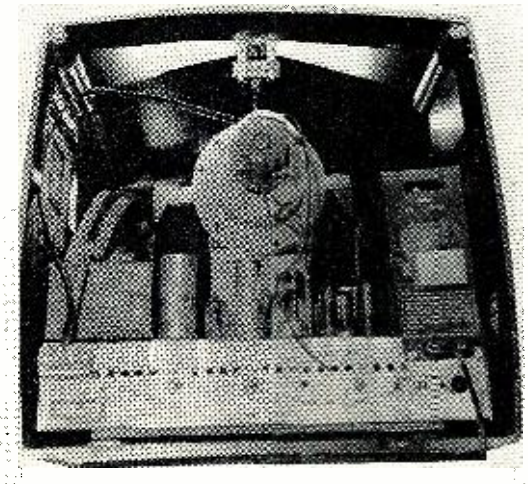
A variable condenser controlled by a tuning knob is also connected by means of a plastic rod extending the depth of the cabinet. The knob projects through a slot at the top front, making it possible to directly tune the antenna for the best picture.

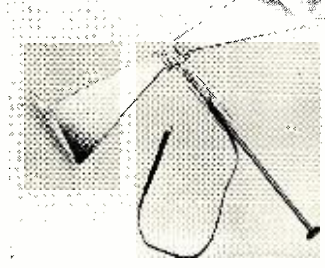
Three loops of wire, two small ones and one long "hairpin" loop, extend along the rod between the condenser and tuning knob. These loops, with the condenser, provide a tunable circuit that makes it possible to match the impedance of the antenna with the impedance of the 300 ohm lead-in to the receiver circuit.

Connecting the aerial system and the high-gain tuner and input circuit is a short strip of standard 300 ohm "twin-x" line, the same type that is used in most TV installations to connect the aerial and receiver, indoor or outdoor.

The matching circuit on this system enables the user to tune in each channel precisely for best response and tune out interference, although in areas with weak signal strength, an outdoor antenna may be found necessary. —30—

Philco electronic built-in aerial shown mounted in a table TV receiver (Model 1104). Note the aluminum foil sections attached across the width of the under side of the top of the cabinet. In the top center is the tuning condenser assembly and behind that the "hairpin" coil and 300 ohm line. The two shorter loops are shown end-on, at either side of condenser assembly.





Spot Radio News

(Continued from page 18)

ions being tossed around the hearing hall lobbies. Representatives of many manufacturers felt that there were too many roadblocks ahead to permit any immediate application of color. Some said that at least three years might pass before all the field work on the equipment and standards could be completed. All agreed that the elimination of fear of receiver obsolescence, through the application of current-type sets in all of the proposed systems, was cheering news and might act as a very effective stimulant to color progress.

Sharpest criticism of the color proposals came from Dr. Allen B. Du Mont who said that . . . "final determination of commercial color TV requires extensive experimentation and field tests. Such tests are imperative before the FCC can consider adopting standards. This will take years. . . . We hope the discussions on color will not cloud the major issue before the FCC, which is the practical assignment of very-high and ultra-high channels to make full use of the spectrum, to prevent monopoly, and to provide the widest service to the public as quickly as possible."

Dr. Thomas T. Goldsmith, Jr., director of research for *Du Mont* and one of the nation's outstanding authorities on propagation, supported Dr. Du Mont's comments and offered an allocation solution in the form of a plan wherein the present twelve channels would be used to the fullest extent, with four channels per city being allotted to most of the 140 metropolitan districts and 48 ultra-high channels, each six megacycles wide, assigned to assure adequate service in other communities. The program would also provide for the reservation of twelve additional ultra-high channels, each six megacycles wide, to protect smaller communities not yet ready to embrace TV and insure that adequate frequencies would be available when they are ready; setting aside of nine other ultra-high channels for non-commercial education purposes; allocation of present band and higher band frequencies in such a manner as to assure competitive operation and a wide choice of programs; and minimization of intermixture of standard and higher channel assignments to reduce or eliminate the need for set owners to buy converters or for station owners to utilize transmitters for two supplementary frequencies.

The color hearings, already in full swing, were scheduled to be followed by extensive testimony on a variety of black and white problems by *Paramount Television Productions, 20th Century-Fox,* Raymond M. Wilmotte of Washington (who planned to discuss his polycasting method and also the use of FM for video), Mayor David L. Lawrence of Pittsburgh, *Television Research* of Washington, *Daily News*

Television Company of Philadelphia, *United Detroit Theatres,* Philadelphia Chamber of Commerce, and dozens of others.

Original plans for an announcement of an acceptable allocation plan before the first of the year were shattered by the bombardment of briefs and requests for appearance at the hearings. It appears now as though spring will probably be the earliest date when a suitable plan will be produced.

POLICE RADIO received quite a tribute from the Mayor of New York City, William O'Dwyer, at the recent New York conference of the Associated Police Communications Officers.

Citing his days as an . . . "old-time copper, as one who understands the work of police," the Mayor declared that he knew the value of improved police communications within the communities and between the various communities.

He declared that . . . "We have gone a long distance in the thirty-two years since Commissioners O'Brien, Whalen, and myself were rookie policemen in this city. At that time, if you were in trouble you had the opportunity to rap your nightstick three times on the sidewalk, in the hope that your side partner, a mile away, might hear it. And that was *communications* when we were cops. . . . Or you blew your whistle. Or you made some outcry. And if a crime was being committed within your sight, and you were single-handedly unable to cope with it, you gave an alarm to the perpetrators by that very outcry. . . . In this modern world the business of taking advantage of the improvement in communications not only within the community and within the precinct, but within the neighborhood, within the city, within the state, and within the nation, becomes of the utmost importance, both in the preservation of life and the protection of property, which are the basic purposes of any police department. . . . We are, today, throughout the nation, principally due to improved communications, actually neighbors. . . . We know that our police in every part of the country are engaged in warfare against the organized criminal, and if we are not prepared to take advantage of every single gift that comes from the laboratories, the chemists and the engineers, and the inventors in the line of communications, our efficiency has been lessened by that degree."

Commenting on international policing and radio, the Mayor told of his trip to Mexico City where he found the police department equipped with two-way walkie-talkies and able to contact border patrols quite effectively.

"I was delighted to see that," he said, "because from now on, with these improved communications, we must prepare to reach out beyond the boundaries of our nation. The day is quickly coming when we will have to

expand our efforts to include the entire hemisphere if we are going to meet the requirements that are our obligations in the field of preservation of life and the protection of property."

THE WORLD'S MOST productive laboratory, the Bureau of Standards in Washington, has now become the site of a unique tube ruggedization program under the direction of I. L. Cherrick of the Bureau's Electron Tube Laboratory. The Bureau's facilities for testing the ruggedness of tubes now include vibration apparatus, mechanical resonance testers, high-impact shock machines, and high-speed centrifuges. Some tests are conducted with typical electrical voltages applied to the tube elements so that noise modulation, short circuits, and other effects can easily be studied. Destructive field conditions can be reproduced through the proper choice of vibration, resonance, impact, and acceleration tests.

After receiving ruggedness tests, tubes are examined for structural failures at the labs. Often x-rays are used to reveal the extent of the changes without opening of the tube envelope. Materials for certain tube elements are examined spectroscopically to determine their exact composition and to find impurities that might weaken the tube structure.

The equipment required to make these unusual tests are lab products, the results of exhausting research by the nation's leading scientists, for searching for better products for better living .....L.W.

IMPORTANCE OF PROPER ION TRAP MAGNET INSTALLATION

By R. H. van HAAGEN

RECENTLY there have been more and more TV sets brought in for checking having all of the symptoms of weakening tubes, but with all tubes checking in the normal to better-than-normal range. This is especially true of the RCA 8T241 and similar Fada, Emerson, and other make receivers.

The trouble has subsequently been found to be in the positioning of the ion trap magnet, which in the newer sets is a horseshoe-shaped spring clip with the magnet at the closed end. The clips are supposed to be placed over the "flags" inside the neck of the picture tube and to be positioned for maximum brightness.

In most installations the heavy magnet is placed at the top of the tube, since it is more easily slipped on from the top. However, the weight of the magnet soon pulls the assembly out of position when the set receives normal household vibration. The trouble can be confused easily with the gradual decrease in the gain of amplifier tubes.

The cure: Simply reinstall the assembly from the under-side of the tube neck, reversing the poles so as to preserve the correct north-south relationship, and adjust the trap for maximum brightness. —30—

LETTERS from our readers

YOUNGSTER WITH A MESSAGE

"IT IS a very good idea, I think, to train more hams of high-school age. I am fourteen years old and first became interested in ham radio at the age of twelve. Several times I have tried to get other boys my age to work for a license, but they backed out because they thought it was too difficult.

"For those who are discouraged by the seemingly 'difficult' exam, I will say that anyone above the age of eleven years, possessing average intelligence, can take and pass the FCC tests, *if* he or she is willing to *work*.

"To abolish the code test would be to take away at least one of amateur radio's practical values, that of having many self-trained code communicators. Another thing: think what would happen in case of an emergency where a transmitter has only c.w. to send a QRRR with, and none of the hams in the vicinity knows code. I don't believe in code as an obstacle to keep the ranks of hams thin; I think that there should be a beginner's class license requiring only about 8 or 10 w.p.m., using a portion of one band, perhaps.

"FB on your program to get more 'new blood' into amateur radio."

James Douglas, W2BMF
51 N. 53rd St.
New York 19, N. Y.

* * *

AIRCRAFT RADIO

"IN MY avid perusal of your most excellent magazine, I have noticed in the last few editions a rabid controversy raging over the code test. I believe code is a good thing. If a person is too lazy or indifferent to master a small item like the Morse Code, he could hardly be expected to do the other things that separate the good amateur from the person who is vaguely interested in radio.

"The writer who quotes the example of aircraft control, stating that code is outmoded, reveals himself unfamiliar with that system. True, aircraft flying over land where ground stations are only a few miles apart do use R/T exclusively, but in aircraft there is no radio equipment that will give dependable R/T communications under adverse conditions over a range of a thousand miles or more. Most long-range aircraft control is by c.w.

"One of my pet peeves is the person with more money than brains or consideration for others who uses far more power than necessary for communication. Methods such as these are not encouraging to the beginning ham.

"Enough beefing. I find the series, 'The Beginning Amateur,' very good. For one thing, they do not use that phrase 'the circuit is conventional.' Perhaps it is to some people, but to new hams it is still a deep subject.

"Once again, my compliments to your excellent magazine. Keep up the good work."

Lloyd O. Olsen
1928 Central Ave.
Prince Albert, Sask., Canada

* * *

FOR DEVELOPING U.H.F.

"FOR about 2½ years, I have been a reader of your publication and believe it is the best in its field, from my standpoint; I am not a ham but hope to be some day, and the information you publish is not too technical for the ordinary reader.

"Lately, I have noticed the pros and cons on the code test in the 'Readers' department, relating to the amateur license. This test should never be discontinued on the 160, 80, 40, 20, and 10 meter bands. The elimination of code tests would only open the way for a great many newcomers who would memorize the theory and regulations of the exams and appear on the air with high-power, 'store-bought' rigs, contributing nothing to the amateur game.

"If these people who want to be amateurs and cannot see the use of code are really sincere, let them have licenses to operate in the u.h.f. bands and let them develop that, the same as the hams had to develop the bands they are now using."

Robert E. Black
Riverhead, N. Y.

* * *

CITIZENS' BAND FOR PHONE?

"AFTER reading 'Letters from Readers' in your August issue, I would like to point out a few reasons why c.w. is and should continue to be part of the training which every prospective amateur must undergo.

"Most prospective amateurs and a few of the licensed ones are quick to state that code is outmoded because many types of communication, both in industry and government, use voice in preference to code. Let's look at the problem clearly. If one has a clear channel, if the desired range is relatively short, and if the service required is more of the 'conversation' type, then voice is certainly justified as a means of communication in that particular service. Taxi and plane-to-ground service, for instance, is mainly composed of short questions and answers, requiring little effort on the part of the operators because the conditions involved favor that type of service.

"However, just what is the prime justification for the amateur's exist-

ence? Certainly if the FCC thought amateur communication was composed of friendly greetings between two or more individuals, the Commission would not feel justified in giving us the number of favorable frequencies we presently occupy. No. The amateur, first and always, is allowed the privileges he enjoys because he is at the service of his country in peace or war. Granted, then, that the amateur must be prepared to communicate during emergencies when conditions are at their worst. Any operator, amateur or commercial, will tell you that c.w. is the only sure means of rapid communication under these conditions.

"If one wants to just talk on the radio, let him use the Citizens' Band, but if one wants to be a true amateur, worthy of the name 'ham,' let him learn code."

James M. Coleman, W5KTE
6900 Louisville St.
New Orleans, La.

* * *

MORE UNFRIENDLY HAMS

"THE letters in your August issue 'Letters' department were certainly good. In one way I agree with those who say code is old-fashioned, and in another way, I can see that knowing it is worthwhile. For instance, if the phone broke down, a ham who did not know the code would be forced to stay off the air until the system is back in order. So, if only for his own sake, knowing code would be a good thing.

"One ham wrote about offering his services to a fellow in the hospital. How about the ones out of the hospitals who would like to become hams? That seems to be a horse of another color. A radio amateur is helpful? That is plain bunk. Darn few of them are willing to try and help a fellow who is interested.

"I made the acquaintance of Nels R. Nelson, WØMEP, of Iowa, on another fellow's station, and since then, he and I have written back and forth, and he has encouraged me to keep on plugging. There is another ham here, too, who has been giving me code practice, and one who has offered me the use of his station until I can build one of my own, but the majority of those I have met at local club meetings offer little help.

"Right now I am stuck between 6 and 8 w.p.m. on receiving; I am not so sharp as I was 15 years ago, since I have been ill, but my ham friends don't see that. Maybe I should take up stamp collecting, like they say."

Joseph A. DuBois
179 Weld St.
New Bedford, Mass.

* * *

10 W. P. M. AGAIN

"IT IS with great interest that I read RADIO & TELEVISION NEWS from cover to cover every month. Reading of the opinions of various readers concerning the new proposed FCC regulations, I thought it was time to add my two-bits worth.

"Recently I graduated from a high

school that received a deluge of war surplus equipment after the war. We all had hopes of being able to set up a ham station in the school and would have except for one reason: code. Why in the name of Jehosaphat should American hams be required to pass a 13 w.p.m. test when the rest of the world requires only 10 w.p.m.? It's not that 13 w.p.m. is so much faster than 10 w.p.m., it's the principle of the thing.

"True, our fathers started on c.w., they had to. They also listened with headphones, drove a Model-T, and danced the Charleston. The old story about a ham not being qualified to operate a ham station if his code isn't up to speed is a lot of hooey. I received my First-class Commercial Radio-Telephone license last summer and don't know much about code. Yet I am qualified as far as theory goes to operate a commercial station.

"If the FCC would open up everything from 6 meters on up into the microwaves, so that we who are interested only in the technical side of radio, and who are qualified, could operate—well, these are just a few things I've been thinking about."

Darrell Forsberg
12023 Dayton Ave.
Seattle 33, Wash.

* * *

NEED CODE INSTRUCTION?

"To help further the cause of ham radio, I would like to offer my services as a code instructor in the New York area, preferring to have the class or classes comprised of at least six or more; they would have to be held at night.

"I am a member of the U. S. Naval Reserve, call letters N9RAH, formerly located in Le Roy, Michigan, and will be pleased to hear from interested persons direct, or through RADIO & TELEVISION NEWS."

C. A. Cool, W8WYP
Gross Sales & Service
214 W. 14th St.
New York, N. Y.

* * *

MR. BURKE AND THE ARMY

"'SERVICING Simplified' by Cataldo and Richard in the January issue and the one in the April issue were probably not meant for top-flight servicemen like Mr. Burke, but for the beginner. I, being a beginner, look in several magazines in the hope of running across such articles and when in twelve issues I get two or three, I consider that I have my money's worth. Incidentally, the 'Cathode Follower V.T.V.M.' in the August issue and the 'Experimenter's Power Supply' published in September I thought were very good. I would like to see more of the same.

"Mr. Burke should seek his own level. There are probably articles that will test his mettle, and if he is helped somewhat he should not begrudge the beginners the assistance they need. Let's take a point he made. He divides his radio in half. Well, I can do better

than that. I start at the antenna. If I get the response I'm looking for, why start at the second detector? If I don't get the response, isn't it better to take it step by step to isolate the trouble and chase it down?

"I'd like to know if all of Mr. Burke's fellow servicemen were his equal. Of course, by and large they must have been good, but I have heard some officers complaining about the caliber of their technicians. All I ask Mr. Burke is, don't begrudge the beginner the help the authors generously extended. No hard feelings."

J. Martin Schmitt
Lock Box 47
Avon, Minn.

* * *

A SERVICING CONTROVERSY

"THIS letter is intended as a comment on John Burke's method of aligning radios (September issue, Letters from our Readers). I am only a tinkerer as far as radio goes, but I have gotten hold of several sets that need i.f. alignment, and the owners have said that a professional man did the repair job before. In most cases the oscillator padders needed readjustment to give reasonable tracking at i.f. frequency.

"It could be that the aforementioned service technicians have used Burke's method of alignment and so have misaligned the sets. However, his method is much better than a signal generator in aligning the r.f. and mixer grid circuit. I would like to know from Mr. Burke if the finger test, as he calls it, means touching the grid terminal and observing the amplitude of the hum output of the speaker."

John Grandstaff
Rt. No. 1, Box 26
Wilsonburg, W. Va.

—30—

BELL SYSTEM OPENS NEW YORK-PHILA. LINK

THREE more television channels, besides hundreds of additional telephone calls, will be carried over the new *Bell System* coaxial cable that went into service the first of September. Although the New York-Philadelphia route already has more communication channels than any other served by the *Bell System*, the demand for facilities made necessary the addition of this, the ninth major cable between the cities.

A total of five TV channels, two from New York and one in the reverse direction, will now be available. At Philadelphia the new cable joins another leading to Baltimore and Washington. Over this route another channel will be added for programs to the nation's capital.

Telephone and television signals are carried by small copper tubes, or coaxials. In the cable, which is about as large as a man's wrist, there are eight of these, a pair of which can carry about 600 simultaneous telephone messages or two video programs. In addition to the coaxials, ordinary telephone wires are packed into the cable to assist in controlling the operations and to handle short-haul telephone messages.—30—

Manufacturers' Literature

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

SYLVANIA TECHNICAL MANUAL

The Radio Division of *Sylvania Electric Products Co., Inc.,* Emporium, Pa., has prepared a seventh edition of its technical manual, containing basic application data for 637 radio receiving tube types and cathode-ray tubes.

Informative data covers characteristic curves for tube types in common use, interchangeable tube charts, a dictionary of tube, circuit, FM, and television terms, and instructions on the use of characteristic curves.

Comprising 418 pages, the revised manual has a plastic ring-type spine that opens flat for convenience in reference work. Radio and television set repairmen, industrial electronic engineers, or others interested in this type of work may obtain the book from *Sylvania* distributors, or direct from *Sylvania Electric Products, Inc.,* Emporium, Pa.

RELAY CATALOGUE

A sixteen page catalogue put out by the *H-B Instrument Company,* 2633 Trenton Ave., Philadelphia, Pa., illustrates and describes equipment used in signaling and controlling temperatures in both laboratory and plant installations. These include temperature controls, relays, thermometers, selector switches, and radio thermometers and thermostats.

"Double-Diamond" relays made by the company are available in two types, panel mounted types or the enclosed normally-open and normally-closed mercury relays; these have hermetically sealed contacts that accommodate 30 amperes at 115 volts a.c.

The booklet, which will be sent free of charge on request, is supplied with simplified price list, combined with the specification charts that furnish all needed information on the products.

ANTENNA SYSTEM BOOK

Jerrold Electronics Corporation, 121 North Broad Street, Philadelphia 7, Pa., has prepared a booklet for its jobbers and dealers on the Mul-TV antenna system that permits the simultaneous operation of a large number of TV and FM receivers from one antenna.

The system can be adapted to any type of installation, from single channel to twelve channel operation. It is used non-amplified in strong signal areas or amplified in low signal areas and accommodates and properly matches any number of receivers intermixing 72 ohm or 300 ohm sets.

Although the basic design of the Mul-TV equipment would seem to permit its use for apartment houses and hotels, the company does not recommend it for those installations and is working on some additional Mul-TV equipment for such applications.

POWER POINTS

How electric power supplies have come to the rescue in situations where emergency electricity supplies were required is described in a 16-page magazine published by *D. W. Onan & Sons, Inc.,* Minneapolis, Minnesota.

Hospitals, public buildings, telephone companies, radio broadcasters, farms, hatcheries, and greenhouses have many times utilized the services of *Onan* power supply equipment to ward off serious losses that might have resulted from temporary power cutoffs during storms or other disasters. The magazine describes and illustrates these examples with many drawings and photographs, making on the whole an attractive as well as informative piece of work.

Those wishing a copy of the booklet, which is free of charge, should specify "Power Points," Vol. 5, No. 2.

MACHINE TOOL GUIDE

A lavishly illustrated 16-page catalogue being offered by the *Walker-Turner Division* of the *Kearney & Trecker Corp.,* Plainfield, New Jersey, gives minute descriptions, prices, and complete specifications of the many types of metal and woodworking machine tools produced by this company.

Drill presses, shaft machines, grinders, lathes, motors, sanders, and pulleys are some of the many machines manufactured by the *Walker-Turner Division,* and described in this catalogue specified as "B." Still other heavier machines are described in a booklet entitled Catalogue "A," including ten-inch tilting arbor saws, twenty-inch drill presses, and variable speed wood turning lathes.

Both of these booklets are available direct from the company or any *Walker-Turner* dealer.

ADHESIVE PRODUCTS PAMPHLET

Paisley Products, Inc., 1770 Canalport Avenue, Chicago 16, Ill., has published a six-page illustrated pamphlet on the many varieties of adhesives used in industries such as home furnishings, electrical products, chemicals, etc.

In fabricating, assembling, labeling, wrapping, and sealing operations, these adhesives are utilized on appliances, dry batteries, fuses, motors, meters, wire and cable, and in the

manufacture of radios, phonographs, and sound equipment.

The ten main divisions of adhesives are described, and a product list shows uses and industries served. A free consulting service is offered by the *Paisley Laboratories* to users who may need assistance on certain problems, or who may require improvements in their regular operations.

ELECTRONICS BOOKLET

A brochure that describes industrial applications of electronic equipment has been issued by *RCA Victor,* Camden, New Jersey. Primary theme of the booklet is the advantages of less cost and greater profits accruing from the applications cited.

Comprising twenty pages, the literature describes fifteen types of equipment that are helping in the development and manufacture of new products and performing manufacturing operations more safely and with greater ease. It shows how leading industries are using sound systems, 16 mm. projectors, intercom systems, mobile equipment, tape recorders, industrial television, test and measuring equipment, and so forth. Other information is given on more than 40 complete lines of electronic products and services.

Entitled "Have You Thought of *RCA* for These Products?" the brochure may be obtained from the Public Relations Dept.

AMATEUR ANTENNA BOOK

The *E. F. Johnson Company* of Waseca, Minnesota, in the sixth edition of its Antenna Handbook recently issued, has compiled much valuable information along with directions on how to operate the rotomatic beam antenna.

Detailed sketches and photographs are scattered through the 47 pages of this book to illustrate the operation of the antenna rotator, antenna coupling, beam assembly and tuning, feed systems, impedance matching networks, and transmission lines, to name only a few of the subjects given.

Increased congestion of amateur frequencies leaves as the only alternative for improving operating conditions the use of directional antennas, this despite the advances made in transmitter design and increased ham station power.

The *Johnson* Antenna Handbook was intended, therefore, as a guide and help to the amateur in perfecting his arrays. Write the company at the above address for copies, which are 60 cents each.

ALLIED BUYING GUIDE

Recording equipment and accessories, including the latest wire, tape, and disc recorders, three-speed record players and changers, high-fidelity amplifiers, speakers, tuners, and other components for custom installations make up only a part of the 196-page catalogue recently put out by *Allied Radio Corporation,* 833 W. Jackson Blvd., Chicago, Ill.

A special public address section describes amplifiers and sound systems, from 8 to 80 watts, and some of the latest intercom, paging, and music units, together with a listing of all associated components and accessories, such as microphones, pickups, speakers and baffles, phono motors, cable and connectors.

Besides the sound sections, the book lists every other component used in the radio, television, and electronic fields: test equipment, television and radio sets, TV parts, and some of the newest portable Geiger counters for uranium prospectors. A ham section lists "Everything for the Amateur," receivers, transmitters, tubes, keys, transformers, etc. Experimenters and builders are not forgotten, and a wide variety of kits are pictured, one-tube units to 16" TV receivers, plus diagrams, accessories and tools and supplies. Special kits and projects for use in radio training classes are also described.

This 1950 catalogue, "Everything in Radio and Electronics," is free of charge and will be sent on direct request to the company.

REPLACEMENT GUIDE

Just announced by *Standard Transformer Corporation,* 3580 Elston Avenue, Chicago 18, Ill., is the third edition of the firm's television replacement components catalogue, which is available from *Stancor* electronic parts distributors or direct from the company.

This bulletin DD338B gives chassis or model numbers of 37 manufacturers' sets, comprising 108 TV receivers, supplying the replacement components available on each arranged according to specification number; these include transformers, chokes, deflection yokes, focus coils, etc.

The guide is conveniently arranged, with holes to allow insertion in a notebook, and is the standard 8½x11 size when folded.

PHOTOELECTRIC BULLETIN

The *International Rectifier Corporation,* 6809 S. Victoria Avenue, Los Angeles 43, California, has prepared a photoelectric cell booklet entitled Bulletin PC-649, which contains diagrams and curves on photocells, besides describing their construction and giving performance characteristics and applications.

Current sensitivity, voltage output, internal resistance, spectral sensitivity, etc., of this new line of selenium self-generating photocells are demonstrated by means of the curve drawings, and a price list that indicates the company's standard sizes, plus a discount schedule, are also included in Bulletin PC-649, which is available without charge on request.

SUPERIOR EQUIPMENT

Tube testers, multimeters, kilovoltmeters, signal generators, volt-ohm-milliammeters, and combination instruments make up the contents of

the new catalogue recently printed by *Superior Instruments Company*, 227 Fulton St., New York 7, N. Y.

Complete specifications with prices are given on each of these units. Besides the AM and FM radio testers and television test instruments, *Superior's* industrial and electrical equipment includes analyzers and utility testers for electrical contractors, maintenance men, motor repairmen, appliance men, etc.

One of the items featured in "The *Superior* Line for 1950" which should be of particular interest to sound technicians is a reflex projector, Model S-35, having a built-in driver unit. This speaker is rated at 35 watts and will handle up to 55 watts without blasting. It provides an 80-degree coverage, and this directional advantage, together with the high sound pressure produced, reduces the required driving power for any specific installation.

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Distortion Analyzer

(*Continued from page 45*)

the system is balanced. Unfortunately, most 6N7 tubes have slightly different characteristics for the two halves, and it may be necessary to vary the individual plate voltages for best results. In no case should the input to the grids of the 6N7 exceed two volts. If greater output is needed, a 6J7 may be substituted for the 6J5 distortion amplifier.

Those experimentally inclined may be interested in adapting this system to the detection of intermodulation distortion. Intermodulation distortion in amplifiers is a case in which two audio frequencies combine to form an objectionable "beat" frequency. Many otherwise good amplifiers are quite poor in this respect, intermodulation distortion running as high as twenty-five per-cent.

To make intermodulation tests, it is necessary to use two audio signals of different frequencies. These are fed into the amplifier under test and the output of the amplifier examined for "beats." Conventionally this is done by a series of filters rejecting the original frequencies and allowing the beat frequencies to pass. However, there seems to be little objection to suppressing the original frequencies in a manner similar to that used in the previously described distortion analyzer.

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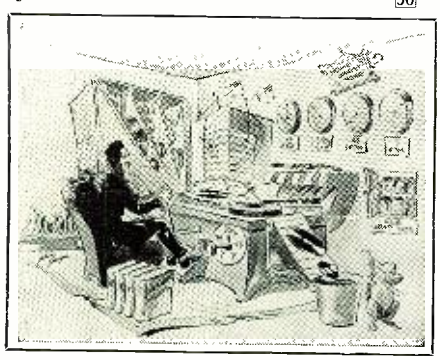


NEW EQUIPMENT FOR THE AUDIO TECHNICIAN

LIGHTWEIGHT AMPRO RECORDER

Ampro Corporation, 2835 N. Western Ave., Chicago 18, Ill., has produced a tape recorder and play-back unit based on a new circuit design that permits a reduction in weight, size, and price.

Magnetic recording tape is used, operating on a "dual track" with either

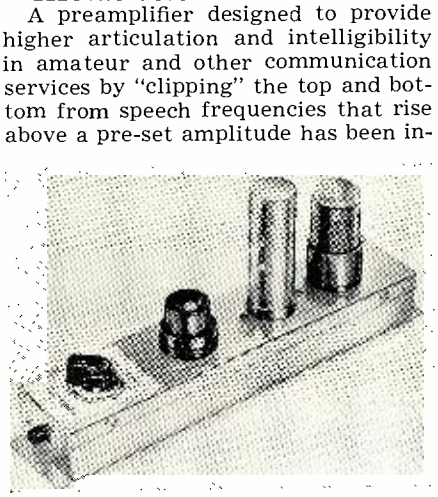
5 or 7 inch reels at a tape speed per second of 3¾ inches. A two-hour program may thus be placed on a single 7 inch reel of tape.

One of the features of the new device is a monitoring system that permits pre-setting the sound level before starting to record from radio or phonograph. Another advantage is the simplified threading and operating, whereby the tape is simply dropped into the single threading channel where it automatically centers itself and adjusts to proper tension.

Complete specifications on the *Ampro* recorder, including details on the timing indicator, erasure system, manual rewind for editing, etc., may be obtained from the company at the above address.

ELECTRO-VOICE SPEECH CLIPPER

A preamplifier designed to provide higher articulation and intelligibility in amateur and other communication services by "clipping" the top and bottom from speech frequencies that rise above a pre-set amplitude has been in-



troduced by *Electro-Voice, Inc.,* Buchanan, Michigan.

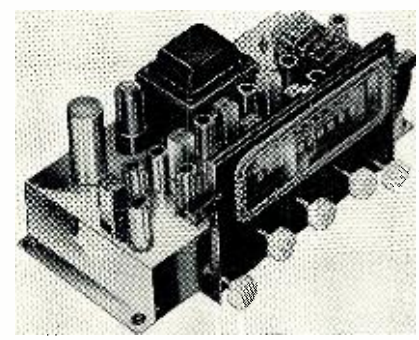
This model, called the E-V Speech Clipper, functions at approximately 150 volts, with a required plate current of 5 ma. Frequency response is 200 to 3000 c.p.s. Operating directly from any high-impedance mike into the microphone input of a conventional speech amplifier, the speech clipper increases the ratio of consonant-to-vowel intensity and adds to intelligibility in speech transmission. This is accomplished by a pi low-pass filter providing attenuation of 24 db./octave on the curve above 3000 c.p.s. An "On-Off" switch makes possible the selection of conventional or "clipped" operation.

The case of this Model 1000 Speech Clipper is of aluminum, 10¼ by 2 by 4½ inches in size, and the output terminal is an 18-inch shielded cable.

AM-FM RECEIVER CHASSIS

The automatic frequency control with which the new AM-FM receiver combination of *The Radio Craftsmen, Inc.,* is equipped, is credited with simple and correct tuning of FM signals, eliminating all trace of side response and even superheterodyne images and adjacent channel interference.

The chassis of this Model RC-8, designed for custom installation, is of chrome, 9 by 15 by 7 inches in size,



weighing 19 pounds. All necessary interconnecting cables, escutcheon, mounting screws, diagrams, mounting templates, etc., are provided. Grouped on the front are five controls: bass, Off-On-Volume, AM-FM-Phono-Television, tuning, and treble. All audio controls are continuously variable.

Two input connections are provided for phonograph, television audio, wire recorder, etc., and are switched from the front, and two a.c. power outlets controlled by the "On-Off" switch supply the amplifier and phonograph motor. A rear socket provides easy access to 6.3 volt a.c. and well-filtered 100 v. d.c. for supplying external preamplifiers and additional pilot lights.

Power supply is a self-contained unit for 105-125 volt, 60 cycle a.c., and power consumption is 100 watts. FM frequency range for the slide-rule dial is 88-108 mc.; for AM, 540-1620 kc. Address *The Radio Craftsmen, Inc.,*

1617 South Michigan Ave., Chicago 5, Ill.. for further details on this chassis which may be had in rack and panel mounting at a slight additional cost.

MILES "RECORDALL"

For handling difficult reproducing jobs, such as conferences, telephone conversations, long-time dictation, court proceedings, etc., the *Miles Reproducer Co., Inc.,* of New York has designed the "Recordall," a machine that may be set to run without supervision, voice vibrations being sufficient

to start the machine, which then automatically stops with a cessation of sound.

Several other unique features are incorporated in the unit, including automatic volume control, spontaneous selection of a designed soundtrack, automatic repeating for complete lines, automatic start and stop on split syllables, mobile or stationary operation, instantaneous playback, etc.

A vernier knob allows the operator to locate any point of an entire 3½ hour recording within a period ranging from a split second to 6 seconds. The dictator may sit, stand, or walk about while using the recorder, an advantage made possible by the ultra-sensitive pickup range.

Information on the "Recordall" will be sent by J. M. Kuchlik, Chief Engineer, *Miles Reproducer Co., Inc.,* 812-814 Broadway, New York 3, N. Y.

AUTOMATIC FILM SPLICER

Handling all types of safety film bases, including the new tri-acetate stock, raw stock, and short ends, an automatic splicer for 35 mm. and 16 mm. motion picture film and magnetic tape in those sizes has been developed by the *Prestoseal Manufacturing Corporation.*

The machine, called the Presto-Splicer Professional Model, is simple to operate so that it can be used by comparatively unskilled persons and even in the darkroom. The splice, which does not add any thickness to the film, will hold up even under the process used for high-speed reproduction of TV, newsreel, and Ultrafax film. The complete operation cycle includes cutting, welding, cooling, and removal of film from the machine, and takes 6 to 10 seconds after editing.

A current control is provided to compensate for current variations, and there is a 2 by 3½ inch viewing light in the base. Maximum current consumption is 3 amps. for cycle

(*Continued on page* 176)

period only. Power specifications are 110-120 v. a.c. at 50 to 60 cycles, with the primary circuit fused. Operation on 220 v. can be provided at a slight additional cost.

More complete specifications are obtainable from the company, located at 38-01 Queens Blvd., Long Island City, N. Y. Address Mr. Leonard A. Herzig, sales manager.

CRYSTAL AND DYNAMIC MICROPHONES

A recent addition to the *Turner Company*'s line of microphones is the Model 25X-25D, available with either crystal or dynamic circuits. All sound installations made with this new design are handled with smooth, wide-range frequency response and high output level. Features of both types are a 90 degree tilting head, ⅝ inch coupler mounting, and a quick-change cable set.

The crystal mike, Model 25X, has an effective output of 52 db. below 1 volt/dyne/sq. cm, with a flat response from 50 to 9000 c.p.s. and is equipped with

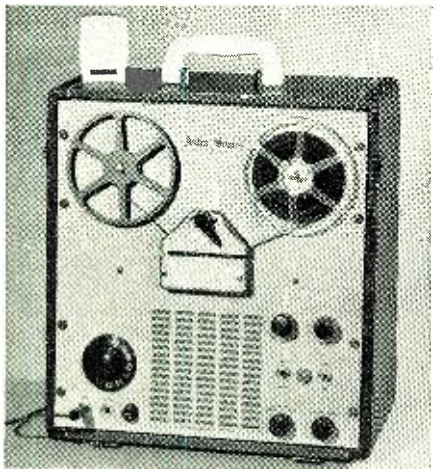
moisture sealed crystal. Model 25D, the dynamic type, has an output level of 54 db. below 1 volt/dyne/sq. cm. at high impedance with a flat response from 50 to 10,000 c.p.s. This mike is provided with Alnico V magnets. Microphone cases are finished in two-tone umber gray with a chrome plated grill or in bright chrome finish, whichever is desired. The *Turner Company*, Cedar Rapids, Iowa, will send more complete specifications on request.

RADIO-RECORDER COMBINATION

Model C-2, a portable recorder-radio combination weighing only 30 pounds, is now being manufactured by the *Pentron Corporation*, 611 W. Division St., Chicago 10, Ill. To provide for maximum ease of operation, accessibility and economy of space, the company devised a special vertical mounting of the mechanism and chassis.

A dual-track mechanism has a recording speed of 7½ inches per second, with a rewind ratio of 20 to 1. The chassis incorporates 7 tubes with 5

watt power output rating, having a frequency response of 65 to 8000 c.p.s. plus or minus 6 db. A superheterodyne



receiver is included, encompassing the standard broadcast band.

The cabinet of the unit is of lock-corner plywood in two-tone simulated leatherette having bronze hardware and plastic trim, and the entire unit comes equipped with crystal microphone, tape, and takeup spool.

EICOR PORTABLE RECORDER

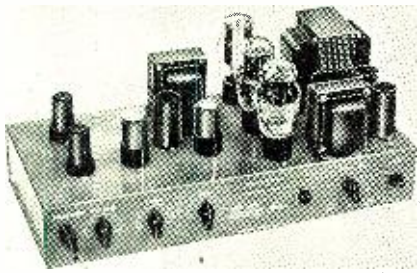
A luggage-type, portable tape recorder, weighing only 27 pounds and containing a five-tube amplifier with six-inch speaker, is now in production by *Eicor, Inc.*, 1501 W. Congress St., Chicago 7, Ill.

A sensitive crystal microphone and radio speaker hookup are provided with this recorder, and there is ample storage space for extra tape, cords, and accessories. Although designed for portability and lower cost, the unit has the advantage of a frequency response equal to that of many higher-priced machines.

AMPLIFIER KIT

One of the newest developments of the *Sun Radio and Electronics Company, Inc.*, 122-124 Duane St., New York 7, N. Y., is an all-triode, high-fidelity amplifier kit, Model CR-10.

The 10-watt, 7-tube unit, based on a



design published by Consumers' Research, Inc., Washington, N. J., provides flat frequency response, plus/minus 1 db., from 20 to 15,000 cycles, with distortion less than 2.5 per-cent. Gain is 75 db. on radio and 97 db. on phono.

Furnished with a punched, hammertone-gray-finished chassis housing, the kit comes complete with step-by-step

instructions, photographs, and diagrams, for the price of $42.50. Assembled, wired, and tested, the unit is $69.50.

SOUND DISTRIBUTION SYSTEM

Latest device announced by the *Webster Electric Company* of Racine, Wisconsin, is a two-channel unit called the "Teletalk," (SS-271A) providing for communication, radio and phono-

graph distribution, voice reinforcement, announcements, etc., all in the one console.

One of the channels provides for AM-FM radio and phonograph reception while the other is used for general announcements, as an amplifier unit, or even as a separate reproducer. Communication may be made to individual rooms without interfering with program distribution to other locations, and an "All-Call" switch permits simultaneous announcements when desired. Communication from individual rooms to the central control is also possible.

LIGHT-WEIGHT WIRE RECORDER

A wire recorder possessing the advantages of speed in spool changing and ease of operation, combined with complete portability, is one of the latest developments of *Lear, Inc.*, of Los Angeles, California.

The "Learepporter," as it is called, Model WC-314A, has both high and low impedance line, permitting cable to be run from the machine to a microphone installation six or seven blocks away. Another advantage making for speed in operation is a removable turntable that can be changed in 15 seconds without immediate rewinding of the tape. The cue meter is calibrated in minutes, and the operator may listen via the microphone before starting the recorder at the point desired.

Los Angeles police collaborated in the manufacture of this device and have already installed it at headquarters, to be used by the detective force. To disguise the machine, the company designed a metal aluminum covered Haliburton carrying case that simulates airplane luggage.

DUAL-HORN REPRODUCER

The *Brociner Electronics Laboratory* 1546 Second Ave., New York 28. N. Y., has introduced a new reproducer that utilizes the corner horn principle. Each Brociner-Klipsch dual-horn unit is available in an attrac-

tively-styled cabinet in period or modern designs. Characteristics of the reproducers are excellent transient response and non-resonant horn loading for clear definition.

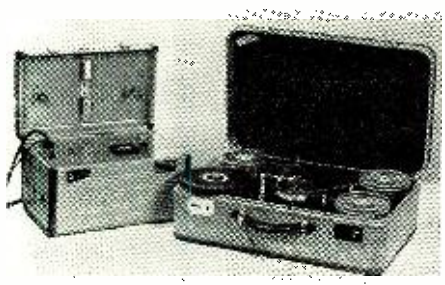
In this design, fundamental tones

from 30 to 15,000 cycles are cleanly distributed. Driver units provide excellent reproduction of extreme bass tones, a better balance than formerly attained in the middle ranges, and a smooth and flat frequency response to 15,000 cycles.

"PRINTING" TAPE RECORDINGS

A simplified method for duplicating magnetic tape recordings on either paper or plastic tape was introduced recently by the *Minnesota Mining and Manufacturing Co.* of St. Paul, Minn., at the National Electronics Conference in Chicago.

Sound is created on magnetic tape by means of patterns formed in the iron oxide dust coating, and the demonstration was accomplished by bringing together two tapes, one recorded and one "blank," in the presence of an A.C. magnetic field. The "printing" was done with a device consisting of two units, each weighing 25 pounds. One of these is comprised of a motor, a



magnet, and a mechanism that winds the master tape and the "blank" together. The second unit is an oscillator generating 2000 cycles in the electromagnet.

For mass production such a "contact printing" machine could make a dozen or more duplicate recordings simultaneously from a single master tape. Stressing the fact that any figure on costs would be only guesswork, it was estimated that a machine of this type could cut production time for a one-hour recording down to a matter of seconds.

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International Short-Wave

(*Continued from page* 151)

in parallel. *RAI* has expanded its "Publicity Program" to five minutes; this commercialization of an international broadcast is, in the opinion of Worris, N. Y., who reports the item, "one of the most fascinating developments in s.w."

Japan—Press dispatches indicate that unrestricted international broadcasting has been authorized for Japan. (Fried, Mich.) *Can anyone confirm this?*

Kenya—VQ7LO, 4.885, Nairobi, heard with relay of BBC news 1315; talk followed, then station identified 1330, followed by light music. (Short-Wave News, London)

Luxembourg — Radio Luxembourg, 6.090, transmits daily 1130-1630; *English* programs (relayed from the l.w. station) are 1130 Sam Costa Show (Sundays); 1200 latest records; 1230 Pin-Up Princess for a Day, Stewart MacPherson; 1530 request program; 1600 Jack Jackson show. (Short-Wave News, London.) They may mean *all* these for *Sundays only?*

Madagascar—FIQA, *Radio Tananarive,* 6.060, is difficult to pick up but sometimes can be heard in Sweden with weak signal during the last half hour of the daily transmission which ends 1400; dance music; closes with "La Marseillaise" and then three times plays some tunes on an oriental instrument; severe QRM noted from Russian jamming transmitters on either side. (Albinsson)

Malaya—British Far Eastern Broadcasting Service, 9.69, Singapore, heard 0700 relaying BBC. (Stark, Texas)

Radio Malaya, 4.780, Singapore, heard in New Zealand to 1030 sign-off after broadcast in Chinese. (Cushen.) The 7.20 outlet has program summary 0530, news, and music. (Sanderson, Australia.) Sent verification on the 7.20 outlet, and listed schedules—daily 2330-0130 Chinese and Indian, 0430-1030 Chinese, Indian, Malay, on 6.135, 4.780; daily 2330-0030 Malay on 7.20, daily 0030-0130 *English* on 7.20, daily 0530-1030 *English* on 4.825; Saturdays 0130-0425 *English* on 6.135, and 0425-1100 *English* on 4.825; Sundays 2030-2330 *English* on 6.135, and 0130-0425 *English* on 6.135, and 0425-1030 *English* on 4.825. (Fellers, Japan)

Malta?—Pearce, England, airmails this data regarding a station on 4.785 announcing "You are tuned to the Forces Broadcasting Service, Middle East." Test transmission first logged 1510 on August 4; call at end of programs. At 1600 gave call and time as 2100 GMT. No further announcement and carrier left the air 1608. On August 7 was logged 1420; recorded program from BBC; relay of BBC's General Overseas Service; call at intervals including 1425 and 1525, when said: "This is a test transmission from the Forces Broadcasting Service, Middle East"; carrier remained to 1605 after final call and time at 1600. On August 12 was heard as early as 1325 with "Sporting Review"; at 1330 relayed Promenade Concert from BBC; continued on air and was still operating 1710 when was tuned out. At the time this was compiled was being heard *only irregularly* around 1300-1330. A letter received by Pearce some time ago from Forces Broadcasting Service, Middle East, Benghazi, Lybia, acknowledging his report on tests over 4.782, said there was a possibility of future broadcasts either from Benghazi or from Malta. This is more likely at Malta now, I believe. Carlberg, Sweden, airmails that he has heard this station on approximately 4.780 closing down 1400, and that location sounded like "Malta."

Manchuria—Harbin, 7.100, now relays the Peiping New China programs, carrying the same news in *English* 0830. A station heard on approximately 5.520-5.530 is believed to be Mukden, Communist-controlled; schedule is unknown but is heard *before* 0700; at 0730 takes Peiping relay to 0830 but does *not* carry *English* then; instead, plays Chinese music; signs off after 1000; has news at dictation speed (presumably in Chinese) *before* and *after* 1000. Dilg, Calif.)

Monaco—Short-Wave News, London, reports—"*Radio Monte Carlo,* 6.035, 9.785, is one of the best s.w. broadcasters from the reliability point of view to be heard at the present time in Britain. First-cass program material is available all day from 0200 to 1815 (may sign-off now 1715?—KRB); a special *English* program of one hour's duration is radiated Sundays at 1700." The 31-m. channel varies from day to day; measured 9.786.3, according to Oskay, N. J., via URDXC.

Mozambique—At the time this was being compiled, CR7BJ, Lourenco Marques, had moved up slightly to around 9.66, although at times has been as high as 9.68; QRM'd by XEQQ in the Portuguese transmission beginning 0000. (Balbi, Calif.) CR7BU, 4.825, heard 1430 with three chimes interval signal and announcement, "Radio Clube de Mozambique"; CR7BV, 4.930, heard in Portuguese 1515, but signals suffer CWQRM in London. (Short-Wave News, London)

New Caledonia—Radio Noumea, 3.410, still heard in New Zealand at fair strength to 0500 close down. (Cushen.) The paralled station is on approximately 6.000.

New Zealand—ZL3, 11.81, is excellent in East 0600 when relaying BBC news; leaves the air around 0620-0630. Cushen, N. Z., says ZL3 is using the 11.81 channel at times to escape QRM from Saigon (both ZL3 and Saigon are allocated 11.78). A *new* channel for ZL2 (listed 9.540) is 9.620 used recently for rugby relays from 0830, Cushen reports. At times, however, ZL2 has also been noted on 9.780.

North Korea—JBBK, 4.400, Pyongyang, not heard in past several weeks; former dual outlet, 7.784, is fair mornings. (Balbi, Calif.)

Norway—Radio Norway informed Osterman, N. Y., that sign-on melody is produced by an electric music box, has no name, and is from an old folk tune. Sends nice card with Norwegian flag on one side, data on other side.

Oslo now has its letter program and musical requests on Saturdays 1400-1500 on 9.645, 15.170, 17.825, 21.730; LLG is now heard on 9.645 instead of previous 9.610. (Pearce, England.) LLN, 17.825, is good signal in Pennsylvania 1315. (Kane, Pa.)

Radio Norway currently is using LKV, 15.170; LLP, 21.670; LKQ, 11.735; LLN, 17.825; LLG, 9.645, and LLK, 11.850. At 2000-2100 LKV, LKQ, LLG are beamed to North American Waters and North Atlantic; at 0600-0645 weekdays, LLP, LLN, LKV, and LLK beam to African Waters and South Atlantic; at 0800-0830 LLP, LLN, LKV, LLG beam to Indian Ocean; at 1400-1500 LLP, LLN, LKV, LLG beam to African Waters and South Atlantic, and at 1800-1900 LKV, LKQ, LLG beam to South America. These transmissions are in Norwegian and consist of home news and music; however, announcements also are made in *English.* (Swedish DX broadcast)

Every Tuesday and Friday, *Radio Norway* has a program in the "samic" language; there are some people in Northern Norway—"up against the Midnight Sun"—who speak this language. It is very interesting to listen to, reports Halvorsen, Oslo. The programs run 1015-1030 over the s.w. transmitter at Tromsoe operating on 6.130 (10 kw.); also goes out over Tromsoe 292 kc. and Finmark 347 kc.; announcement is "Dek lae Norge Rikaradio, Tromsast. Di labetet Samegiel' programma." Translated it reads—"This is the Norwegian State Broadcasting, Tromsoe. You hear a program in Samic." Address for reports is *Radio Norway,* Tromsoe, Norway.

Outer Mongolia—Ulan-Bater, 5.265, is being heard in California mornings. (Dilg.) Is listed 15 kw.

Pakistan—Indian correspondents have informed *Radio Australia* that the *new* 50 kw. transmitter at Karachi has been operating on 11.885 for some weeks now. Daily schedule is 2030-2245, 0110-0130, 0200-0330, 0700-0720, 0730-0740, 0800-0810, 0830-0915 (External Service in Burmese), 1015-1045, 1045-1130 (Persian), 1135-1140, 1200-1240 (Afghan-Persian), 1245-1330 (Arabic), and a further program in Arabic is radiated *from* 1400. News is scheduled 2100, 0110, 0210, 0700, 0945, 1135. With the exception of the 0210 newscast, all these are relayed by Dacca on 15.335. Karachi announces Dacca's channel for 15.27; however, this is incorrect as Dacca long since moved to 15.335. Karachi has Western music 0300-0330. For some time I have been hearing the 11.885 Karachi outlet here in West Virginia with fair to excellent level at 0700 and again at 2100 during *English* newscasts "relayed from the Home Service of *Radio Pakistan.*" Announces Karachi channel as 11.880 but it is higher, usually being slightly *above*

Moscow's 11.88 (which at times *does* QRM Karachi).

Dacca, 15.335, is audible at 0700 some mornings but usually has bad QRM. It comes in extremely well in South Africa at 1000-1100 according to Ridgeway.

The Karachi outlet on 11.885 is good level in New York 0700 with news. (Osterman)

Panama—HORT, 6.060, *"Radio Balboa,"* Panama City, identifies at 2115. (Leinbach, N. Y.)

Peru—OAX4Z, 5.894, *Radio Nacional de Peru,* Lima, noted 2030, readable but suffers from severe CWQRM; *no English noted.* OAX4V, 5.970, *Radio America, La Voz del Nuevo Mundo,* Lima, heard from 2330 to 0200; *no English noted;* stated that OAX4W, 9.375, was in parallel. (Novomestky, Puerto Rico)

Philippines—"Voice of America" relay schedules list Manila I, 11.89, 0400-0915 to Far East, 1700-1900 to China; Manila II, 15.250, 1700-1900 to East Asia; Manila II, 15.330, 0215-0345 (Tue.-Sat.) to S. E. Asia (UN), 0400-0915 to East Asia; Manila III, 17.760, 0400-0915 to E. Asia.

Simpson, Australia, received a letter-verification signed by the president of the Far Eastern Broadcasting Company, Inc., John C. Broger, for report on the *new* Manila station DZH6, 6.030. Mr. Broger said that verification cards are not at hand as yet, and that Simpson's was the first report received from anyone—but was followed within 30 minutes by one from a California listener! DZH6 is using "about 1 kw." with a half-wave dipole antenna about 50 feet above ground. DZH6 is currently operating on 6.030; DZH7 was to be using 9.730 around the middle of October; DZH8 should be on the air on 11.855 around the first of November, and DZH9 in the 19-m. band (15-megacycle range) should take to the ether around the middle of November. Heard by Simpson from around 0500. *(Radio Australia.)* This is a *new* missionary broadcaster—similar to HCJB, Quito, Ecuador); operates 0500-0900 daily and 2000-2300 Sundays; opens with "Oh, Hear the Power of Jesus' Name" (may mean "All Hail the Power of Jesus' Name"?), then news to 0515; music to 0530, then missionary broadcast; signal good in New Zealand to 0600, then has interference from HP5B, Panama. (Cushen)

DZH4, 6.000, heard 0645 with news and music; DZH3, approximately 9.500, heard 0400 with musical program and local news; DUH5, 11.84, heard 0615 with news and music; DZH6, 6.030, heard 0500 with news and music. (Sanderson, Australia)

Portugal—CS2WI, 12.864, Parede, heard with good signal 1645; at times plays recordings in *English.* (Oskay, N. J., via NNRC) CS2MA, 6.374, Lisbon, identifies 1930, excellent signal in New York. (Leinbach)

Portuguese Guinea—CQM-4, 6.993, Bissau, heard recently with weak signal 1724 to 1759 sign-off. (Ferguson, N. C.)

Portuguese India—Radio Goa has moved from 7.230 to 9.610; is on *daily* now 0730-1030 and on Sundays there is a further transmission 0100-0230 (this one in *English*) when announces, "This is *Radio Goa,* the Voice of Goa, the Voice of Portugal"; the daily schedule is rather complicated by languages but the station appears to use Concuri, Portuguese, Urdu, Marathi, and Hindustani. When closing 1030 always goes off the air following the playing of the Portuguese National Anthem ("A Portugesa"). *(Radio Australia.)* To my knowledge, up to the time this was compiled, *Radio Goa* had not been heard in America.

Roumania—Radio Bucharest, 9.25, heard with fair level in South Africa with news 1500. (Ridgeway.) Is also carried on channels of 5.950, 6.210, 11.900. (Swedish DX broadcast)

South Africa—Ridgeway, South Africa, writes—"ZRB is a government-owned transmitter at Roberts Heights, near Pretoria; this is a South African Air Force Station whose main function is to give weather reports and other meteorological data on the hour (although I believe not necessarily every hour). The schedule appears *daily except* Sundays and Wednesdays from 0000 to 1100 on 9.110, 6.210. There is no transmission on Sundays, and on Wednesdays it leaves the air around 0600. When not giving weather reports for the use of aircraft, ZRB relays programs from the Johannesburg transmitters—which are divided into two classes, an "A" and a "B" program carrying *English* and Afrikaans programs, respectively. ZRB takes relays from either of these programs just as it chooses. It is, therefore, quite probable that you will get *English* or Afrikaans news at 0000—sometimes Afrikaans for a few days running, and sometimes *English.* It relays news in *English* from the BBC at 0100 as do *all* SABC transmitters. ZRB and Cape Town have no connection whatsoever."

ZUD-24 verified for Jack Fox, N. Z., stating transmitter is a 7 kw. job; also said is on fixed service at 0045 on 13.186; however, this transmission was logged by Fox and by Bluman, Israel, on 17.745; the 8.695 channel has been good in New Zealand at 1045-1125 on Saturdays; according to the letter, this Robert Heights location was to be changed as well as name of the station. *(Radio Australia.)* This one is used primarily for relays.

Southern Rhodesia—Good, England, has heard test transmissions from Salisbury, 3.320, to 1500; asked for reports. (Swedish DX broadcast)

Spain—Widely reported is Madrid's daily transmission 1800-1830 (in *English*) to the United States on 9.369; now announces as "The National Broadcaster in Madrid, Spain." (Worris, N. Y.) This is the first time Madrid has used an *English* equivalent for *Radio Nacional de Espana,* comments Worris.

Sweden—Radio Sweden now broadcasts in *English* for scouts on the first

Sunday of each month following "Youth Meeting of the Air"—at 0230 on 6.065, 15.155, and rebroadcast 1030 and 2030 on 10.78, 15.155. (Pearce, England, McPheeters, N. Y.)

The weekly DX session on Saturdays is carried 0215 on 6.065, 15.155; rebroadcast 1015 and 2015 on 10.78, 15.155. Correspondence concerning the programs is welcomed by the DX Editor (Arne Skoog), *Radio Sweden,* Stockholm 7, Sweden.

A special presentation of Swedish music and Swedish artists is now being broadcast on Thursdays 1910 by *Radio Sweden* on 10.78, 15.155. (Swedish DX broadcast)

Tahiti—Radio Tahiti, officially given as 12.080, was measured in West Virginia as 12.080.2. (Arthur.) Measured by Gross, Washington State, as 12.082, and by Huse, same state, three nights in a row, as on 12.080. Ferguson, N. C., measured it 12.081; and Simpson, Australia, measured it 12.082, according to *Radio Australia.* Announces wavelength of 24.83 metres (which converts to 12.087).

Thailand—HS8PD, 6.010, good signal with news 0615. (Sanderson, Australia.) The 11.65 outlet should be in parallel, and one or both should have a further (native) transmission beginning 0700.

Trinidad—Radio Trinidad, 9.625, Port-of-Spain, noted with good signal 0530 and 2130 to closedown 2200; sometimes is like a "local" in New York mornings. (Osterman) Is excellent here in West Virginia 0600 with BBC news relay.

Turkey—TAQ, 15.195, Ankara, states *English* program 1530-1600 is now radiated to Britain on Thursdays *only;* has dropped temporarily the similar broadcast on Mondays; news continues *daily* at 1345 over TAP, 9.465, and *Postbag* remains at 1530-1600 on Sundays over TAQ. (Pearce, England)

Uruguay—Verification from CXA10, 11.900, Montevideo, lists these outlets —On medium-wave, CX6, 650 kcs., CX38, 1290 kcs.; on short-wave, CXA4, 6.125, CXA10, 11.900, Transmitter "A," 20 kw.; CXA6, 9.650, CXA18, 15.300, Transmitter "B," 5 kw. These are *Radio Electrica* outlets and QRA is Servicio Oficial de Difusion Radio Electrica, Andes 1465, Montevideo, Republic of Uruguay. (Osterman, N. Y.)

U. S. A.—Fried, Mich., has received word from Associated Broadcasters, Inc., West Coast, that the signal he heard on 11.94 and which he thought might be a Far Eastern relay of KWIX-KWID is a result of the beat frequency between the two transmitters being cross modulated, to produce a new frequency on 11.94 (the stations actually operate on 11.86 and 11.90). The two transmitters are in the same building and r.f. from one rig does get into the other, the official stated. "We had a similar condition previously when operating on 9.57 and 11.86. The 40 kc. separation makes it impossible to filter one transmitter frequency from getting into the other without affecting the transmitted signal. Sta-

tion KWID operates with 100 kw. into high-gain antennas and KWIX operates with 50 kw. The signal you receive is evidently our back wave. Usually the reflector curtains hold this to a minimum. However, with 100 kw. forward radiation, there is sufficient signal to be heard in all directions. We appreciate your comments and are sorry you were disappointed in not receiving a DX signal. I hope we are not causing interference."

The format of the *new* "Voice of America" schedule booklets has been radically altered. They now are attractive magazines with full-color illustrations on the covers and show great improvement in technical details of transmission schedules. The "Voice" is now distributing a *Worldwide English Edition* which contains complete schedules of *English* and *non-English* programs. This is *in addition* to the former *eight* other editions. (Worris, N. Y.)

U. S. S. R.—Moscow, 15.14, is good, and 15.34, in parallel, is fair during the *English* program to Asia 0700-0800.

Vatican—HVJ, 11.740, heard well in *English* 1000 and 1315; at 1000 uses 15.095 and approximately 9.64 in parallel, and at 1315 is parallel with approximately 9.64 and 5.970. (Pearce, England)

Western Samoa—ZM2AP, Apia, formerly ZMB6, 7.700, verified by card; no longer operates on s.w. but is on 420 kc. with 2 kw. (Legge, N. Y.)

Yugoslavia—Radio Belgrade, 9.505, heard with Spanish around 0100 and news in *English* 0115-0130; announces next *English* for 1115 on 49.18 m. (6.140?). Pearce, England) Noted in French from 2345 to 2400 sign-off, woman gave news in French. (Bellington, N. Y.) Is listed 10 kw. Heard by Osterman, N. Y., 0115 to closedown 0130 with news in *English* read by woman; almost buried in QRM from BBC's 9.51 outlet; confirms Pearce's report announcing next *English* for 1115; slogan seems to be "Radio Belgrad, 'The Voice of the People!' "

The 9.505 channel heard in Texas 0000-0015 in foreign language, woman announcer. (Stark)

* * *

Last Minute Tips

At the time this was compiled, I was finding Asiatic DX beginning to open up well here in the East. Several mornings I had been hearing Nanking, 5.985, 9.73; Peiping, 10.260, with good signals around 0500-0700. *Radio Malaya,* 6.025, Kuala Lumpur, was being heard with news and market reports 0630, and Bangkok, 6.010, was heard one Sunday with excellent quality and level during the daily 0615 newscast, signs off 0630.

Hong Kong's ZBW-3, 9.525, is heard 0430; good, clear signal in Australia. (Sanderson) Should carry BBC news relay 0600.

Radio Espana Independiente has been heard in Sweden on a *new* channel of approximately 15.850, afternoons (EST). (Carlberg, Sweden)

Sendergruppe West, Dornbirn, 6.005,

Austria, noted 1420-1450 with popular recordings. (Nordh, Sweden)

For the benefit of SWL's *outside* the USA, the "Voice of America" is now QSL'd by regular-size card; it has blue and red background with white letters, very attractive. (Hubbard, N. C.)

A station heard in Australia on 4.495 from 0500 to 0900 or later may be Korea. (Hutchins, *Radio Australia*)

Radio Saigon, 11.78, will broadcast a special DX program for the Swedish DX Fan Club, England-Sweden, on December 13. (Good, England) Time had not been learned when compiling this copy, but the broadcast most likely will be carried around 0500 EST (1000 GMT) and it is possible that 6.165 also will be used. Definite time and other details will be given well in advance in the DX session from *Radio Sweden* and probably also in the DX program from *Radio Australia.*

Some weeks ago, the Liner *Italia,* about 1,600 miles northeast of New York, was heard passing tickets to Rome for wireless-telephone calls; heard on 17.700 at 1240-1254. (McPheeters, N. Y.)

Balbi, Calif., reports as *new* a station on approximately 6.020 with sign-on around 0630; all-Chinese talk to 0710 sign-off; no music or any particular announcement at either sign-on or sign-off; man sounds like a Russian; signal strong, modulation poor; Balbi is fairly certain this is a U. S. S. R. outlet.

An unidentified station has been heard on 4.450 in Sweden carrying BBC programs around 0800; may be a BBC relay station in the Far East? (Carlberg)

Direct via airmail from Halvorsen, Oslo, Norway, comes this word—"In the near future—I suppose in October or November—the college men in Trondheim will have their special week, *Studenteruka-49.* During the week they will have a transmitter in operation. I cannot yet tell you the frequency they will use, but in 1948 it was in the 41-meter band. They issue a nice, amusing QSL card."

Here are tips received at press time from Dilg, California—Shanghai was heard for a few days on approximately 11.685 mornings, but not more recently, so may have moved up to (former) 11.860 region. India heard opening up strong 1100 on 15.160, announced program would be in Hindustani. North Korea has moved from 4.400 to around 4.500; is in dual with 7.785 mornings. Nanking, 5.985, takes Peiping (North China) program at times—but does *not* carry the *English* at 0830. Peiping now announces frequencies of 9.730 (Nanking), and others, but no longer lists the station on 6.096; they do *not* mention the 9.740 Hankow outlet although that one does take the *English* program from Peiping at 0830; the 9.740 station is in dual with Peiping only part of the time and one day at the close of the *English* relay from Peiping (which ends 0850), the Hankow station played some old American records (including "Red Wing"). An In-

donesian heard mornings on approximately 5.060 may be Makassar, Celebes, but is *not* in dual with the 9.550 Makassar outlet. Bandoeng was heard recently on about 10.070 one morning and what may be Bandoeng was heard also on 11.600 around 0800. Mukden, Manchuria, is still using approximately 5.525 and has a good signal; relays portions of Peiping's New China programs but does *not* take the *English* period 0830.

Leven, Brazil, airmails that *Radio Nacional,* Rio de Janeiro, is now transmitting on a *new* channel of 6.147 at 1130-1500, using the call PRL-9 (formerly—or still?—assigned to the 17.85 outlet). *Radio Tamoio,* Rio de Janeiro, is on 9.61 with ZYC8, scheduled 0500-2200 *daily,* and now is permanently in parallel with m.w. outlet PRB-7, while ZYC9, 15.37, is now parallel all day with m.w. PRC-3, *Radio Tupi,* Rio de Janeiro. *Radio Ministerio da Educacao,* Rio de Janeiro, continues with PRL-4 on a "most unfortunate" frequency of 9.767—the same as OTC-2, Belgian Congo. Leven says "mutual" QRM is terrific. PRL-4 is given with 1 kw. power and is scheduled the same as m.w. PRA-2, 800 kcs.—weekdays 0500-1200, 1300-1400, 1500-2130, Sundays 0800-2130. This is a government-owned station and therefore makes no commercial announcements, a fact highly appreciated at least by the Rio audience because s.w. shouldn't be reaching very many people outside Rio, Leven comments. Programs are of a high cultural nature and standard, and Rio papers always are full of praise for them. Leven comments that it is really most regretable that s.w. transmissions from this outlet are not coming outside Brazil better. Sao Paulo's ZYB-8, 11.765, is transmitting a daily program in Spanish starting at 1200 with news and commentaries about life in Brazil.

Finally, Bellington, N. Y., flashed at press time that *Kol-Yisrael,* Tel-Aviv, Israel, has been moving around, perhaps testing its *new* 7.5 kw. transmitter. Has been heard around 1500 to 1515-1530 sign-off, very strong signal on approximately 11.94. Also has been heard on same channel at 2245 opening, with 6.83, and Haifi, 8.17, both weak, in parallel; later was heard back on 9.000 and *not* on 11.94—but more recently it was heard opening 2245 on about 12.09 to 12.10 with "tremendous" signal compared to reception on other channels it has used. May be testing preparatory to starting the projected beam to North America (to be in English in addition to Hebrew). I hope to have further details on current operations of *Kol-Yisrael* next month.

* * *

Acknowledgment

As the 1949 winter DX season gets under way, reports are beginning to increase. Many thanks, fellows, and keep them coming to 948 Stewartstown Road, Morgantown, West Virginia, U. S. A. New monitors for the *ISW Department* are always welcomed from anywhere in the world. . . . K.R.B.

Servicing P.A. Systems

(*Continued from page 71*)

per-cent or more below normal should be replaced, since the oxide or other emitting element usually deteriorates rapidly from this point. Tests for shorts and leakage should be made according to instructions with the individual tube tester. The most common point of leakage, both constant and intermittent, is from heater to cathode. This very often is the cause of distortion in beam power tubes.

Intermittent operation can be checked by tapping the tube envelope with the fingers or with a small rubber mallet. Tube noise and microphonics may best be determined by this method, with the tubes in the amplifier. Often a short will appear momentarily and then disappear when tapped or when the operating temperature increases. Tubes showing this indication may be responsible for later trouble and a "comeback." Any tube which appears abnormal, even momentarily, should be replaced as a safe measure.

Voltages

All voltage tests should be made with the amplifier in normal operation or as near normal as possible, with all tubes in their sockets. Point-to-point measurements should be made, starting at the tube sockets. For practical purposes, an ordinary 1000 ohms-per-volt meter will serve for plate, screen, and cathode voltage readings. For a.v.c., limiter, inverter, and other critical circuits, however, a vacuum-tube volt-meter must be used.

Resistors

These should be checked for thermal noise, open circuit, and overheating. Carbon resistors sometimes develop high internal noise; wirewound units may short between adjacent turns or become open due to heat expansion. The cause of overheating should be found as quickly as possible. In most cases it is desirable to turn the amplifier off and check for component shorts with an ohmmeter. Resistors with values exceeding the usual ten or twenty per-cent tolerance should be replaced.

Condensers

Electrolytic and paper condensers may be checked with an ohmmeter, condenser bridge, or by the substitution method. The ohmmeter is preferred for locating shorted condensers. For complete tests, the condenser analyzer is recommended. The usual bridge is reasonably priced, simple to operate, and saves time otherwise spent in substitution tests. A simultaneous check can be made for capacity, leakage, intermittents, opens. shorts, and power factor in electrolytics. For accurate tests it is necessary to disconnect only one lead of the condenser to be tested.

Condensers should be checked for noise and intermittents while in the circuit by tapping, probing, or vibrating gently, and should be inspected for open or dried-out containers and evidences of overheating. Coupling condensers and a.v.c. circuits are especially noted for leakage. In replacing these units, be sure to use only the best replacements available.

Interstage and Output Transformers

Windings should be checked with an ohmmeter for opens and shorts. Primary and secondary windings seldom short to each other but often a section of one winding will become shorted internally. Halves of push-pull windings should be checked for balanced readings and replaced if the ohmic values are not reasonably close together. Transformers should be examined for overheating and loose core laminations.

Gain Controls

These seldom give trouble outside of becoming noisy and worn. A noisy control can sometimes be cleaned by removing the back cover, flushing with carbon tetrachloride, and applying a thin film of vaseline to the moving parts. If the control is worn or

RCA's high-level sound system in Philadelphia's Convention Hall.

extremely noisy, replacement obviously is the only solution. Variable controls in the grid circuit usually are between 250,000 ohms and 1 megohm. Values differing radically, unless in cathode bias or special circuits, usually indicate defects or tampering and should be corrected. If in doubt consult the manufacturer's notes or the circuit diagram.

Leads to controls should be kept well away from a.c. and filament leads and shielded to reduce hum pickup from these sources.

Microphones

Crystal microphone troubles usually are limited to de-activated crystals, open cable leads, or paralysis due to rough treatment. Dynamic microphones may have "frozen" or warped diaphrams caused by dropping or rough handling, de-magnetized fields from operating too near high-level a.c. fields, and occasional coupling transformer troubles. Velocity microphones seldom are used in rugged p.a. installations, due to the tendency of ribbons to stick, sag, or "pop," especially in windy or open-air installations.

Tube Sockets, Terminals

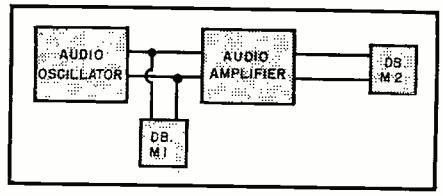
Sockets should be checked for loose prongs, dirty contacts, and evidences of arcing between prongs (especially the rectifier socket). Soldered connections should be examined for high-resistance or cold-soldered joints; wiring should be inspected for breaks and worn insulation; and all a.c. and filament leads must be routed as far away from low-level circuits as possible.

Quality Test, Frequency Response Measurements

After the entire amplifier has been serviced, a final test should be made to determine over-all operating efficiency and frequency response. An audio oscillator (see Fig. 1), with a db. meter or low-range a.c. voltmeter across its output, is connected to the amplifier input. An output meter is connected across the amplifier output transformer, preferably from plate-to-plate. With the gain controls set at normal, the audio oscillator is varied from about 30 cycles to 10,000 cycles and its output level adjusted, if necessary, to maintain a constant reading on the first meter. The amount by which the second meter (at the amplifier output) varies indicates the frequency response of the amplifier system. A typical high-fidelity amplifier will be "flat" to within plus or minus 2 db. over the entire range.

—30—

Fig. 1. Standard setup for measuring amplifier frequency response.



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DEALERS, Servicemen, Hams. Save 50% or more. Buy your TV antennas and accessories direct. Chimney mounts, $1.25 ea. in lots of 12, singles $1.40. Shipping wt. 4 lbs. each. Send for complete catalog. Television Supply Co., Dept. 12-C, P. O. Box 213, Gracie Square Sta., New York, N. Y.

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ALTIMETER. New AVQ-6A (APN-1 modified by RCA for CAA approval). Includes shock mount, antennas, 15-position switch, indicator meter and instruction book. Wt. 25.4 lbs. Price, $25.00. Griffin, 2394 Edgerton, St. Paul 6, Minn.

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ALUMINUM tubing, etc. Complete Beams for Amateurs, TV, FM. Lists free. Willard Radcliff, Fostoria, Ohio.

CONDENSER, Cornell-Dubilier 3 MFD, 600 VDC. #T6060 G, 27c each. Suppressor, Erie Resistor Corp. 90° distributor type, 10,000 ohm $8.50 per 100, $65.00 per 1,000. Machinery Sales Co., 5955 Fitch Road, North Olmsted, Ohio.

"TAB" Guaranteed Tube Bargains! 6J6, 6AK5, 6AG5, ea. 57c; 6C4, 24c; 388A, 40c; 954, 14c; 955, 16c; 1N34 Crystal, 84c; GE-2J1G1 Selsyns used tested pair $1.49; Tuning Meter 5ma, 98c; 30CM/12" UHF Mobile Hamband Antenna AT5/ARR1 39c; 4/$1. Hi-Gain Dynamic Mike Transformer plus excellent Fidelity Dynamic Mike, both $1.49. Write for bargain "Tabogram." "Tab," Dept. 11 RX, 6 Church St., New York, N. Y.

TELEVISION Wiring Diagrams. Ten different sets, $1.00 postpaid. Melpro Co., P. O. Box 40-RN. Bay Ridge Sta., Brooklyn 20, N. Y.

WANTED

WANT to buy BC447, APS-6, ARC-5. Interested in substantial quantity for parts requirements new or used condition acceptable. Harry O. Eyrse. P. O. Box 218, Grand Prairie, Tex.

WE are anxious to secure high grade laboratory electronic equipment. The Overbrook Co., Overbrook, Mass.

RADIO Equipment Factory in Germany wants to buy radio parts & tubes. Also interested in taking licenses, or exchange patents. Willing to accept development for manufacturing single parts & tubes. Write Chiffre: Box 489, c/o Radio & Television News, 185 N. Wabash Ave., Chicago 1, Ill.

WANTED: T47/ART-13 Transmitters, good condition, complete with accessories. Box 490, c/o Radio & Television News, 185 N. Wabash Ave., Chicago 1, Ill.

WILL swap BC-348 or pay cash for new or good used Bendix RA-1 Receiver. W3DL, 1628 Naturo Rd., Towson 4, Md.

HELP WANTED

JOBS in Brasil. Living conditions? Business opportunities? Land grants? Other information? Prompt personal replies. Write airmail: Caixa Postal 628, Fortaleza-Ceara-Brasil enclosing one dollar.

INSTRUCTORS in Electronics and Radio. Prefer former Navy Radio Technician instructors willing to locate in the Detroit, Mich., area. Write to Box 452, c/o Radio & Television News, 185 N. Wabash Ave., Chicago, Ill.

PATENT ATTORNEYS

LANCASTER, Allwine & Rommel. Registered Patent Attorneys. Patent practice before U.S. Patent office. Validity and Infringement investigations and opinions. Booklet and form "Evidence of Conception" forwarded upon request. Suite 414, 815 15th St., N.W. Washington 5, D.C.

HERMAN Lewis Gordon, Registered Patent Attorney. Patent Investigations and Opinions. Warner Building, Washington, D. C.

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RAILWAY Telegraphy needs men. Complete training. Instruments furnished. Positions waiting. Bell Telegraph Railway Institute, 10 Parker Ave., San Francisco 18, Calif.

USED Correspondence Courses and Educational Books bought, sold, rented, catalog free. Educational Exchange, Summerville, Ga.

AMATEUR radio licenses. Complete code and theory preparation for passing amateur radio examinations. Home study courses. American Radio Institute, 101 West 63rd St., New York 23, N. Y.

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FINE radio television business. Large territory. Dealership of top television lines. Must move family to Arizona. Vernon Koenig, 4327 N. 62nd St., Lincoln, Nebr.

QSLs, SWLs. Samples free. WIHJI, Box 32-C, Manchester, N. H.

15 TESTED one-tube circuits, including "Radio-builder," catalog—25c. Laboratories, 578-H, San Carlos, Calif.

SWL-QSL cards, 100 for $1.50, beams receivers, transmitters. Royal Radio Supply, 1920 N. 27th St., Milwaukee, Wis.

ELECTRIC Testing made easy. All purpose electric tester, 50c postpaid. HaHco, 1758 Hillview Rd., Cleveland, Ohio.

PHONOGRAPH Records, 15c. Catalogue free. Paramount. VE-313 East Market, Wilkes-Barre, Pa.

TECHNICAL Report No. 101. Practical Transformer Design, Construction and Repairing How to do it yourself, $2.00 postpaid. Conrad Roeschke, Buckhorn, New Mex.

EMBOSSED Business Cards 1,000, $3.45 postpaid. Spada Enterprises, 10D Lexington, Wethersfield 9, Conn

2- YEARS of experience Radio Repairing Simplified system. No calculations. No formulas. Total price $2.00 postpaid or C.O.D. Moneyback guarantee. Ross Radio, 14615 Grandriver, Detroit 27, Mich.

QSL and SWL cards printed. W5FAY, 6118 Goliad, Dallas, Tex.

BUILD your own Geiger Counter. Save money! Write for free parts list and diagram. Woodwid Industries, 5217-F Hollywood Blvd., Hollywood 27, Calif.

RIDER'S Manuals. Abridged Volume I-V; complete Volumes VI-XIV; master index. Excellent condition. $105.00. James E. Dunning, 1005 Jamestown Crescent, Norfolk, Va.

RADIOMEN. Servicemen, Beginners. Make more money, easily, quickly. $250 weekly possible. We show you how. Information free. Merit Products, 216-32R 132 Ave., Springfield Gardens 13, N. Y.

ERRATUM

In the September issue, on Page 68, the director length given in Table 1 for Channel 7 should read 2'6¾" instead of 4'6¾".

* * *

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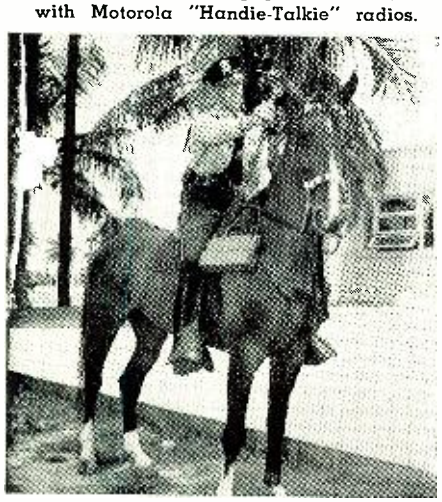
The first radio-equipped horse in the country, ridden by a Miami patrolman. Miami police plan to equip thirteen horses with Motorola "Handie-Talkie" radios.



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NOVEMBER 1949

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TOGGLE AND PUSH SWITCHES

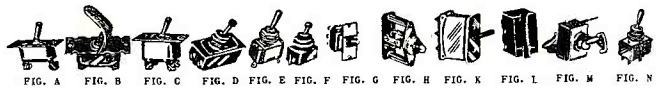


FIG. A FIG. B FIG. C FIG. D FIG. E FIG. F FIG. G FIG. H FIG. K FIG. L FIG. M FIG. N

STOCK NUMBER	FIG.	CONTACT	CONTACT ARRANGEMENT	MANUFACTURER & NUMBER	TYPE LEVER	MOUNTING DATA	UNIT PRICE
370-1	A	5a - 125v.	SPST MOMENTARY	CH AN-3022-6B	BAT ⅝	1-13/16 MTG/C.	$0.25
370-6	A	5a - 125v	SPDT CENTER OFF	CH B-9A	BAT ⅝	1-13/16 MTG/C.	.35
370-14	A	5a - 125v	SPDT CEN. OFF 1 SIDE MOM.	CH B-7A	BAT ⅝	1-13/16 MTG/C.	.30
370-25	A	5a - 125v	SPST MOMENTARY	CH B-6B	BAT ⅝	1-13/16 MTG/C.	.25
LT-108	A	5a - 125v	SPDT CENTER OFF	CH AN-3022-1B	BAT ⅝	1-13/16 MTG/C.	.38
LT-102	A	5a - 125v	SPDT MOMENTARY	CH 8215K2	BAT ⅝	1-13/16 MTG/C.	.30
LT-103	A	5a - 125v	SPST	CH B-5 A	BAT ⅝	1-13/16 MTG/C.	.35
LT-104	A	20a - 24v	SPST 1 SIDE MOMENTARY	CH 8905K568	BAT ⅝	1-13/16 MTG/C.	.35
LT-109	B	5a - 125V	SPST MOMENTARY	CH B-19	BAT w/ARM	1-13/16 MTG/C.	.35
309-65	C	20a - 125v	DPST	CH AN-3023-2	BAT	1-13/16 MTG/C.	.45
309-163	C	20a - 125v	DPDT CEN. OFF MOMENTARY	CH C-11	BAT ⅝	1-13/16 MTG/C.	.55
309-162	C	30a - 125v	DPST	CH C-1	BAT ⅝	1-13/16 MTG/C.	.45
309-164	C	20a - 125v	DPST MOMENTARY	CH 8711K3	BAT	1-13/16 MTG/C.	.40
370-31	C	20a - 125v	DPDT	CH C-1B	BAT ⅝	1-13/16 MTG/C.	.55
305-87	D	5a - 125v	1 SIDE DPST MOM 1 SIDE SPST	AH&H	BALL	8-32 BUSHING	.95
305-111	E	5a - 125v	SPST MOMENTARY	CH 8817K2	BAT	7/16-32 BUSHING	.28
305-153	E	5a - 125v	SPDT CENTER OFF	CH AN-3021-1B	BAT ⅝	7/16-32 BUSHING	.35
LT-100	F	3a - 250v	SPST	CH	BAT	7/16-32 BUSHING	.22
LT-101	F	6a - 125v	SPST MOMENTARY	AH&H w/LEADS	BALL	7/16-32 BUSHING	.20
301-51	G	5a - 125v	4PDT MOMENTARY	CH 8905K14	BAT ⅝	1-13/16 MTG/C.	.75
LT-108	G	20a - 125V	3PDT	CH 8744K5	BAT	1⅛ x ⅞ MTG/C.	.69
305-140	H	3a - 125v	DI NO MAKE EACH SIDE	OPEN FRAME	BALL	3/8-30 BUSHING	.25
309-161	K	50a - 125v	SPST	CH 8781K3	BAT ⅝	1-13/16 MTG/C.	1.95
301-1	L	20a - 125v	DPST	AH&H	BAKELITE	2-3/8 MTG/C.	1.25
305-76	L	30a - 250v	DPST	AH&H OPEN FRAME	BAKELITE	3-1/4 MTG/C.	.75
301-12	M	5a - 125v	DPST	AH&H SPECIAL FOR	HANDY TALKIE	7/16-32 BUSHING	.40
LT-107	N	3a - 250V	DPST	AH&H	SHORT BAT	7/16-32 BUSHING	.25

⅝ INDICATES A LUMINISCENT TIP

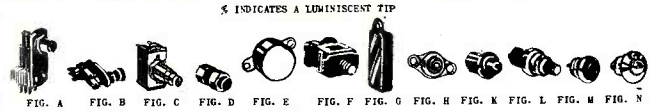


FIG. A FIG. B FIG. C FIG. D FIG. E FIG. F FIG. G FIG. H FIG. K FIG. L FIG. M FIG. N

STOCK NUMBER	FIG.	CONTACTS	MOUNTING DATA	BUSHING LENGTH	KNOB	ADDITIONAL INFORMATION	UNIT PRICE
301-39	A	N.O.	3/8-32 THD.	3/16	BLACK BAKELITE	USED ON SCR-300	$0.15
303-68	A	SPDT	3/8-32 THD.	3/8	BLACK BAKELITE		.25
303-75	A	3 MAKE	3/8-32 THD.	3/8	RED OR GREEN PLASTIC		.35
303-77	B	N.O.	3/8-32 THD.	3/8	BLACK BAKELITE		.25
305-163	B	DPDT	3/8-32 THD.	3/8	BLACK BAKELITE		.37
303-70	C	DPST N.C.	7/16-32 THD.	1/2	METAL		.25
370-13	C	N.O.	7/16-32 THD.	7/16	METAL w/ PLASTIC TIP		.25
LP-101	C	N.O.	7/16-32 THD.	1/2	METAL	GENERAL ELECTRIC	.25
LP-102	C	DPST N.C.	7/16-32 THD.	1/2	METAL	AH&H	.25
LP-103	C	N.O.	7/16-32 THD.	1/2	METAL	CUTLER HAMMER	.30
309-135	D	N.O.	END OF CORD		BLACK BAKELITE	MARKED SA-26/U	.99
370-35	E	N.O.	1-7/16 MTG/C.		METAL CAP	SIGNAL CORPS SW-180	.25
309-166	E	2 MAKE	5/8 MTG/C.		BLACK BAKELITE	SW-109 FOR T-17 MIKE	.35
370-7	F	N.O.				CH #8911K509	.50
311-77	G	2 N.O.	END OF CORD		BLACK BAKELITE	SIGNAL CORPS SW-141-G	.30
370-26	H	N.O.	1-1/8 MTG/C.		BLACK BAKELITE		.25
309-99	K	N.O.	5/8" PRESS FIT		BLACK BAKELITE		.25
370-21	K	N.O.	3/4" PRESS FIT		WHITE PLASTIC	3 SCREW TERMINALS	.35
301-40	L	N.C.	7/16-32 THD.	7/16	BLACK BAKELITE		.35
303-69	L	N.C.	7/16-32 THD.	1/2	BLACK BAKELITE		.25
301-94	M	N.O.	5/8-28 THD.	1/4	BLACK BAKELITE		.18
370-37	M	N.O.	5/8-28 THD.	1/4	WHITE BAKELITE		.25
303-35	M	N.O.	5/8-28 THD.	1/4	BLACK BAKELITE		.15
370-39	N	SPST N.O.	5/8 PRESS FIT		CHROME		.30
305-139	~	3 N.O. & 3 N.C.	15/32-32 THD.	1/2	BLACK BAKELITE	ASSEMBLY OF 3 SWITCHETTES	.89
370-3	~	N.O.	1" CABLE CLAMP		GREEN ENAMELED	WITH 3 CONDUCTOR CABLE	.35
370-40	~	N.O.	1-13/16 MTG/C.		METAL	SIMILAR TO MICRO SWITCH	.89

Micro Switches

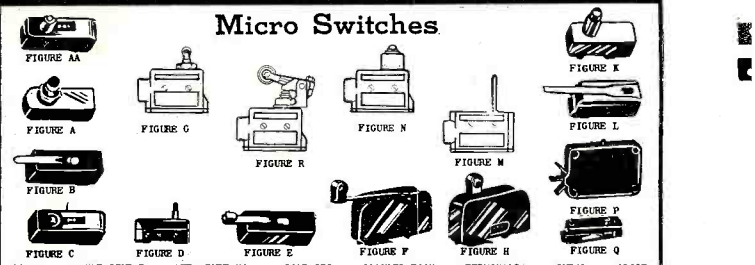
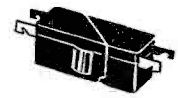


FIGURE AA FIGURE K FIGURE A FIGURE G FIGURE N FIGURE L FIGURE R FIGURE M FIGURE B FIGURE P FIGURE C FIGURE D FIGURE E FIGURE F FIGURE H FIGURE Q

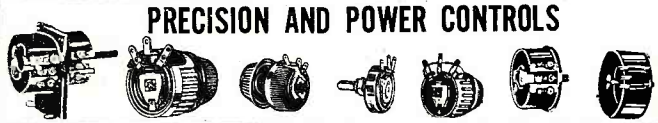
STOCK NUMBER	MANUFACTURER	MFR. TYPE NO.	CONTACTS	ILLUSTRATION	TERMINALS	OUTER CASE	PRICE EACH
305-10	Microswitch	WP9M5	N.C.	FIG. AA	SCREW	Bakelite	$0.40
307-210	"	YP3A	N.O.	FIG. AA	"	"	.50
306-75	"	YZ-RQ1	N.O.	FIG. A	SOLDER	"	.92
303-67	"	YZ7RA6	N.O.	FIG. A	SCREW	"	.71
1-1001	"	B-8T	SPDT	FIG. B	SOLDER	"	.65
301-46	MC-Switch	MIB-321	SPDT	FIG. B	"	"	.85
301-83	Microswitch	YZ-2YITC1	SPDT	FIG. B	"	"	1.01
301-89	MC-Switch	BQ2W	SPDT	FIG. B	"	"	.95
301-78	"	Green Dot	DPST	FIG. B	"	"	.75
303-79	Microswitch	BZ-RL32	SPDT	FIG. B	"	"	.75
305-154	Acro	3D4-5L	SPDT	FIG. B	"	"	.78
311-115	Microswitch	YZ231	N.C.	FIG. C	SCREW	"	.71
305-161	"	YZ3R3	N.O.	FIG. C	SOLDER	"	.71
311-123	"	WZ-7R	N.C.	FIG. C	"	"	.60
370-24	"	YZ-R31	N.O.	FIG. C	SCREW	"	.60
370-6	"	X757	N.C.	FIG. C	SOLDER	"	.45
369-1	"	YZRTC	N.C.	FIG. C	"	"	.55
311-116	"	SW-186	N.C.	FIG. D	"	"	.69
303-49	"	YZ21ST	DPST	FIG. D	SCREW	"	.68
309-93	"	BRS36	SPDT	FIG. D	"	"	.69
370-17	MC-Switch	QRS	DPST	FIG. D	SOLDER	"	.75
305-84	Microswitch	WZ8L2	N.C.	FIG. E	"	"	.65
305-82	"	R-RL2	N.C.	FIG. E	"	"	.65
311-25	MC-Switch	CTN24155	N.C.	FIG. E	"	"	.85
370-10	Acro	RQ2W12T	N.O.	FIG. E	SCREW	"	.70
303-32	Microswitch	YZ-3R42T	N.O.	FIG. F	"	"	.85
306-10	"	BZE-2RQ9TM1	SPDT	FIG. G	"	Metal	2.48
309-101	"	BZ-2FW221	SPDT	FIG. H	SOLDER	Bakelite	.95
1706-1010	Acro	3D7-R5W9	N.O.	FIG. K	SCREW	"	.55
370-18	"	HR071P2TSF1	N.O.	FIG. K	"	"	.60
370-19	Microswitch	YZRQ41	N.O.	FIG. K	"	"	.65
370-40	Cutler Hammer	"	N.O.	FIG. K	"	"	.75
303-31	Microswitch	BZ-2RWTC	SPDT	FIG. L	SOLDER	"	.95
370-8	"	RN-11-H03	SPDT	FIG. M	Screw	Metal	1.50
306-157	MC-Switch	"	N.C.	FIG. N	"	"	1.15
370-15	"	AHB203	SPDT	FIG. N	"	"	1.25
370-7	Microswitch	WZE-7RQTS	N.C.	FIG. N	"	"	1.35
305-11	Acro	2W031A	N.O.	FIG. P	SOLDER	Bakelite	.37
305-71	"	2WD41A	SPDT	FIG. P	"	"	.35
305-50	Microswitch	Open Type	SPDT	FIG. Q	"	"	.35
370-28	"	YZE-RQ22	N.O.	FIG. R	SCREW	Metal	2.75

SWITCHETTE



STOCK NO.	MANUFACTURER'S TYPE NUMBER	CONTACTS		TERMINAL LOCATION	UNIT PRICE
303-20	CR1070C103-A3	N.C.		SIDE	$0.47
301-29	CR1070C103-B3	N.O.		END	.47
303-24	CR1070C103-C3	1-N.O.	1-N.C.	END	.47
303-18	CR1070C103-F3	1-N.O.	1-N.C.	SIDE	.47
303-19	CR1070C103-E3	N.O.		SIDE	.47
303-43	CR1070C123-B3	N.O.		END	.47
303-23	CR1070C123-C3	1-N.O.	1-N.C.	END	.47
305-83	CR1070C123-J2	SPDT		END	.47
303-22	CR1070C123-J4	SPDT		END	.47
303-17	CR1070C124-M4	SPDT		SIDE	.47
303-16	CR1070C128-C3	1-N.O.	1-N.C.	END	.47

PRECISION AND POWER CONTROLS



STOCK NO.	RES. OHMS	WATTS	BODY DIA.	SHAFT LGTH.	MFR.	GENERAL DESCRIPTION	PRICE
321-151	200	6	3"	4"	De Jur.	Meter type, precision.	$1.25
400-1	10W-dual	6	3"	1¾"	De Jur.	Meter type, with mtg. bkt.	3.00
301-90	20W	6	3"	¾"	De Jur.	Meter type.	1.25
321-142	5	25	1-9/16"	SD Slot.	Ohmite.	Type H, lock type bushing.	0.94
RH-25	6	25	1-9/16"	SD. Slot.	Ohmite.	Type H.	0.94
321-150	8	25	1-9/16"	¼"	Ohmite.	Type H.	0.94
321-149	10	25	1-9/16"	¾"	Ohmite.	Type H.	0.94
321-124	50	25	1-9/16"	SD Slot.	Ohmite	Type H, lock type bushing.	0.94
RH-26	60	25	1-9/16"	SD. Slot.	Ohmite.	Type H, lock type bushing.	0.94
345-6	75	25	1-9/16"	7/16"	Ohmite.	Type H.	0.94
321-153	100	25	1⅛"	¼"	Ohmite.	Aircraft, AN 3155-25-100	0.96
321-152	100	25	1-9/16"	SD. Slot.	Har.Hin.	Type K25	0.96
353-112	125	25	1-9/16"	7/16"	Ohmite.	Type H.	0.96
353-111	125	25	1-9/16"	7/16"	Ohmite.	Type H.	0.96
321-160	100	25	1-9/16"	SD. Slot.	Ohmite.	Type H.	0.96
313-74	140	25	1-7/8"	7/16"	Ohmite.	Cockpit lamp type.	0.96
400-2	145	25	1-3/4"	7/16"	Grimes.	Cockpit lamp type.	0.96
321-137	150	25	1-5/8"	7/16"	Clarostat		0.96
315-42	175	25	1-9/16"	SD. Slot.	Ohmite.	Type H.	0.96
305-146	175	25	1-9/16"	SD.Slot.	Har. Hin.	Type K25	0.96
321-164	175	25	1-9/16"	7/16"	Ward L.		0.96
RH-27	200	25	1-5/8"	7/16"	Ward L.		0.96
313-72	200	25	1-3/4"	7/16"	Ohmite.	Type D.	0.96
321-141	350	25	1-9/16"	5/16"	Har-Hin.	Type K25.	0.96
321-165	750	25	1-9/16"	7/16"	Ohmite.	Type H.	0.98
321-143	5M	25	1-9/16"	SD. Slot.	Ohmite.	Type H.	1.10
RH-28	10M	25	5-3/8"	1/2"	Muter.	Type 433AC, Linear.	1.14
321-162	5	50	2-1/2"	7/16"	Ohmite.	Aircraft AN-3155-50-5	1.08
315-43	30	50	2-1/2"	7/16"	Ohmite.	Type 03A-Aircraft Enclosed.	1.08
309-123	50	50	2-3/4"	7/16"	Ohmite.	Aircraft Power Type.	1.08
321-134	125	50	2-1/2"	S.D.Slot.	Har-Hin.	Type B50, .630 Amps.	1.10
313-73	150	50	2-1/2"	7/16"	Ohmite.	Aircraft, Type AN-3155-50-150	1.10
353.110	150	50	2-1/2"	S.D.Slot.	Har-Hin.	Type B50, 577 Amps.	1.10
321-91	200	50	2-1/2"	7/16"	Ohmite.	Aircraft Type AN-3155-50-200	1.10
313-71	200	50	2-1/2"	SD.Slot.	Har-Hin.	Type B50	1.10
309.121	500	50	2-1/2"	SD.Slot.	Har-Hin.	Type B50	1.12
321.122	500	50	2-1/2"	SD.Slot.	Har-Hin.	Type B50	1.12
309.123	5	100	3"	1/2"	Har-Hin.	Type C100	1.68
309.120	5	100	3"	7/16"	Ohmite.	Type 1.47 Amp.	1.68
353.113	100	100	3"	1/2"	Har-Hin.	Type C100, 1 Amp.	1.75
400-3	10	100	3"	1/2"	Har-Hin.	Type C100, 3.16 Amp.	1.68
321-153	1.5	150	4"	1/2"	Har-Hin.	Type D150, 10 Amp.	2.35
311-108	6	150	4"	7/16"	Ohmite.	Type L, 5.48 Amps.	2.35
321-155	750	150	4"	1/2"	Har-Hin.	Type D150, .447 Amp.	2.75
309.122	2250	150	4"	7/16"	Ohmite.	Type L, .25 Amp.	2.95

WE ARE LISTING ABOVE OUR MOST POPULAR WIRE WOUND METER CONTROLS AND RHEOSTATS PRODUCED BY LEADING MANUFACTURERS SUCH AS OHMITE, WARD LEONARD, CLAROSTAT, ETC. PLEASE WIRE OR WRITE FOR QUANTITY DISCOUNTS.

ADJUSTABLE WIRE WOUND RESISTORS

OHMS RES.	WATTS	TYPE	MFR.	PRICE EACH
2.	50.	Lugs		19¢
2.	20.	Lugs	Utah	19¢
2.75	150.	Lugs	Utah	55¢
3.	10.	Leads	-	13¢
5.	100.	Lugs		50¢
10.	25.	Lugs	Mallory	22¢
10.	20.	Lugs	-	19¢
15.	20.	Lugs	Mallory	19¢
15.	33.	Lugs	Ward-L.	21¢
20.	200.	Lugs	Ohmite	82¢
25.	50.	Lugs	Ohmite	33¢
50.	10	Lugs	Ohmite	15¢
50.	20.	Lugs	Clarostat	19¢

OHMS RES.	WATTS	TYPE	MFR.	PRICE EACH
75.	20.	Lugs	Ward L.	19¢
100.	10.	Leads	Ohmite	17¢
110.	45.	Lugs	Mallory	24¢
200.	10.	Lugs	Ohmite	17¢
225.	50.	Lugs	Mallory	35¢
350.	20.	Lugs	IRC	20¢
750.	25.	Lugs	Utah	23¢
2500.	100.	Lugs	Lectrohm	63¢
2500.	25.	Lugs	-	24¢
5M.	200.	Lugs	Clarostat	92¢
7500.	50.	Lugs	-	50¢
25M.	50.	Lugs	-	56¢
400.	20.	Lugs	Ohmite	20¢

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1N21 Xtal Diode	.65	VT-158	9.85	717A	.90	724B	3.95
1N21B Xtal Diode	.80	6SJ7/GT	.65	VG-172	29.50	721A	4.25
1N23 Xtal Diode	.80	6SK7/GT	.65	203B	1.95	725A	4.25
1N23A Xtal Diode	.85	6SL7/GT	.65	211 (VT-4-C)	.65	724B	4.25
1N27 Xtal Diode	.85	6SN7/GT	.80	215A	1.95	725A	19.95
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1T4	.95	7C7	.65	307A	4.25	803	6.95
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2C26A	.45	7F7	.75	350B	2.55	805	5.45
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2J31	9.95	12A6	.25	450TH	19.95	814	3.75
2J32	14.85	12K8	.65	GL-471A	2.75	815	2.85
2J33	19.95	12SF7	.70	527	11.25	826	.49
2J37	13.85	12SH7	.40	WL-530	17.50	829	3.25
2J38	12.95	12SK7	.60	WL-531	17.50	830B	3.95
2J48	14.95	12SL7/GT	.70	532A/1B32	3.55	857	1.75
2X2/879	.65	12SR7	.40	GL-559	3.75	838	3.25
3A4	.35	12z825 2 amp.		KU-610	7.45	841	.55
3A5	1.05	Tungar	2.25	HY-615	1.20	843	.55
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3B22	2.95	15R	1.40	700C	9.95	WL-860	2.55
3B24	1.75	FG-17	2.85	700D	9.95	861	32.50
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3CP1-S1	1.95	23D4 Ballast	.45	703A	4.85	865	2.55
3C24/24G	.47	2526/GT	.55	705A	2.65	866A	1.30
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REL-5	17.95	39-44	.35				
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5BP1 CRT	2.95	46	.80				
5CP1 CRT	3.85	EF50-VT2C0	1.10				
5GP1 CRT	6.55	CEQ 72	1.10				
5J23	14.25	72-3B24	1.75				
5J29	14.25	VR-75	.90				
5Y3G	.40	VR-78	.65				
6A8	.90	80	.45				
6AB7	.95	FG-81-A	3.95				
6AC7	.90	83	.85				
6AK6	.80	83V	.95				
6B7	.65	89Y	.40				
6BE6	.65	VR-90	.70				
6C4	.45	VR-92	.65				
6C5	.75	100R	3.25				
6C21	19.75	VR-90	.70				
6D6	.60	VR-92	.65				
6E5	.70	FG-105	9.95				
6H6	.50	VR-105	.85				
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6N7/GT	.80	VT-127 English	.25				
6R7G	.80						

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PK715B	7.95						
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955	.55						
956	.55						
957	.55						
991 (NE-16)	.30						
1005	.60						
1148	.40						
1201	.75						
1616	1.25						
1619	.55						
1624	1.25						
1625	.45						
1626	.45						
1629	.45						
1635	.95						
2051	.35						
7193	.35						
8011	2.55						
8012	4.25						
8020	3.35						
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9001	.70						
9002	.45						
9003	.65						
9004	.45						
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NE-16	.24
NE-20	.24
NE-21	.24
NE-48	.24
NE-51	.06

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Stock No.	Mazda No.	Volts	Watts	Bulb	Base	Price Bulb
330-40	44	6	.24	T-3¼	Min. Bay	.18
330-51	47	12-16	1.5CP	G-4½	Min. Bay	.18
330-52	1445	12	6	G-6	Cand. Scr.	.13
330-53	1445	12	2 amp.	G-6½	Min. Scr.	.27
330-54	51	28	.06	T-3¼	Min. Bay	.18
330-55	268	120	3	S-6	Can. Bay	.11
344-29	PR-19	6	3 amp.	B-3½	Min. Flang	.28
330-59	Bulb	120	500W	T-20	Med. Pf	1.45
330-60		24	.333 A	T-3¼	Min. Bay	.18
330-61		110	1	C-7	Cand. Scr.	.17
330-62A	52	10-16V	1½	T-3¼	Min. Bay	.27
330-100A	Airplane Headlight	24V	23W	A-19	Med. Pf	.28
330-101	333	3	(Aircraft)	T-3¼	Min. Bay	.18
330-101A	LM-40	115V	200W	T-20	Med. Pf	.42
330-102	1155	12-16	.50 CP	BP-11	DC Bay	.34
330-102A	CC-18	110V	10W	T-3	DC Bay	.34
330-102B	1691	2.4	.3 Amp		DC Bay	.34
330-102C	1493	24	(Airplane type)		DC Bay	.34
330-104	313	28	.17 amp.	T-3¼	Min. Bay	.11
330-105	1819	125	25A		Min. Bay	.34
330-106	12A	12	24-11	T-2	Tel. Base	.18
330-107	24-42 WZ	24	25-105	T-2	Tel. Base	.18
330-109	8-14 Argon	105	25w Watt		Med. Scr.	.27
330-110	Telephone Type	5	5 Watt	T-2		.17
330-113	1477	24	1	T-3	Min. Scr.	.18

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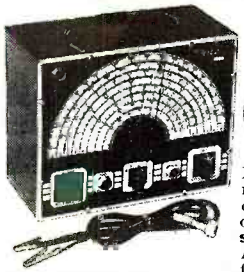

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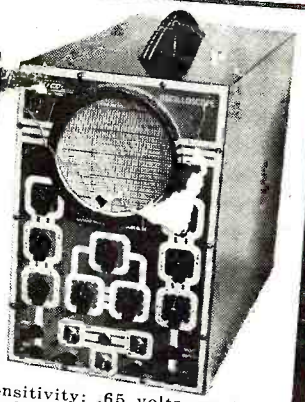

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