RADIO & TELEVISION NEWS

MARCH
1952
35¢
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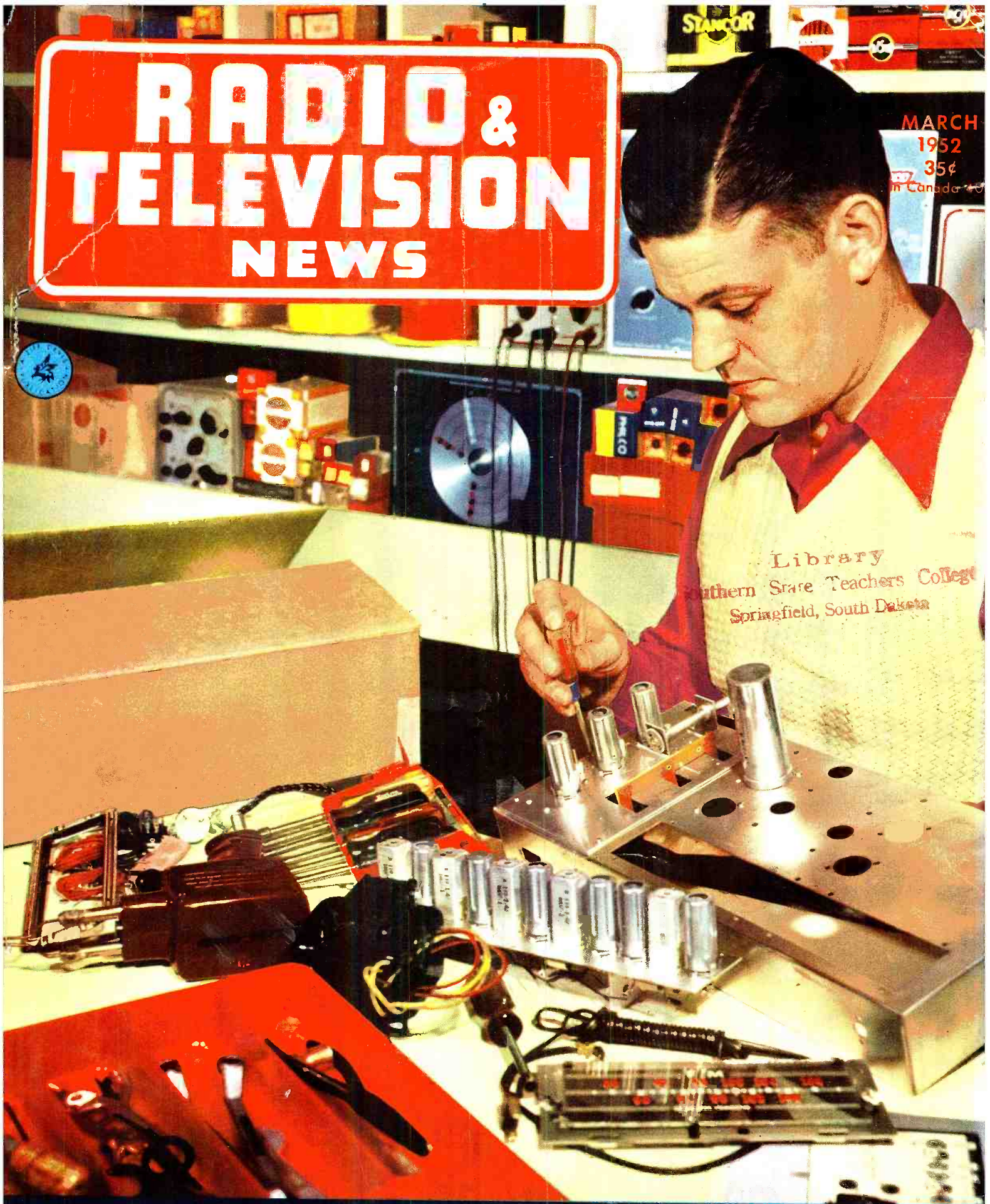
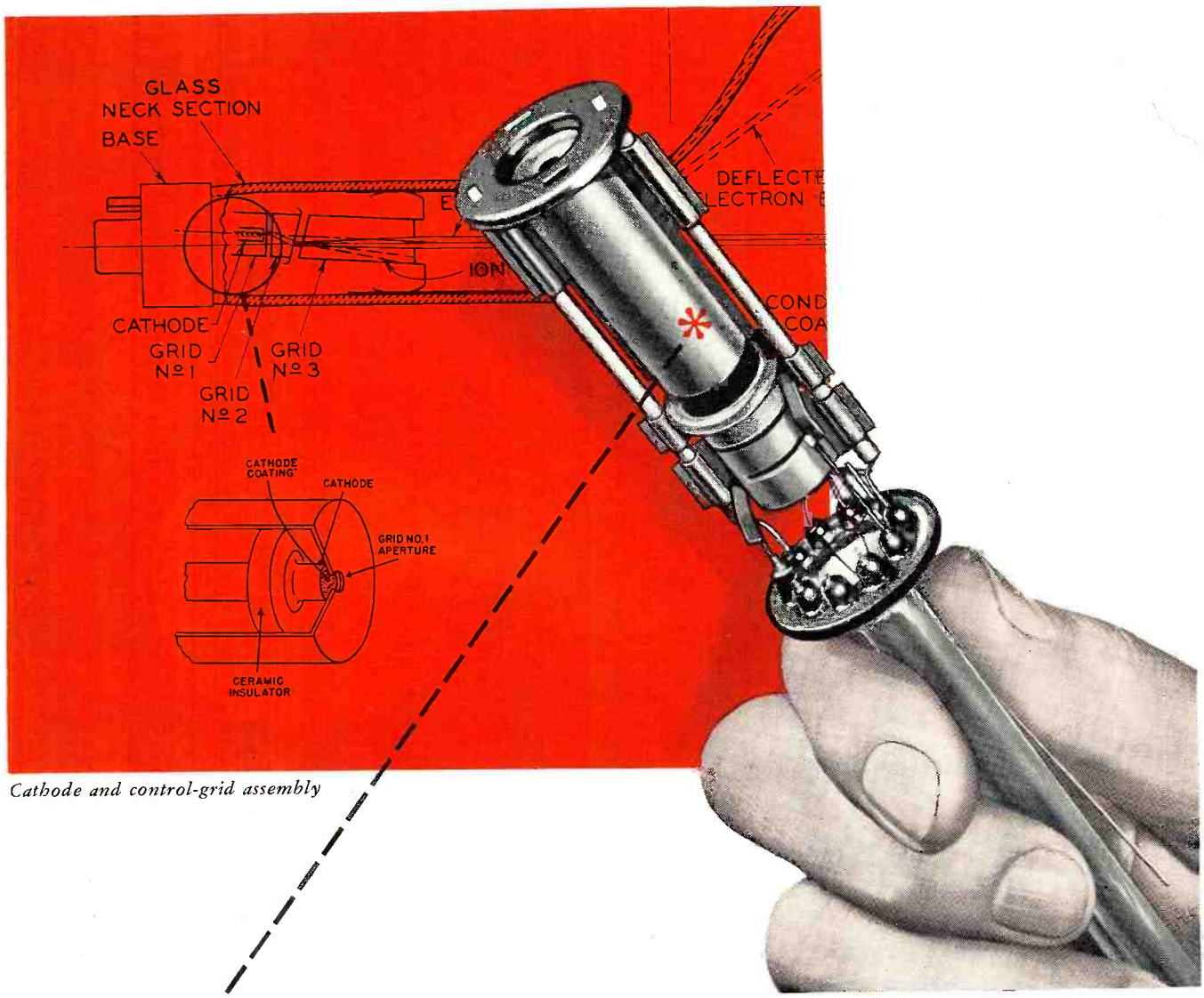


PRE-FABRICATED AM-FM TUNERS

SEE PAGE 52

A MIDGET V. F. O. ★ ★ AUDIO SIMPLIFIED



Cathode and control-grid assembly

The gun that looked 100% "perfect"

. . . yet never "fired a shot"

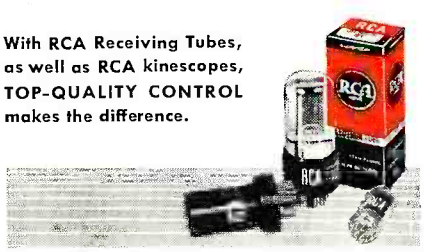
The electron gun you see looks perfect, but actually it "never fired a shot." You see, RCA rejected it because the spacing between grid No. 1 and the cathode was out of bounds. Only a 0.001" departure from the design value for this spacing is sufficient cause for gun rejections in RCA factories.

Why does RCA prescribe such a close tolerance? Simply because RCA engineers have found that if the cathode-to-grid spacing is too small, or too large, the grid would have faulty "control." Such tubes, when installed in TV receivers, may be the cause of poor picture performance, and may result in troublesome and time-consuming service problems and call-backs.

RCA takes no chances with its reputation for quality. You get the benefit of RCA's quality reputation when you use RCA tubes. Constant vigilance and *quality control* at *all* stages of manufacture assure meeting RCA standards on the final production line. That's why RCA picture tubes are unmatched for reliability and uniformity.

In RCA picture tubes, the difference is *top-quality* control. That's why, dollar for dollar, RCA picture tubes have no equal.

With RCA Receiving Tubes, as well as RCA kinescopes, TOP-QUALITY CONTROL makes the difference.



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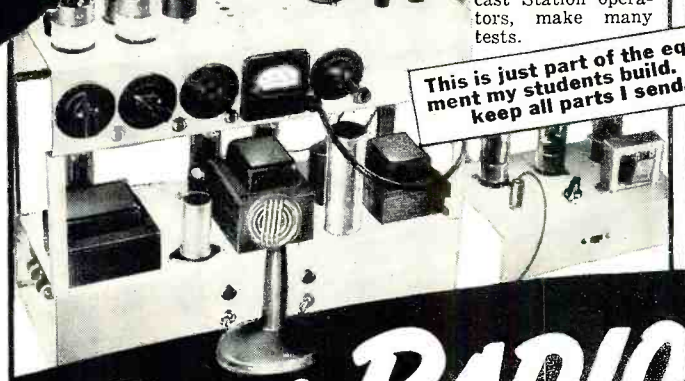
ELECTRON TUBES — **HARRISON, N. J.**

...actice COMMUNICATIONS

... parts to build ...nsmitter

As part of my Communications Course you build this low power broadcasting transmitter, learn how to put a station "on the air," perform procedures demanded of Broadcast Station operators, make many tests.

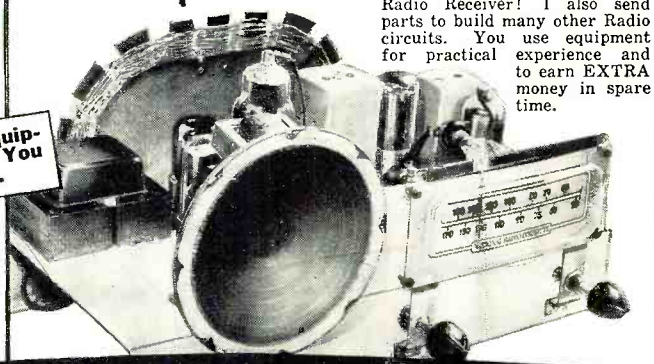


This is just part of the equipment my students build. You keep all parts I send.

You Practice Radio SERVICING

on this modern radio you build with parts I send

As part of my Servicing Course, I send you the speaker, tubes, chassis, transformer, loop antenna, EVERYTHING you need to build this modern, powerful Radio Receiver! I also send parts to build many other Radio circuits. You use equipment for practical experience and to earn EXTRA money in spare time.



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NOW! Advanced Television Practice

New, special TV kits furnished to build high-definition SCOPE . . . RF OSCILLATOR with flyback power supply . . . complete TV set . . . many other units. You see pulse, trapezoidal, saw-tooth wave forms. Get valuable PRACTICAL EXPERIENCE locating and correcting TV troubles. Mail coupon for facts, pictures and prices!

Learn Servicing or Communications Practice at Home in Spare Time

J. E. SMITH, President
National Radio Institute

Do you want good pay, a job with a bright future and security? Would you like to have a profitable shop or store of your own? If so, find out how you can realize your ambition in the fast growing, prosperous RADIO-TELEVISION industry. Even without Television, the industry is bigger than ever before. 90 million home and auto Radios, 3100 Broadcasting Stations, expanding use of Aviation and Police Radio, Micro-wave Relay, Two-way Radio for buses, taxis, etc., are making opportunities for Servicing and Communications Technicians and FCC-Licensed Operators.

Television is TODAY'S Good Job Maker

In 1950, over 5,000,000 TV sets sold. By 1954, 25,000,000 TV sets estimated. Over 100 TV Stations now operating. Authorities predict 1,000 TV Stations. This means more jobs, good pay for qualified men all over the United States and Canada.

Many Make $10 Extra a Week in Spare Time

Keep your job while training. Hundreds of successful RADIO-TELEVISION TECHNICIANS I trained had no previous experience, some only a grammar school education. Learn Radio-Television principles from illustrated lessons. Get PRACTICAL EXPERIENCE—build valuable multitester—experiment with circuits common to Radio and Television. Keep all equipment. Many students make $5, $10 extra a week fixing neighbors' Radios in spare time. SPECIAL BOOKLETS start teaching you the day you enroll.

Send Now For 2 Books FREE—Mail Coupon

Send now for my FREE DOUBLE OFFER. You get actual Servicing lesson to show you how you learn at home. Also my 64-page book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning; see equipment you practice with at home. Send coupon in envelope or paste on postal. J. E. SMITH, President, Dept. 2CE, National Radio Institute, Washington 9, D. C. Our 39th Year.

I TRAINED THESE MEN

"I have been operating my own Servicing business. In two years I did $14,000 worth of business; net profit $6,850. Have one full time employee, an NRI student."—PHILLIP G. BROGAN, Louisville, Ky.

"Four years ago, I was a bookkeeper, with a hand-to-mouth salary. Now I am a Radio Engineer with a key station of the American Broadcasting Company network."—NORMAN H. WARD, Ridgefield Park, New Jersey.

"When halfway through the NRI course, I made $5 to $8 a week fixing sets in my spare time. Am now selling and installing Television sets and antennas."—E. J. STREITENBERGER, New Boston, O.

"My first job was operator with KDLR, obtained for me by your Graduate Service Dept. I am now Chief Engineer of Police Radio Station WQOX. I never hesitate to endorse NRI."—T. S. NORTON, Hamilton, Ohio.

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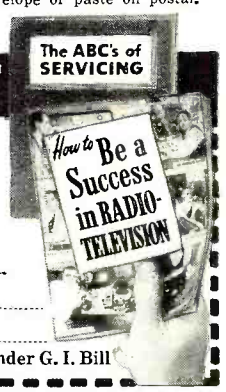

COVER PHOTO: Assembling a Collins "Pre-Fab" unit. Pre-punched chassis and pre-assembled circuits simplify the construction, particularly for the beginner.
(Ansco color photo by R. E. Collins)

First in radio-television-electronics
Average Paid Circulation over 200,000

RADIO TELEVISION NEWS
Reg.

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CONTENTS MARCH, 1952

Radio Control on the Citizens Band.....*Vernon C. MacNabb* 35
The Loudness Control—An Aid to Higher Fidelity.....*Ron Pickett* 38
Selling Maintenance—And Yourself.....*Yvon O. Johnson* 40
Problems of Indoor Antenna Reception.....*E. M. Noll & M. Mandl* 42
A Midget V.F.O. .....*W. W. Purvis, W3QQA* 43
The Electronic Brain "Codetyper".....*Nathaniel G. A. Dorfman* 46
Corner Loudspeaker Enclosure.....*Richard H. Dorf* 48
A Low-Cost Audio Amplifier.....*Frederic T. C. Brewer* 50
"Pre-Fab" Tuners .....*W. H. Collins* 52
150-Watt Universal R.F. Amplifier.....*John F. Clemens, W9ERN* 53
Crystal Diodes in Modern Electronics (Part 6).....*David T. Armstrong* 56
High Quality 50-Watt Amplifier.....*James Baumgardner* 58
Electrostatic Focus for Picture Tubes.....*Walter H. Buchsbaum* 62
Interlacing Troubles and Vertical Sync Circuits.....*John K. Frieborn* 64
A Dual-Channel AM Receiver.....*Glen Southworth* 66
Saturable Reactors .....*Erwin Levey* 68
Mac's Radio Service Shop.....*John T. Frye* 70
Audio Simplified (Part 7).....*David Fidelman* 72
Check That Picture Tube.....*F. C. Kroeger* 84
Radio-TV Service Industry News..... 100
Folded Long Wires.....*Bob Perthel, W9MWD* 125

DEPARTMENTS

For the Record.....*The Editor* 8
Spot Radio News..... 16
Within the Industry..... 24
Short-Wave.....*K. R. Boord* 71
What's New in Radio..... 94
Technical Books..... 131
Manufacturers' Literature..... 134
New TV Products..... 156

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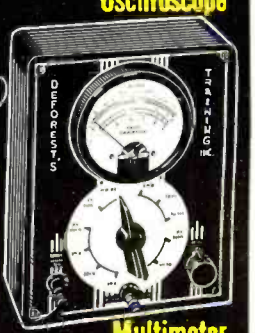

Multimeter

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Differential tempering of leads near body prevents sharp bends and resistor damage. Copper leads are locked in—anchored deep in the body for permanence.

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Gives complete data and list of RMA values. Includes dimensional drawings and handy color codes.

Look inside an OHMITE Little Devil resistor, then you'll begin to understand why these tiny composition units have become the standard for *dependable performance* among design engineers, servicemen, and amateurs the world over. Packed into each unit is a ruggedness, stability, and current-carrying capacity unmatched by any other on the market. Little Devils come in ½, 1, and 2-watt sizes in ±5% or ±10% tolerance. Furnished in standard RTMA values, 10 ohms to 22 megohms. In 1-watt size, ±10% tolerance, values as low as 2.7 ohms are available.

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VIDEO "PUNCH" AND "SNAP"

The Video Amplifier Response must be capable of resolving the finest picture detail contained in the video signal at present standards. The video amplifier is to respond with uniform gain as near to 4.5 MC as the art will permit. This provides the "snap" in the picture detail A non-uniform response will cause a phase shift "smear."

The Video Capability must fully drive the picture tube (with full rated HV) from black to maximum brilliance at picture whites. This gives the picture that "punch" that is needed for a full contrast range even in bright daylight A two stage video insures the necessary drive.

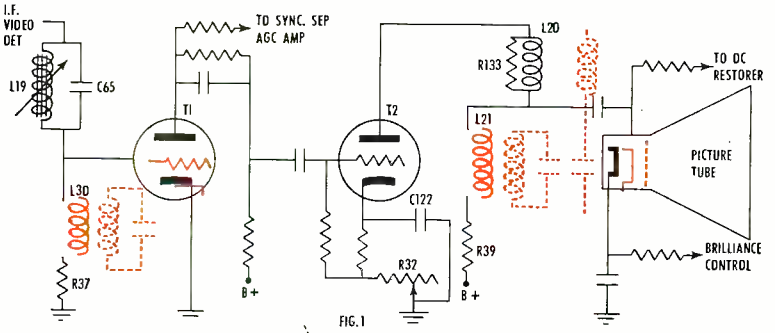

FIG. 1

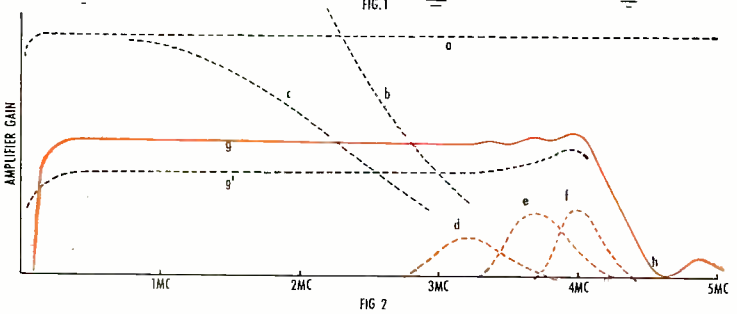

FIG 2

Video Peaking networks are used to extend the frequency range of a resistance coupled amplifier The amplifier gain as illustrated in Fig. 2 (Curve a) will be shunted by the capacity at the input grid of the picture tube, Curve b, to form a falling off response (Curve c). A low plate load resistor will extend the response but the stage gain is reduced However, the tube capacity may be used in series (L 20 and Curve f) or shunt (parallel) resonance (L 21, L 30, Curve e and d) to extend the range of a practical plate load resistor (R 39) to form Curve g Point h is the 4.5 MC sound trap (L 19 and C 65)

The Plate Load Resistors (R 39 and R 37) will determine the Q or the effecting range of the shunt peaking coils. In series peaking, damping (R 133) may be required to keep the Q down so as to prevent "ringing" A cathode feed-back contrast control (shunted by C 122) will provide added "snap" to the high frequency detail when the contrast control (R 32) is reduced as shown in Curve g1

Improved Circuitry such as this is one of many reasons why you can feel free to recommend Raytheon TV to a friend or customer

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For the RECORD

BY THE EDITOR

PRE-RECORDED MAGNETIC TAPE

THE production of pre-recorded magnetic tape is analogous to music on records only in that an original must be reproduced in great quantity and with a minimum of loss in fidelity with respect to the original. We all know how the multiplication of an original disc is achieved through quality-control pressing processes and injection molds. Some twenty million turntables now in use attest to the acceptance of the phono-record. But you can't duplicate an original tape in a pressing machine or in an injection mold.

Up to a year ago there were two or three attempts to market music which was pre-recorded on magnetic tape. Unfortunately for the industry as well as the entrepreneur the products were poor and the enterprises failed. One venture which reached catalogue proportions failed because its production fell far short of the high fidelity standards now demanded of any pre-recorded music.

Industry is literally crying for a tape multiplication technique which is economical in its use of labor time.

The catalogue of tape music which we mentioned before as having failed made use of a technique evolved with the assistance of a development laboratory. The company achieved some interesting results—interesting in that it did turn out copies. The quality of these copies might have been adequate if another phenomenon in American life had not taken place. And that phenomenon is the growth of the high fidelity market—music lovers who insist on distortionless reproduction. With the advent of this phenomenon and the "discriminating ear" which is now in itself a rapidly growing industry, the quality of that pre-recorded tape music caused a public rejection.

Well, what is one to do? Should one invent the barrow before discovering the wheel? If there is no barrow, what good is the wheel? If there is a wheel and no barrow, what to do with the wheel? The analogy is: If there is no one who wants to create a catalogue of pre-recorded magnetic tape music and who is willing to invest in the introduction and marketing of a quality catalogue, how is either the wheel or the barrow to come about? What would then be the encouragement or stimulus for the invention of a tape multiplication technique?

Or, look at it this way: If there had been no such thing as a phonograph record to be played, there would not have been a phonograph player. If there had not been a phonograph player, there would not have been a reason to invent a record presser. When it became practicable to press records economically in quantity, it became commercially feasible to produce record players which were within the means of the general public, again increasing the demand for records and bigger and better process facilities, a cycle that is profitable to industry.

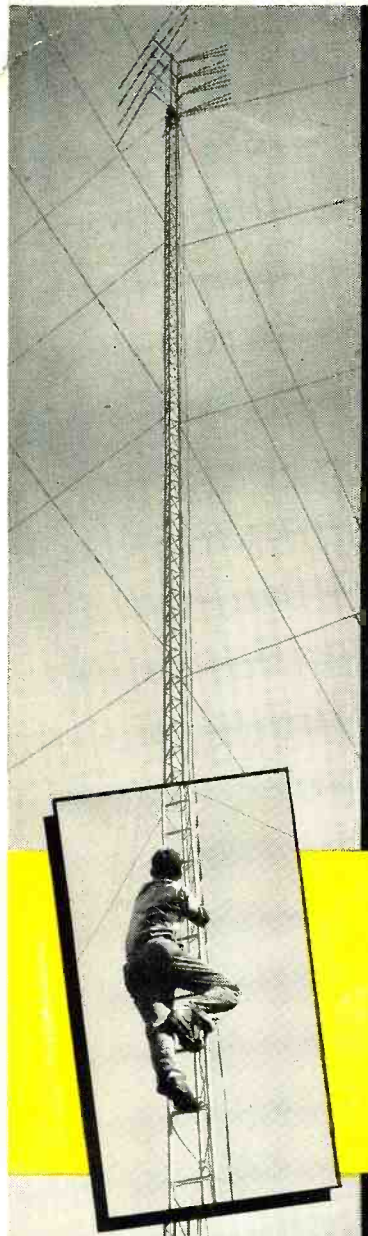
Even though several past attempts to pre-record on magnetic tape have failed, at least one company has invested time, effort, and money with the firm belief that from continued pioneering there would evolve a workable technique that could produce limited quantities of high fidelity tape. *A-V Tape Libraries, Inc.,* New York is doing such a pioneering job. This technique, while not the final answer, does produce copies of original masters that are indistinguishable from the master in fidelity. The technique is, briefly, one of direct, high-speed re-recording from a tape playback machine to a bank of studio tape recorders. The major disadvantage is that the process is long, tedious, and not the most economical way of making long-runs of thousands of copies of one original recording.

We have run tests on and have listened to these pre-recorded tapes and can attest to their excellence. Believing that there will be an ever increasing demand for this medium of recorded music, we are making a complete study of ways and means to promote pre-recorded magnetic tape as the ultimate medium for high fidelity music.

One or two others have already taken steps to develop new processes and techniques for the mass production of tapes. The *Tape Recording Industries* of Lansing, Michigan have submitted selections for our review. Using high-speed re-recording techniques it will be interesting to compare their products with those produced by *A-V Tape Libraries* or by others entering this new field.

Audio enthusiasts will welcome the feature article next month describing and illustrating the technique employed by *A-V Tape Libraries.*

The public has been honestly and well educated to the advantages of magnetic tape. Even before the availability of pre-recorded magnetic tape they had bought over a half million recorders. It will be interesting to chart future sales of record players and tape machines to see how they compete with one another in dollar volume. . . . . O. R.



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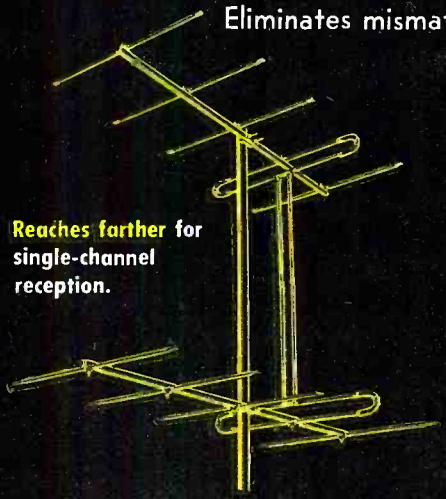

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- Wider spaced elements for higher gain.
- 100% gain in stacking!
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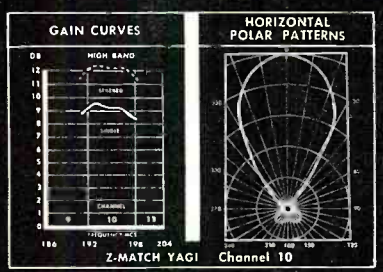

*Patent Applied For

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When antennas are stacked, the center feed bars of the folded dipoles are removed, automatically creating a perfect 300 ohm match for the entire stacked Yagi array. These same center bars are then used as half-wave connecting rods. This means

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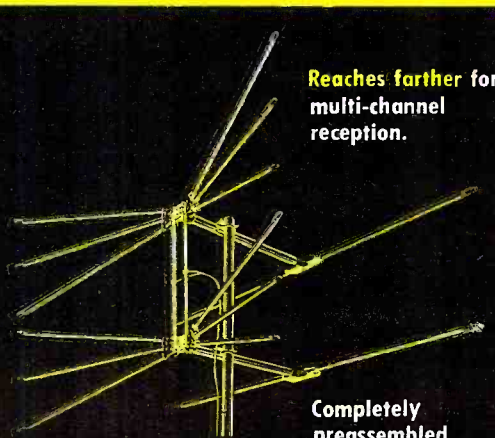

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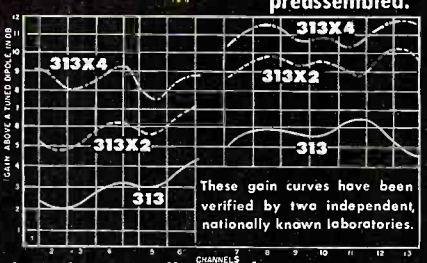
Completely preassembled.



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Here's the best picture tube news you ever heard. It's the Sylvania GLASS ALLOWANCE PROGRAM. You can make $2.25 to $5.25 *more* on every picture tube you sell. You also protect your reputation by installing only new, fully guaranteed Sylvania Picture Tubes in your customers' sets. The process is simple! No strings attached!

Here's all you do!

1. Return old picture tubes to your Sylvania tube distributor. Sylvania has made it possible for him to give you a GLASS ALLOWANCE CREDIT of from $2.25 to $5.25 per used tube on the purchase of any new Sylvania picture tube.
2. Return tubes may be of ANY MAKE but must be types shown on the suggested Sylvania Glass Allowance Price List. (See list below.)
3. Returned tubes must be under vacuum and free from chips, scratches, etc.
4. New tubes purchased need not be the same as those returned. You may choose any type Sylvania has for sale.

Sylvania reserves the right to change cash values or tubes shown on the suggested Glass Allowance Price List. SO ACT NOW. Take your used picture tubes to your Sylvania Distributor . . . TODAY! For further details call your Sylvania Representative or Sylvania Electric Products Inc., Glass Department, Seneca Falls, New York.

Here's your Suggested Glass Allowance PRICE LIST

(Clip this list and keep it handy)

12KP4A	$2.25	17AP4	$2.25	20CP4	$4.25
12LP4A	2.25	17BP4	2.25	20CP4A	4.25
12VP4	2.25	17BP4A	2.25	20DP4	4.25
		17BP4B	2.25	20DP4A	4.25
16JP4A	3.25	17FP4	2.25	20FP4	4.25
16KP4	3.25	17FP4A	2.25	20GP4	4.25
16KP4A	3.25	17HP4	2.25	20HP4	4.25
16LP4A	3.25	17JP4	2.25	20HP4A	4.25
16QP4	3.25	17KP4	2.25	20JP4	4.25
16RP4	3.25	17LP4	2.25	21EP4	5.25
16TP4	3.25	17QP4	2.25	21EP4A	5.25
16UP4	3.25	17RP4	2.25	21FP4	5.25
16XP4	3.25	17SP4	2.25	21FP4A	5.25
16ZP4	3.25			21KP4	5.25
				21KP4A	5.25

SYLVANIA

RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

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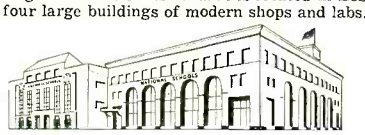
LEARN RADIO -TELEVISION

AND ELECTRONICS BY EASY SHOP METHOD TRAINING AT HOME!

You get all the parts—even tubes!— for this modern Superheterodyne Receiver. You learn to build it step by step. And you keep it! Get all the facts. Mail coupon now.

Let NATIONAL SCHOOLS—a resident-training school for nearly 50 years—train you at home for today's unlimited opportunities in Radio-Television-Electronics. National Schools is one of the largest schools of its kind. It is located in Los Angeles—the center of Radio and TV world! It has four large buildings of modern shops and labs. Its faculty is considered tops in the business.



You learn from lessons prepared by experienced instructors and engineers. Men who are successful Radio and Television technicians. Men who have trained 1000's of men like YOU!

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Page after page—in color—tells you everything you want to know. Mail the coupon. Get this valuable book today. And if you hurry—YOU GET A FREE SAMPLE LESSON, TOO! Shows how easy National Schools Home Training is. Mail the coupon today.

You Train At Home—In Your Spare Time

National Schools Shop Method Home Training gives you basic and advanced instruction in *all* phases of Radio-TV-Electronics. And remember—your training is based on resident school training principles. You learn *just* from hundreds of diagrams and pictures. All instructions are written by experienced technicians who work in Radio and TV every day. All instructions have been developed and tested in National Schools' own labs and studios, which are equipped with the latest RCA equipment. No wonder this National Schools course is so up-to-date, practical, interesting. And so easy to learn! And no wonder it is held in such high regard by leaders of American industry! Approved for eligible Veterans.

We Teach You How To Make Welcome Extra Money—While You Learn!

Many National Schools students—men like you—make plenty of extra dollars each week in spare time! Fixing neighbors' radios, appliances—and other ways we teach you. You start learning and earning from the day you enroll. From the very first lesson!

Only National Schools Gives You This Professional Multi-Tester!

You get this amazing, new testing instrument—factory-made and tested—complete—ready to use! Simple to operate. Accurate and dependable. An instrument every Radio-TV man needs. Light enough to carry around—so you can use it at home or on service calls. You'll be proud to own this valuable equipment.

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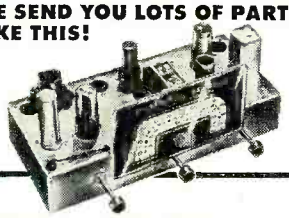
National Schools graduates have secure, good-paying jobs like these! So don't wait—mail the coupon today. Now—while you're thinking about it!

WE SEND YOU LOTS OF PARTS LIKE THIS!



With National Schools Shop Method Home Training, you get basic principles and plenty of *practical* training. *You learn by doing.* No wonder you learn so fast! We send you many parts—all of professional, modern quality. You do lots of practical experiments. You advance day by day, step by step. Until you can even build the modern Superheterodyne Receiver you see above—plus other important testing units. The free book tells you all about it. The free sample lesson shows how easy the training is. Use the coupon. Send today — without fail!

Attention! Men Going into Service Soon!

National Schools' course quickly prepares you for many important jobs in the Armed Services. With National Schools Training you have an opportunity to get into *special* service classifications—with higher pay and grade—immediately!

FREE SERVICE FOR GRADUATES

National Schools uses its great influence and prestige to help you find your place in the field of your choice. Don't put it off! Start yourself toward a skilled trade! Get the big pay you've always wanted!

Today's Shortage of Trained Technicians Creates Chance of a Lifetime For You!

Think of it! With guided missiles, radar, and other electronic devices so important to national defense! With big, new developments in TV. With over 90,000,000 home and auto radios, over 12,000,000 TV sets. With more than 3100 radio stations...over 100 TV stations—and more building every day . . . yes, imagine the great opportunity you have today! YOU are wanted in Radio-Television-Electronics! America's fastest-growing field. High-pay jobs—the kind you've always wanted—are waiting for YOU!

Job Security! Big Money! For YOU! in Today's Expanding Industries!

Trained Radio and Television technicians really make important money these days. Thousands of National Schools graduates—men just like you—are earning good money all over the country. Why not you? And—National Schools graduates get the personal satisfaction of being highly-skilled technicians. Men people respect. Men who *enjoy* their work—rather than having to drag along in just any old job.

National Schools Has Trained 1000's of Successful Men! Why Not YOU?

In almost every state—and many foreign countries—National Schools graduates are filling big jobs with famous companies. Or running their own successful businesses. What are YOU waiting for? National Schools training is *complete* training. So when you graduate you can take advantage of today's big opportunities in Radio-Television-Electronics—fast.

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DON'T PUT IT OFF! GET THE BIG SALARY YOU HAVE ALWAYS WANTED!

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Mail in envelope or paste on penny post card.

Mail me FREE the book mentioned in this ad. Also a free sample lesson. I understand no salesman will call on me.

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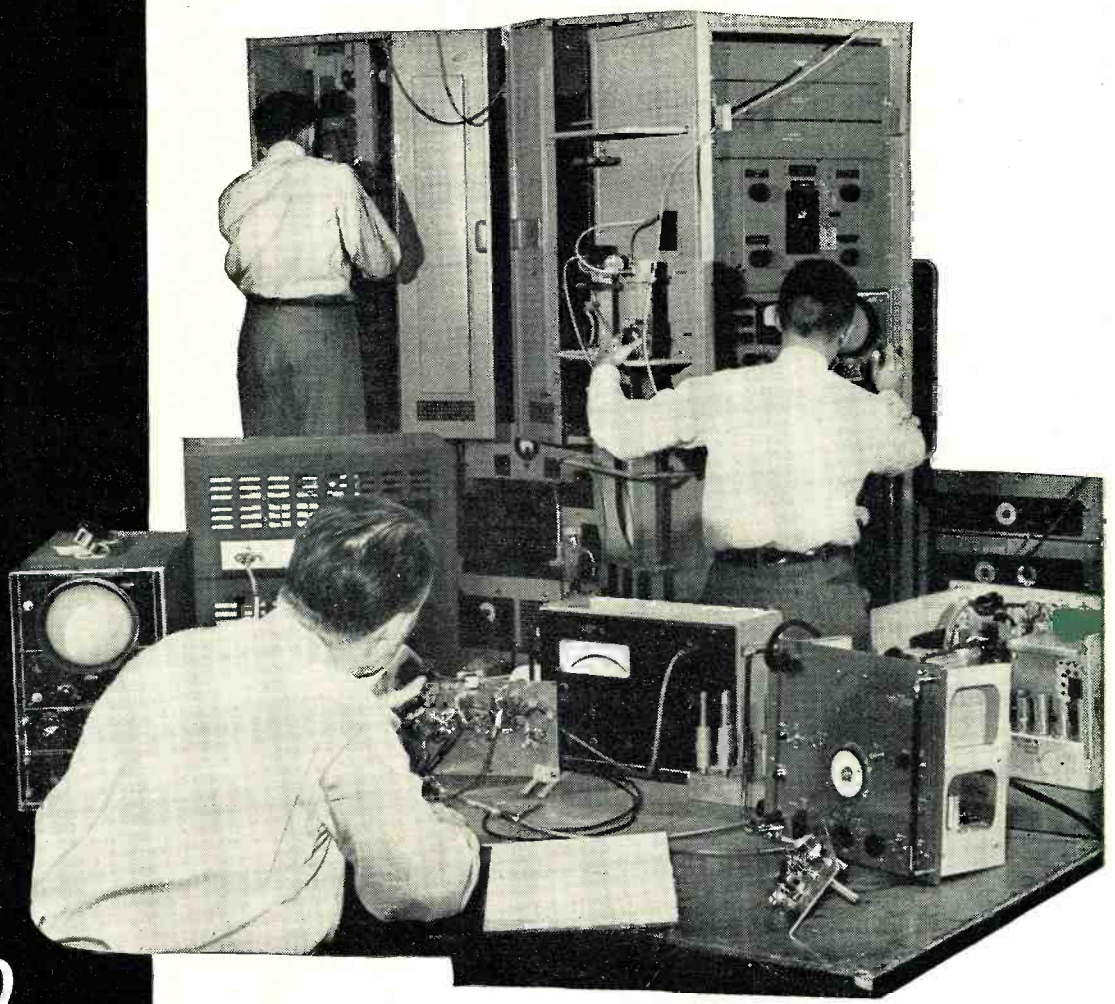
CITY _____ ZONE ____ STATE _____

☐ Check here if you were released from the Service less than 4 years ago.

What kind of men?



What kind of men are the 2500 scientists and engineers of Bell Telephone Laboratories?

They are men of many types, yet they work well together, for all have good minds as a foundation, years of study in the fundamentals of their science and in the methods of research and design. Vital, too, is their teamwork — for without the co-operation of many individuals the products of research and development could never be perfected.

Above all else these men have "the spirit to adventure, the wit to question, and the wisdom to accept and use."

Such men can develop the world's finest telephone systems — and have done so.

Perhaps there is a place among them for you. Write the Employment Director, Bell Telephone Laboratories, New York 14.

BELL TELEPHONE LABORATORIES

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

"OUR FASTEST SELLING SPEAKER LINE FOR THE PAST 7 YEARS!"

Quality Product Plus Smart Promotion Spell Success for Aggressive Parts Jobber

"My dealer customers don't bother to open the cartons – as they do with other brands – before buying G-E speakers. They know that General Electric factory-packed Alnico units come to them in perfect shape, ready for use. Customer confidence pays off. Because I stock all 27 G-E models, my dealers know I can fill any speaker need."

What Dave Marks does not mention is that his merchandising skill has made him one of the top parts distributors in the East. He makes frequent and profitable use of all G-E sales tools: catalogs, booklets, envelope stuffers, display pieces of all kinds. They're available to you, too, through your General Electric distributor or representative. Call him today for your share of these sales helps.

Drive-In Theatre Speaker Sales Hot! With G.E.'s special weather-tested outdoor speaker, Dave Marks, shown here with general manager Ted Sharaf, has increased his drive-in business four times over in two years!

DEALERS AND SERVICEMEN

Here's a complete new service manual on all General Electric television receivers – 102 models manufactured since 1945! You get 80 pages packed with circuit diagrams, symbols and numbers, tube locations, top and bottom chassis views. Plus photographs and lists of service aids. Mail coupon for it today. Only $1.00.

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Electronics Park, Syracuse, New York

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PRESENTING COLLINS AM-FM "PRE-FAB" TUNERS

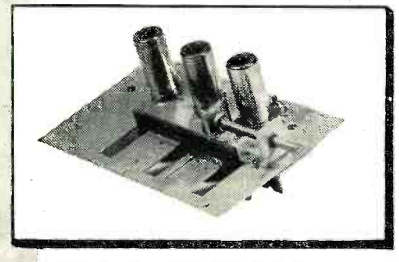
***NOW** you can build a Collins AM-FM tuner from the Pre-Fab units shown below!*

COMPLETE VERSATILITY is the byword in this new tuner design. Through the addition of the AM circuit, the Collins tuner will meet all requirements for home music systems and installations where a fine tuner is required.

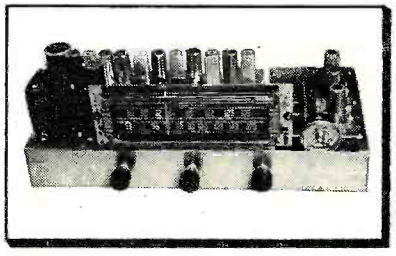
ECONOMY: The very finest in tuner design is offered you at exceptionally low prices. Collins quality is your assurance of a fine product that will work to your complete satisfaction. You cannot duplicate this tuner in its completed form at *twice the price!*

3 Ways to purchase COLLINS Tuner . . .

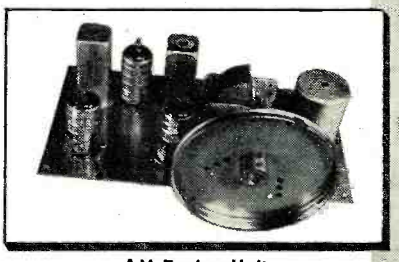
1. **As an AM tuner kit**
2. **As an FM tuner kit**
3. **As an AM-FM tuner kit**



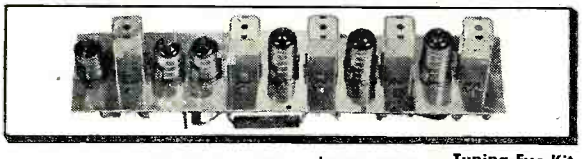
FM Tuning Unit $15.25



The Collins FM-AM Pre-Fab Tuner Kit As It Looks After You Assemble It (Total Kit Cost $69.00)

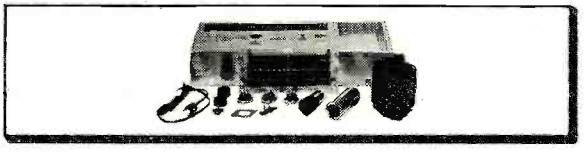


AM Tuning Unit (Includes IF and Audio Amplifier) $19.25



FM IF Amplifier $19.75

Tuning-Eye Kit Available At $2.85



UC-2 Universal Chassis Kit $14.75

ALL PRE-FAB UNITS ARE ASSEMBLED, WIRED, TESTED, AND ALIGNED AT FACTORY. PRICES SHOWN INCLUDE TUBES.

The FM tuning unit employs a 6J6 dual triode RF amplifier; 6AG5 converter, and 6C4 oscillator. Permeability tuned, stable, and drift-free. High sensitivity of between 6 and 10 microvolts. Dimensions: 7¼"x4½". The IF amplifier for FM uses 6 tubes! 6BA6, (4) 6AU6, and 6AL5 discriminator. High gain, wide band response for highest fidelity reception. Frequency response of FM section, plus or minus 2 DB, 20 to 20,000 cycles. Distortion less than ½ of 1%. Dimensions: 11 5/16"x2½".

The AM tuning unit utilizes a super-het circuit employing three tubes: 6BE6 converter, 6BA6 IF amplifier, and 6AT6 detector. Extremely high sensitivity and selectivity is accomplished through the use of new, high gain iron-core transformers. Careful alignment provides widest response available from this type of circuit. If builder desires, triode amplifier section of 6AT6 tube may be used as first audio stage.

Chassis Kit includes all necessary parts. Nothing else to buy! Instruction Manual included with detailed, step-by-step procedure, pictures and schematic diagrams. Chassis measures 8"x17"x 2½". Overall, the tuner, when assembled, measures 8"x17"x6".

MAIL ORDER COUPON TODAY!

TO: COLLINS AUDIO PRODUCTS CO. INC.
P.O. Box 368, Westfield, N.J.

Enclosed Find ☐ **Check** ☐ **Money Order For**

- ☐ **AM Tuning Unit**
- ☐ **FM Tuning Unit**
- ☐ **FM IF Amplifier**
- ☐ **UC-2 Chassis Kit**
- ☐ **M-1 Tuning Eye Kit**

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"Here's why Tom gets my service business!"

Today's wary customers want to know *how you do business* as well as *how capable a technician you are.* That's why thousands of Radio and Television Service Dealers across the nation are discovering that, all other things being equal, their status as RAYTHEON *Bonded* Electronic Technicians tips the scales in their favor.

If you don't know how this exclusive Raytheon *Bonded* Program builds customer confidence and good will by cash-protecting your radio and television service 90-day guarantee, *at no cost to you*, you'd better get in touch with your Raytheon Tube Distributor. He'll be happy to tell you whether you can qualify for this important sales aid.

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Spot Radio News

★ ***Presenting latest information on the Radio Industry.***

By RADIO & TELEVISION NEWS'
WASHINGTON EDITOR

TV AND RADIO, which have become such vital forces in our way of life, and won a pre-eminent position in Washington where their power and influence are deeply respected, was accorded a vibrant welcome in the Capitol as Congress reconvened for the new year. Not only were the legislators concerned with the growing strength and effect of the sight and sound arts, but with several pending measures which sought to introduce new types of control. Among the items which seemed to interest most representatives and senators was Senator William Benton's proposal for a National Citizen's Advisory Board on Radio and Television, and Senator Ernest W. McFarland's bill to streamline the FCC. Both had been introduced in earlier sessions with impressive results. The McFarland measure had been "ayed" by the Senate and was up for House approval, when the '51 session concluded. Senator Benton's plan, which had been presented to the Senate Interstate and Foreign Commerce Committees, was slated for many more review conferences.

The advisory board idea has been and still is strongly opposed by many industry groups which have described the suggestion as contrary to American principles of freedom and absolutely unnecessary in the light of the stern new code recently adopted by the broadcasters. One of the strongest opponents of the measure is Dr. Du Mont, who has bitterly criticized the plan on many occasions, noting that station operators are fully capable of policing their programming departments. Describing the care applied in this direction in the *Du Mont* television station operation, the eminent pioneer declared during a hearing on license renewals that . . . "We shall always be alert to the fact that our programs are 'guests' in the homes of viewers, and shall always be guided by principles of programming which will make our programs acceptable and satisfying to families and their components insofar as their interests extend. . . . We shall abide by the television broadcasting code, but this shall not be restrictive in terms of expenditure of efforts to make our standards even higher." He cited the special attention given to programming for children . . . "to encourage a healthy orientation for a child to his social surroundings and develop a respect for his parents." Describing the continuing need for the highest moral standards in all programming formats, Dr. Du Mont said that the policy of *Du Mont* will be . . . "to raise and never lower the educational, moral, cultural, political, and entertainment standards of the average home."

Acknowledging that television was in its infancy and subject to many variables, the picture-tube authority declared that broadcasters have and will continue to adhere to the cardinal principles of diligently serving the public interests.

Not only have many members of industry censured the government-control idea of Senator Benton, but some members of the Commission have voiced their opposition, too. It is believed that these blasts of discontent may alter the views of some of the committee members and perhaps effect a shelving of the move.

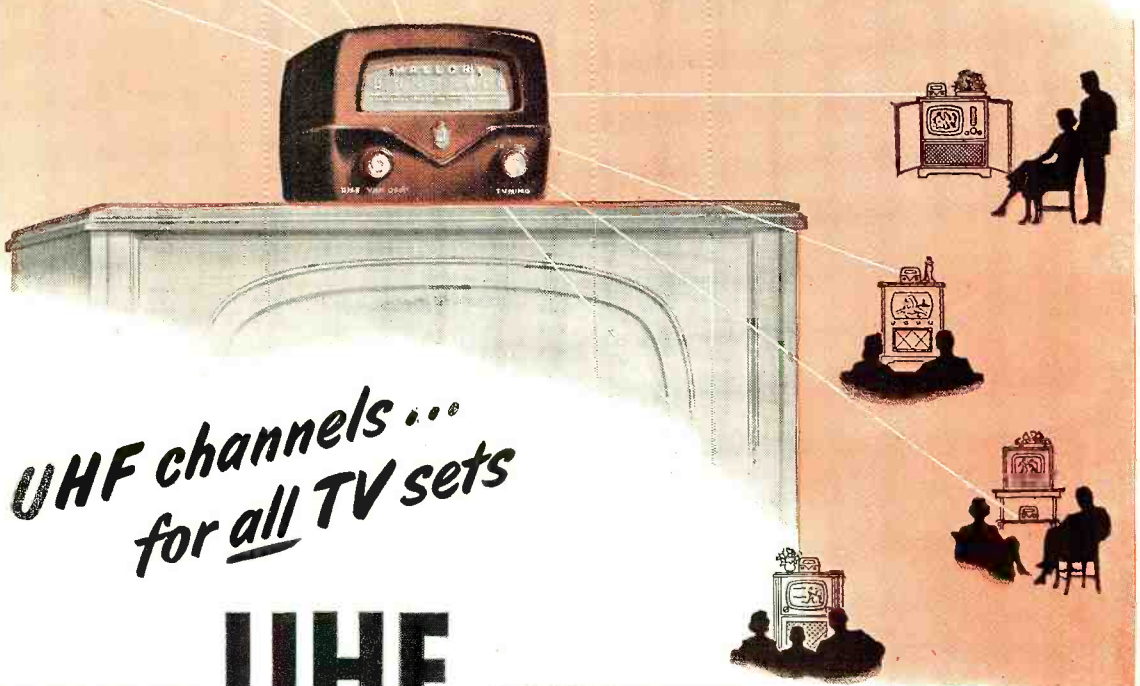
A budget problem, circling the TV-radio world, also faced Congress as it got together. The FCC spiraled a request at the legislators that prompted many frowns. They asked for about two million dollars more than they received for the fiscal year '52, or about eight-million as a total appropriation. About $600,000 of this money was needed, it was said, for additional hearing examiners and staff to handle the expected increase in filings and applications for new stations which will certainly result as soon as the freeze is ended. The remainder of the extra dollars was required, explained the Commission, for monitoring stations; a request that had been relayed to the budget committee last summer and denied because of military-fund requirements.

Congressional committees have quite a whirling agenda before them to complete before the hectic presidential-campaign days appear on the scene.

THE EMERGENCY COMMUNICATIONS PLAN, which was approved by the President shortly before the Christmas holidays of '51 and entered in the books as the law of land, has become a priority project of all broadcasters who will be required to obey a series of strict regulations involving perhaps complete silencing when the Air Force believes an air attack is imminent.

Presently, two sets of techniques have been suggested for broadcast sta-

UHF*



All UHF channels ... for all TV sets

MALLORY UHF CONVERTER

The Mallory UHF converter is right for *all* your TV customers because it can be used with *any* TV set . . . in *any* UHF broadcast area. And it's easy to install — no adjustments or connections to make in the TV set . . . just connect power lines and antenna leads.

These Mallory features mean real customer satisfaction . . . real sales for you in the new UHF market—

- *Reception of all UHF channels*
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No larger than a small portable radio, the Mallory UHF converter is precision-built for long, trouble-free service. Get complete details today on the Mallory UHF converter from your Mallory distributor.

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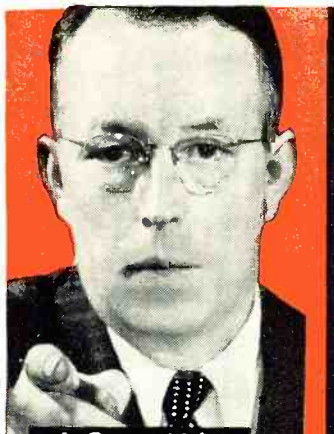
tion procedure involving reduction of power and frequency stages, the latter to be used by stations in single-market areas, and the former to be effected by clusters of stations operating in multiple-transmitter areas. Stations may be obliged to alter their setups through the installation of new crystals and modification of their antennas. It will also be necessary to have emergency standby power. Most operators have indicated that the changes should not be too difficult to make. Since standby power is a feature at most transmitter plants, no difficulties are anticipated.

Amateurs will also play quite a role in the emergency plan. The Commission has proposed a Civil Emergency Service for the hams which would permit the boys to provide radio communication for civil defense purposes on a local, area, and national basis. The new rules state that those now holding ham tickets should apply for additional authorization to operate in the new service. Authorizations will be granted upon the express understanding that the grant is subject to change or cancellation at any time, without hearing, if at the discretion of the Commission, the action is necessary for national defense and security.

In Philadelphia, a striking demonstration of the operation of one of the key links in the communication plan, civil defense mobile radio, was offered recently. On view was a bomb-proof, insulated, air-conditioned 28-foot van, equipped with a 10-kilowatt emergency power supply, 70-watt public-address system, a two-way system, four sets of antennas, walkie-talkies, a sixteen-line-phone board, cables, and transmission-line reels. The two-way setup provided contact to all police cars and also with police headquarters. In addition, it was possible to make contact with fire equipment and fire base stations. Even planes, flying overhead, could be reached on a special CAA-assigned frequency. Hams operating mobile transmitters were also contacted. According to the CD authorities, it will be possible to receive and transmit on three amateur channels and reach over one-hundred hams who operate mobile facilities within the city, and a hundred-odd more who are just beyond the city limits. Contact with broadcast stations operating AM, FM, and TV facilities was also described as being possible from the emergency center, believed to be the first of its kind in the country.

COMPONENT SHORTAGES, particularly on the resistor and selenium-rectifier front, which it has been said may become acute, received a bright, hopeful appraisal recently in Washington, when it was disclosed that European sources could supply millions of resistors, potentiometers, and rheostats, and a substantial supply of selenium cells, too. The surprising information was uncovered by Ed Morris, Jr., serving as chairman of the

(*Continued on page* 96)



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TRAIN IN 10 MONTHS OR LESS

At Home in Your Spare Time

Now . . . be ready for Radio-Television's big pay opportunities in a few short MONTHS! Frank L. Sprayberry's completely new "Package" training unit plan prepares you in just 10 MONTHS . . . or even less! Equally important, there is NO monthly payment contract to sign . . . thus NO RISK to you! This is America's finest, most complete, practical training—gets you ready to handle any practical job in the booming Radio-Television industry. In just 10 months you may start your own profitable Radio-Television shop . . . or accept a good paying job in this fascinating expanding field at work you've always wanted to do. Mr. Sprayberry has trained hundreds of successful Radio-Television technicians—and stands ready to train you in less than one year, even if you have no previous experience. You learn by DOING . . . actually working with your hands with equipment of special design to illustrate basic theory instead of relying on books alone.

VALUABLE EQUIPMENT INCLUDED WITH TRAINING

The new Sprayberry "package" plan includes many big kits of genuine, professional Radio-Television equipment. While training you actually perform over 300 demonstrations, experiments and construction projects. In addition, you build a powerful 6-tube standard and short wave radio set, a multi-range test meter, a signal generator, signal tracer, many other projects. All equipment is *yours to keep* . . . you have practically everything you need to set up your own service shop. The interesting Sprayberry book-bound lessons and other training materials . . . all are yours to keep.

EARN EXTRA MONEY WHILE YOU LEARN!

All your 10 months of training is AT YOUR HOME in spare hours. Keep on with your present job and income while learning . . . and earn EXTRA CASH in addition. With each training "package" unit, you receive extra plans and ideas for spare time Radio-Television jobs. Many students pay for their entire training this way. You get priceless practical experience and earn generous service fees from grateful customers. Just one more reason why the Sprayberry new 10 MONTH-OR-LESS training plan is the best Radio-Television training in America today. If you expect to be in the armed forces later, there is no better preparation than good Radio-Television training.

FREE 3 BIG RADIO TELEVISION BOOKS

I want you to have ALL the facts about my new 10-MONTH Radio-Television Training—without cost! Act now! Rush the coupon for my three big Radio-Television books: "How to Make Money in Radio-Television," PLUS my new illustrated Television Bulletin PLUS an actual sample Sprayberry Lesson—all FREE with my compliments. No obligation and no salesman will call on you. Send the coupon in an envelope or paste on back of post card. I will rush all three books at once!

SPRAYBERRY ACADEMY OF RADIO
Dept. 25-G, 111 North Canal St., Chicago 6, Ill.

IF YOU ARE EXPERIENCED IN RADIO

Men already in Radio who seek a short intensive 100% TELEVISION Training with FULL EQUIPMENT INCLUDED are invited to check and mail the coupon at the right.

Mail Coupon Today!

NO OBLIGATION
No Salesman Will Call

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111 North Canal St., Chicago 6, Ill.

Please rush to me all information on your 10-MONTH Radio-Television Training Plan. I understand this does not obligate me and that no salesman will call upon me.

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

Address.....

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

Please check Below About Your Experience

☐ Are You Experienced? ☐ No Experience

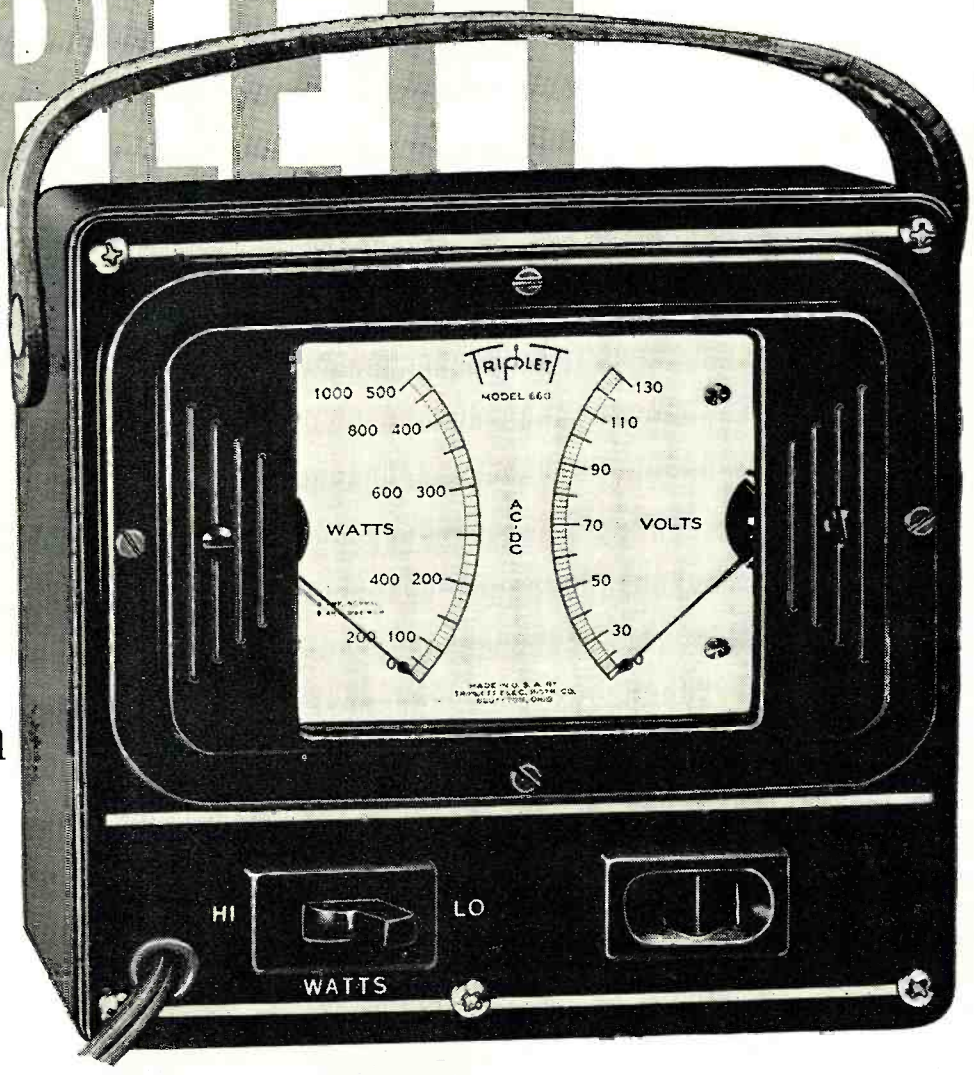
TRIPLETT

Load-Chek

introduces

Servicing by Power Consumption

MODEL 660



LOAD-CHEK *for the first time* makes it possible for every technician to utilize what is perhaps the simplest and quickest of all service methods—Servicing by Power Consumption Measurements.

Power consumption measurement has long been proved by auto-radio servicemen as a rapid method of localizing troubles in auto radios. But Triplett's new LOAD-CHEK is the *first* Wattmeter to be produced *at moderate cost*, and with the *proper ranges*, to bring this short-cut method within the reach of *every* radio and TV service man.

Basis of the LOAD-CHEK method is the tag or label on every radio and TV chassis which shows the normal power consumption. The following examples are only two of many time-saving uses of this new instrument.

LOCATING A SHORT—The chassis tag may show a normal consumption of 225 Watts. Simply plug the power cord of the chassis into LOAD-CHEK (there are no loose ends to connect or be in the way). Note the reading—which should be possibly 350 Watts. By removing the rectifier tube you can determine at once which side of the tube the short is on. With a soldering iron and long-nosed pliers you can check through the chassis, locate and correct the trouble without having to lay down tools or to check with lead wires!

REPLACING BURNED OUT RESISTORS—With the chassis to be repaired plugged into a LOAD-CHEK MODEL 660, note the wattage reading with the burned out resistor circuit open. Now replace the resistor. Should the increase in watts be greater than that of the resistor rating being installed, it indicates that an extra load has caused the trouble which has not been cleared.

LOAD-CHEK is made-to-order for the busy service man and can help stop costly "come back" repair jobs. It's a profit-maker because it's a Time-Saver. And at its moderate cost LOAD-CHEK can be standard equipment on *every* service bench. *By all means*, inspect this versatile instrument at your distributor and place your order, for under present conditions we must fill all orders on a basis of "First Come, First Served."

SEE MODEL 660 LOAD-CHEK AT YOUR DISTRIBUTOR'S

FOR THE MAN WHO TAKES PRIDE IN HIS WORK

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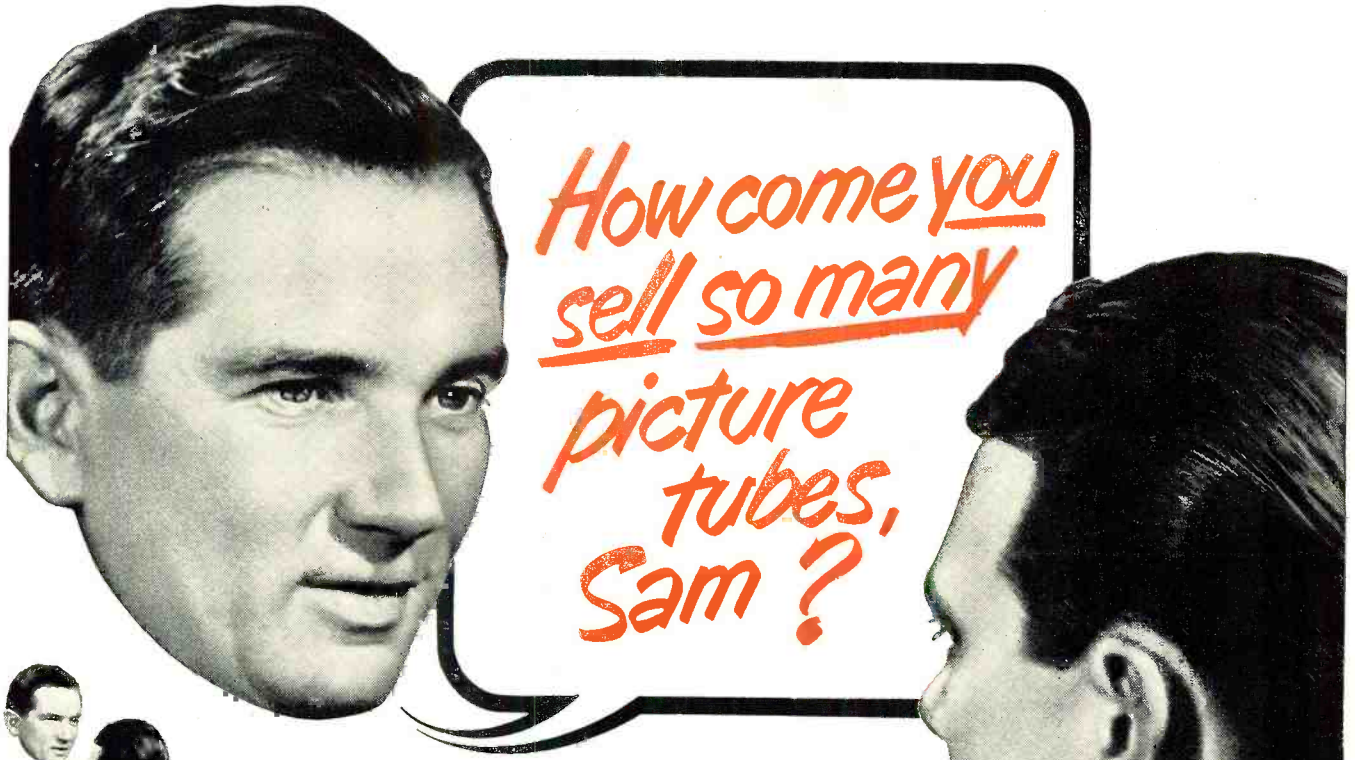


"I'm using the CBS-Hytron Easy Budget Plan, Joe. My CBS-Hytron distributor gave it to me."

"Tell me more."

"Well, CBS-Hytron's Plan helps me sell TV picture tubes and service to many a customer who just doesn't have $50 cash. Now I make sales I'd lose otherwise. My customer pays for the job painlessly a few dollars a month. Yet I get my cash right away — and can discount my bills with my distributor."

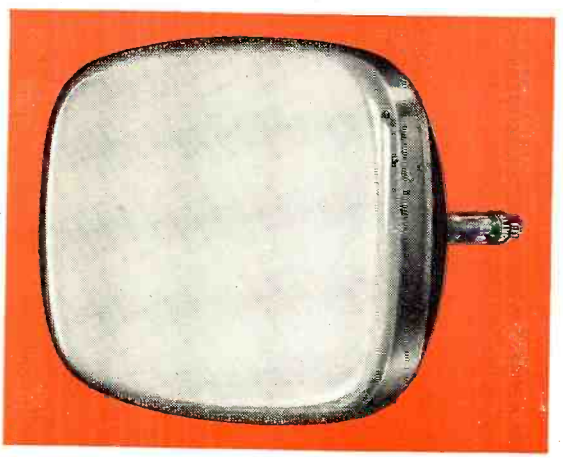
"Fine! How does it work, Sam?"

"Simple. I introduce my customer to the finance company authorized by CBS-Hytron. The finance company does the rest. Acts as my credit department to secure me against losses. Takes care of all the details . . . paper work, collections, etc. My customer gets his tube and I get my cash — at once."

"That's swell, Sam. Now I can see why you always have plenty of working capital."

"That's right. And talk about service! This CBS-Hytron Easy Budget Plan has even brought me immediate cash from old accounts I'd written off as bad debts. CBS-Hytron is perfectly willing, too, that my regular budget loans include my service work and other components besides CBS-Hytron tubes. I owe my CBS-Hytron distributor a vote of thanks for letting me in on this wonderful Plan."

"Fair enough! I've sure been losing sales I shouldn't, Sam. I need the CBS-Hytron Easy Budget Plan. CBS-Hytron tubes are tops, too. Thanks for the tip. I'll see my CBS-Hytron distributor today."



SAVE THE SALE No need for *you* to miss a single profitable picture-tube sale . . . just because your customer does not have the cash. Get the details on this original CBS-Hytron service for you. See *your* CBS-Hytron jobber . . . or mail this coupon . . . today!

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CBS HYTRON RADIO TUBES

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SALEM, MASSACHUSETTS

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NAME.....
(Please print)

STREET.....

CITY.....STATE.....

Within the INDUSTRY

BERNARD TULLIUS was recently appointed sales engineer for the transmitter division of the *Allen B. Du Mont Laboratories, Inc.*

In his new post Mr. Tullius will act as a sales and technical counselor to *Du Mont* clients, aiding them in planning, laying out, and installing u.h.f. and v.h.f. transmitter equipment, coordinating transmitter design and construction work, and supervising field work of many kinds.

He has a comprehensive background in both AM and TV broadcasting and in engineering fields. He was formerly station and transmitter engineer for several Oklahoma City stations, has served as a field engineer for *Hazeltine Electronics,* and has been an instructor in television at the *Eastern School of Radio and Television.* Before joining *Du Mont,* he was a senior engineer at *Radio Engineering Labs* in Long Island City, N. Y.

* * *

ADMIRAL CORPORATION of Chicago has purchased the **MOLDED PRODUCTS CORP.,** one of the largest custom molders of plastics in the country. The plastics firm, which is located at 4533 W. Harrison Street in Chicago, will be operated as an **ADMIRAL** subsidiary.

* * *

RTMA's Transmitter Division has been reorganized to better serve the expanding electronics industry, according to H. J. Hoffman, *Machlett Laboratories, Inc.,* chairman of the division.

The division's executive committee has voted to recommend to the RTMA board of directors that the name of the Transmitter Division be changed to Technical Products Division. They also established a government relations section, under Ben Edelman of *Western Electric Co.,* to deal with problems of electronics manufacturers handling government contracts. In addition, the committee established a new general communications section, under James D. McLean of *Philco Corp.,* which will absorb the former marine and aviation sections as well as the former general communications section.

* * *

ELECTRONIC INSTRUMENT CO., INC., has purchased a six-story plant at 84-86 Withers Street, Brooklyn 11, New York, which will add more than 30,000 square feet of factory and office space to the company's facilities for producing *"Eico"* test equipment kits and instruments . . . **BENDIX RADIO DIVISION** has opened offices at 261 McDougall Avenue in Detroit to enable the company to work more closely with auto manufacturers in the design and production of auto radios. V. C. Judd is in charge of the new office which will also handle the company's entirely new line of mobile communications equipment . . . **BURLINGAME ASSOCIATES,** 103 Lafayette Street, New York, N. Y., has acquired an additional floor at that address to handle its increased business as representatives of some of the country's leading electronics manufacturers . . . **RCA VICTOR DIVISION** has established a West Central Region with headquarters in Kansas City. The new regional office, which is in charge of V. A. Kamin, will handle the Denver, St. Louis, Omaha, Des Moines, Sioux Falls, and Kansas City distributing areas . . . To house its rapidly growing Communications and Electronics Division, **MOTOROLA INC.** of Chicago has purchased a new 200,000 square foot plant at 4501 Augusta Blvd. in Chicago. The new plant is immediately adjacent to the company's main radio and television factory . . . **INSTRUMENT CORPORATION OF AMERICA** has opened a new and modern plant in Blacksburg, Va. to handle the production of miniature slip ring and commutator assemblies.

* * *

EDWIN D. FOSTER has been elected to the post of vice-president and director of planning for the *RCA Victor Division* of *Radio Corporation of America.*

The postwar growth and rapid expansion of the company's production facilities, brought about by the increasing demands for military electronic equipment as well as consumer products and services, has led to the establishment of a separate department devoted to business and economic planning.

As director of this new department, Vice-Admiral Foster (U.S. Navy, Ret.), will consult with product department executives on business and economic trends as they affect long-range planning of products, services, and markets.

Prior to this new assignment, Vice-Admiral Foster served as director of the company's mobilization planning department.

* * *

THE ELECTRONIC PARTS SHOW'S 1952 program is being planned to give the country's electronics parts distributors a role in determining what subjects they wish discussed at the semi-

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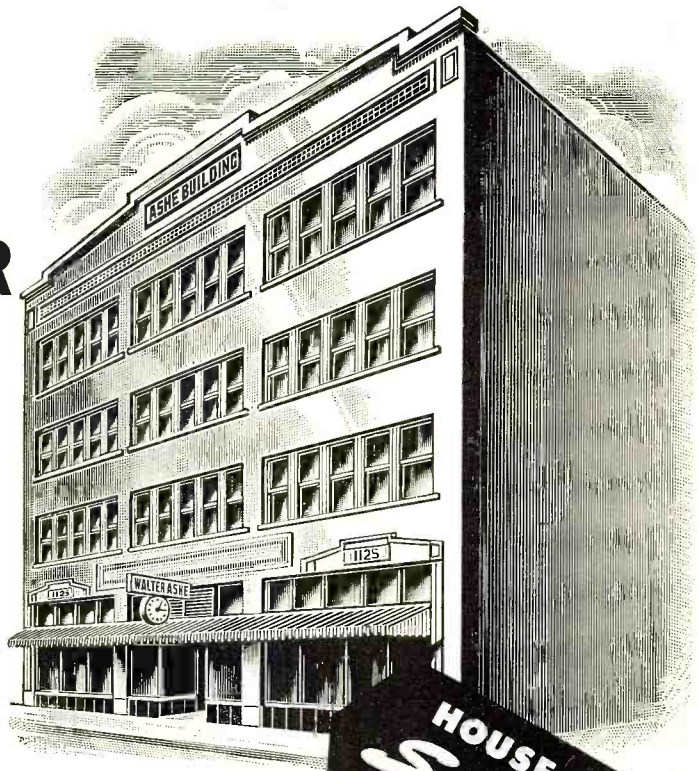

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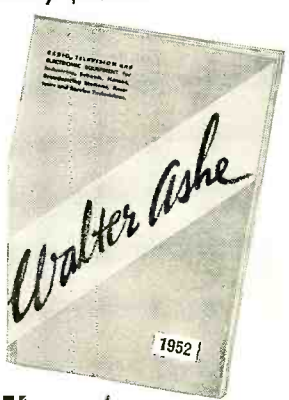

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nars and group educational meetings to be held May 20 and 21 in connection with the Show.

Questionnaires have been forwarded to distributors and the committee, headed by Jack A. Berman of *Shure Brothers, Inc.*, will consider the replies carefully in making up the two-day agenda of seminars and discussion periods. To assist the distributors in evaluating the various topics under consideration for discussion at the seminars, the educational committee listed a number of major proposed subjects. On the basis of the distributors' judgment as to their timeliness, the proposed topics or those suggested by the distributors themselves will be offered on the program.

The 1952 Electronics Parts Show will be held at the Conrad Hilton Hotel in Chicago from May 19 through 22.

* * *

PHILIP BARNES is the new director of the *Weston Electrical Instrument Corporation's* sales division.

Formerly general sales manager of the company, Mr. Barnes has been associated with *Weston* for 16 years. Following his return from active duty in the U. S. Navy during World War II, he became advertising manager and then general sales manager for the firm.

At the same time Mr. Barnes' new appointment was made public, the company announced that Hubert M. Ricks had been named general sales manager, succeeding Mr. Barnes. Mr. Ricks has been associated with the company for 26 years.

* * *

INDIA'S INTERNATIONAL RADIO AND ELECTRONICS EXHIBITION which had been scheduled to take place during February 9th to 29th has been postponed to November 10th to 30th, 1952.

Further details about the exhibition are available from The Secretary, International Radio & Electronics Exhibition of India, Fateh Manzil, Opera House, Bombay, India.

* * *

FRITZ A. FRANKE is the new assistant radio sales manager for *The Hallicrafters Co.* . . . **NICHOLAS DEFALCO** has been appointed manager of the receiver quality control department of *Allen B. Du Mont Laboratories, Inc.* . . . **IVOR M. LESLIE** has been elected to the dual post of vice-president and director of *Crosley Radio and Television, Ltd.*, Canadian subsidiary of *Avco.* His new title is that of general manager . . . *E. I. Guthman Company, Inc.* has added two men to its Attica, Indiana factory staff. **A. SCHWARZKOPF** is the new plant manager and **ROBERT MOORE** has taken over the job of production engineer . . . **ARMIN P. BUETOW,** general manager of *Magnecord, Inc.,* has been named executive vice-president of the organization. He joined the company in January of 1951 . . . **IRWIN WEINSTEIN,** formerly assistant chief engineer of the *Sarkes Tarzian* rectifier division, has joined the staff of *Electronic Devices, Inc.* as assistant sales manager . . . **ROGER BROWN** is the new national sales manager of *Emerson Radio and Phonograph Corporation* . . . **HENRY C. ROEMER,** executive vice-president of *Federal Telephone and Radio Corporation* since September, 1950, has been elected president of the firm, the manufacturing associate of *I. T. & T.* . . . **IRVING G. ROSENBERG** has been appointed director of operations for *Allen B. DuMont Laboratories, Inc.'s* television receiver and cathode-ray tube divisions. He has been with the company since 1942 . . . **FERDINAND W. SCHOR** has been named chief engineer in charge of military engineering for *Motorola, Inc.* of Chicago . . . The appointment of **DR. COURTNEY PITT** to the post of vice-president-finance has been announced by *Philco Corporation* . . . **ROBERT E. LEE,** manager of finance for the *General Electric* Tube Department in Schenectady, has been appointed assistant manager of the company's cathode-ray tube operations . . . **FRED T. CALDWELL,** for many years a senior officer and director of *International Telephone and Telegraph Corporation,* passed away recently in New York City. He had been associated with *I. T. & T.* in various capacities since its founding in 1920 . . . **IRVING ROBBINS** has been named vice-president and general manager of

(*Continued on page* 88)

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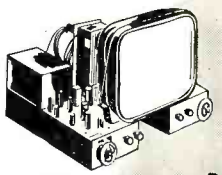

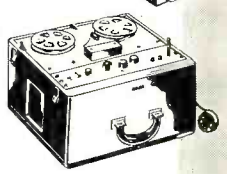

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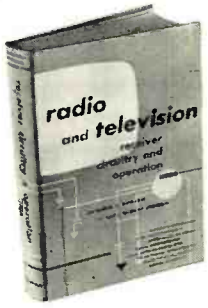

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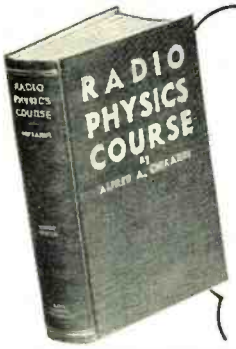

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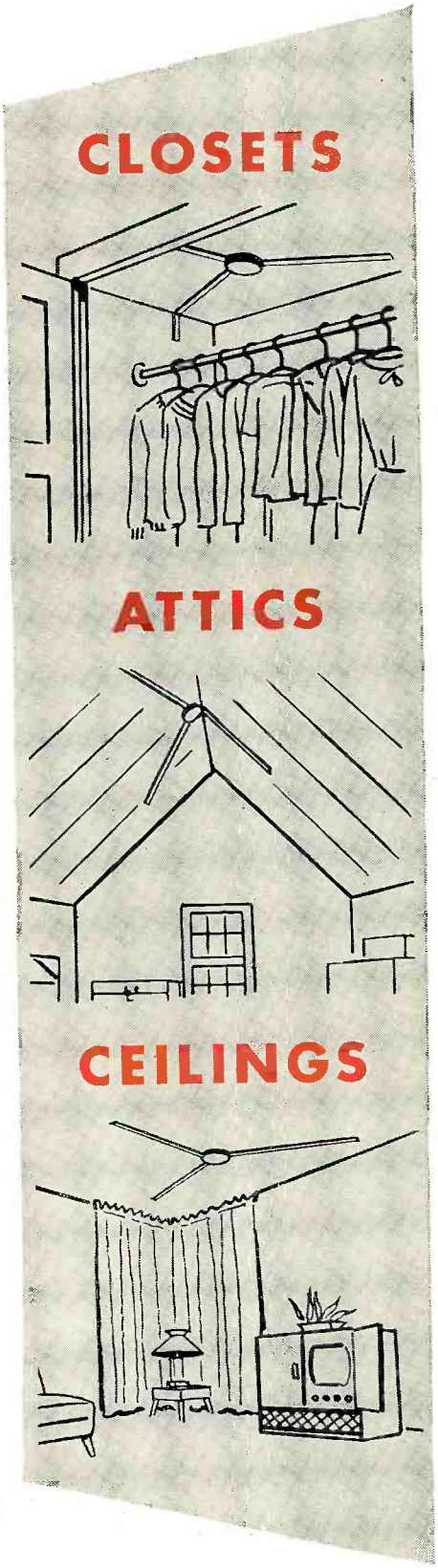

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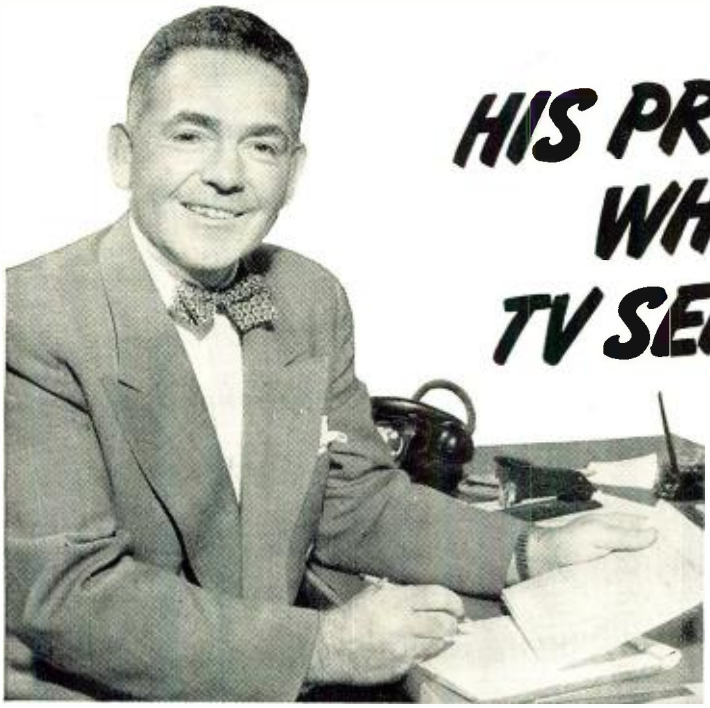

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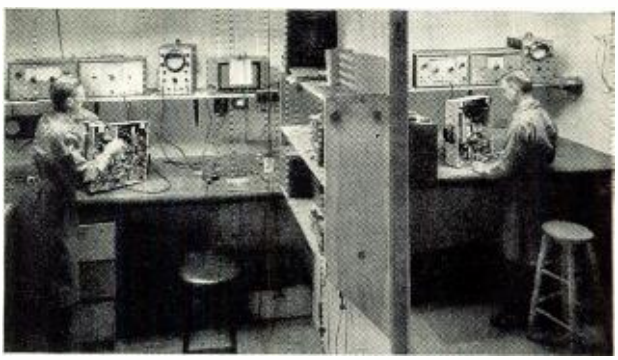

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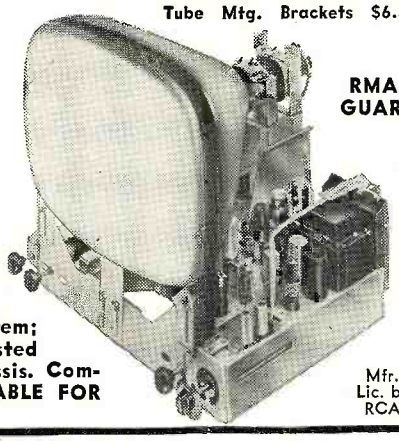

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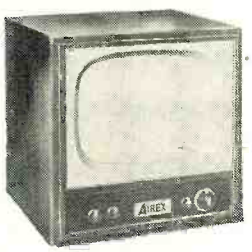

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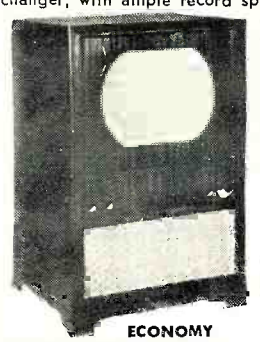

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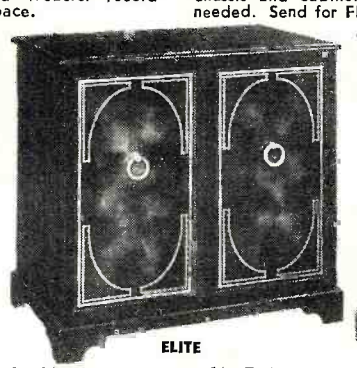

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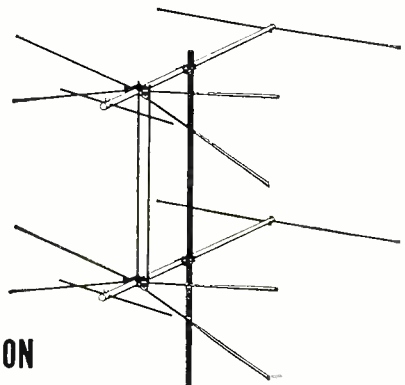

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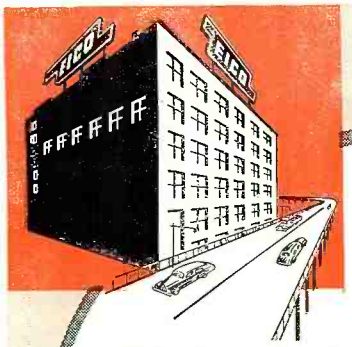

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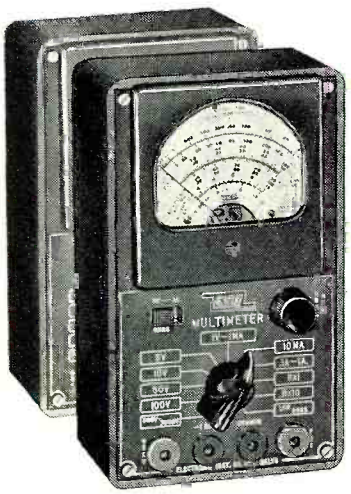

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Radio Control On The Citizens Band

Although designed primarily for controlling planes, this unit may be used with ships and other models.

By
VERNON C. MACNABB*

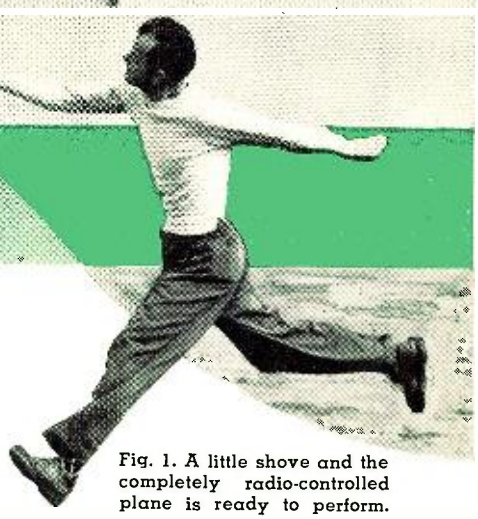


Fig. 1. A little shove and the completely radio-controlled plane is ready to perform.

ANYONE can now control model airplanes and boats by radio. Some readers may wonder why such an obvious statement is made. You always could control anything by radio within certain limits. Control of mobile or distant objects by radio is as old as radio itself, but for the average citizen, a limitation existed in that he had to be a radio amateur, which today means learn the code and pass a technical examination.

In June 1949, the Federal Communications Commission, realizing the necessity for a band of frequencies which would allow the average citizen to operate a transmitter without technical knowledge or ability to read code, opened a band of frequencies known as the Citizens Band, running from 460 to 470 megacycles. This band of frequencies falls somewhere near the indistinct dividing line between what is known as very-high frequencies and ultra-high frequencies. It presents a serious problem in making equipment work on these frequencies because it is close to the limit possible with conventional tubes and tuned circuits and at the same time it is so low in terms of ultra-high frequencies, that short-wave plumbing or waveguides have large and rather unwieldy dimensions. Some recent technical developments, however, have produced some subminiature tubes which will function properly at this frequency so the equipment described in this article is more or less conventional in that it uses tuned circuits instead of cavity resonators.

The photographs, Figs. 4 and 7, show the transmitter and receiver. The transmitter dimensions are 9"x4"x 2¾", and the batteries are self-contained. The weight of the complete unit with batteries installed is less than four (4) pounds. The receiver itself weighs five (5) ounces and the recommended batteries to use with this receiver will weigh an additional nine (9) ounces, making the total weight less than one (1) pound. Dimensions are 3¾"x2⅛".

The accompanying photo (Fig. 1) of a model builder hand-launching a plane illustrates the size airplane that will readily carry this equipment. This plane is powered by a .019 engine. The closeup view of the cabin (Fig. 6) shows the receiver installed in a plane.

The transmitter is a self-excited oscillator with a directly coupled antenna and the problem in designing this unit was one of stability. The circuit diagram, Fig. 2A, looks like any conventional single tube unmodulated transmitter but the chassis, shown outside the case in Fig. 3, shows that mechanically it is a rather radical departure. The tuned circuit and antenna coupling coil is punched out of the chassis for rigidity and grounding reasons. As a result the chassis is connected to "B+." The comb-like piece reduces capacity coupling between the tuned circuit and antenna pickup coil to help pass FCC frequency stability requirements. A piece of bimetal is used to form a small capacity which varies with temperature across the tuned circuit to provide temperature stability. The transmitter had to be approved by the Federal Communications Commission before it could be manufactured, and the requirements were that it should not drift more than 0.4 per-cent from 465 megacycles under a number of conditions, such as tube warm up, decline in battery voltage, and temperature change. It took over eighteen months of development work to satisfy the FCC on these rigid requirements. An individual will find it impractical to try and design a transmitter for his own use as the FCC will not undertake approval tests unless 100 units are to be manufactured.

The folded dipole and reflector which plugs into the top of the transmitter allows the small output of the transmitter to be concentrated in one direction and the reflector also serves the purpose of making the box cold as far as r.f. is concerned. The transmitter operates with 6 volts of filament power and 135 volts of "B" battery. The filament draws 200 milliamperes and the plate current, when the transmitter button is pushed, is 20 milliamperes.

To operate the transmitter, the filament switch is turned to "On" and a minute allowed for tube warm up. A conveniently placed *Micro Switch* is then depressed as the unit is held in the hands to apply "B" voltage and send out the signal.

The function of the receiver is to close a relay when the signal is received from the transmitter. In order to make it suitable for model planes, the weight must be kept to a minimum and one tube is all that is used in the circuit. A superregenerative type of circuit, Fig. 2B, is used which is so sensitive that even when a very weak sig-

* President, Vernon C. MacNabb Company, 915 Westfield Blvd., Indianapolis 20, Ind., manufacturers of "Citizen-Ship" radio control equipment.

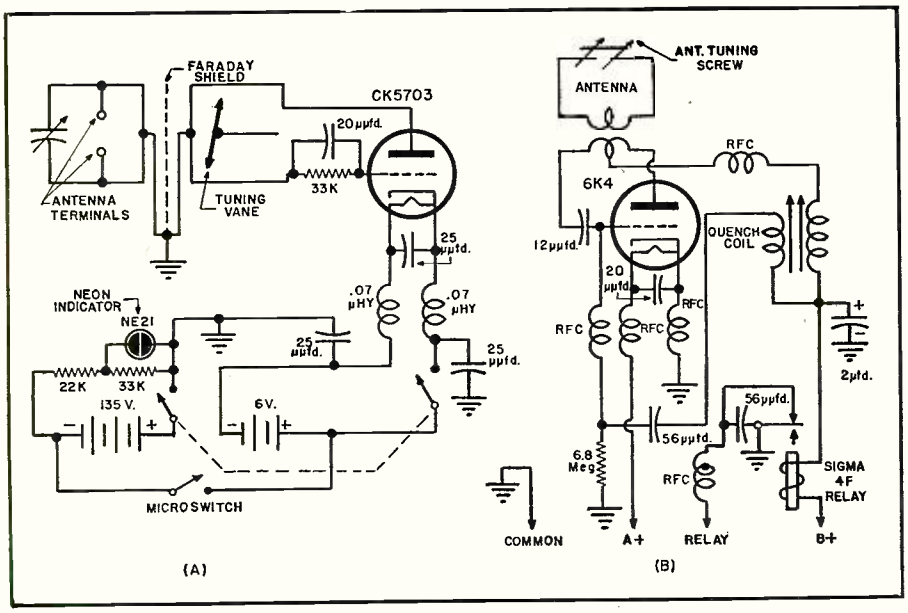


Fig. 2. (A) Complete schematic diagram of the transmitter portion of the radio-control unit. (B) The unusually sensitive superregenerative-type receiver section.

nal is received from the transmitter the plate current change is approximately ten to one. The normal idling current is 0.1 milliampere and when the transmitted signal is received the plate current jumps to 1.0 milliampere, or more. The sensitive relay is set to operate at about 0.3 milliampere therefore it has a large factor of safety and extreme reliability. This action takes place over distances in excess of one-half mile when carried by a plane in the air so that ground reflections and absorptions are not present. At waist heights along the ground, the equipment will work at approximately three-tenths of a mile. Because the plate current is so low, two hearing aid type "B" batteries delivering 60 volts may be used to supply the "B" voltage and their life is as long as their shelf life. The tube in the receiver is a 6K4 subminiature and uses 6 volt filament supply at 150 milliamperes. The intermediate sized flashlight batteries will operate the unit for about an hour.

Looking at the receiver, Fig. 7, it will be noticed that there is a square or rectangular band of aluminum underneath the main chassis base. This is the antenna which is a dipole folded into an approximate square so it is not directional. The tuned circuit is a copper band at the left end of the chassis and the relay is in the right foreground. Four *Fahnestock* clips are provided for connections, "plus A," "plus B," "ground," and the fourth clip for connection to the escapement, motor, or any other device used to control the airplane or boat. The *Fahnestock* clips on the receiver also serve the purpose of mounting the receiver on rubber bands to avoid engine vibration and shock.

Radio control of model planes is not new as they have been flown for approximately fifteen (15) years by such pioneers as Clinton DeSoto and the Good Brothers. The Good Brothers are the most famous for their contributions in this field. One of the simplest means of controlling a model plane in flight is by controlling the rudder only. Most model planes are self-stable, that is, they fly level or return to level flight if disturbed from their normal course without correction of elevators or ailerons. Therefore, all that is necessary to control flight is a rudder, which will cause the plane to turn and return to the operator at will. They are also designed to climb slowly while the motor is running and to glide to earth gently after the motor has run out of gas or is shut off.

It is surprising the number of maneuvers that can be performed by rudder alone. Not only can all types of turns be executed, such as square patterns, figure eights, etc., but by properly setting the amount of rudder control, the planes can be made to spiral dive and at the end of a spiral dive, by giving opposite rudder, it can be made to loop. The spiral dive, of course, is useful in losing altitude in case the plane is climbing too high under power.

The most common method of obtaining rudder control is by a sequential device known as an escapement as shown in the photograph of Fig. 5. It is a small electromagnetic device weighing only one-half ounce, which is driven by a rubber band and triggered by the closing of the relay in the receiver. The escapement moves the rudder from neutral to right, back to neutral, to left, always returning to neutral when the transmitter is off. If right rudder has just been used and the rudder is back to neutral, one pulse

Fig. 4. Over-all view of transmitter with antenna. The entire radio-control unit weighs less than four lbs. including batteries. →

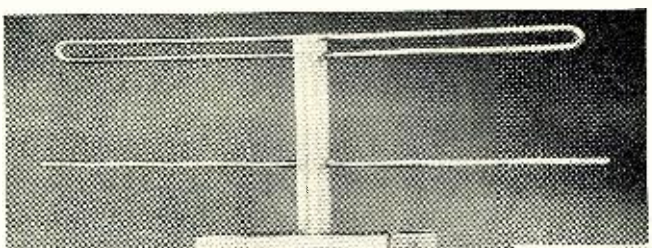
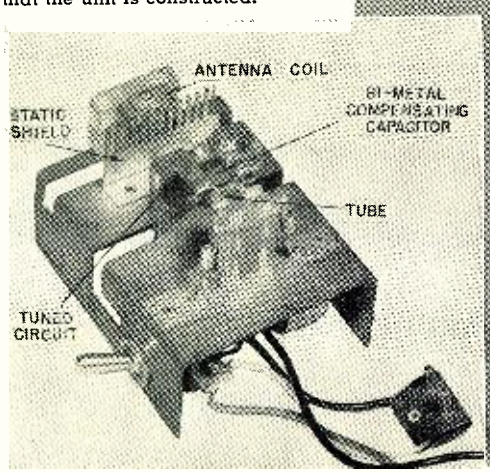


Fig. 3. Transmitter removed from case and showing the unusual way that the unit is constructed.



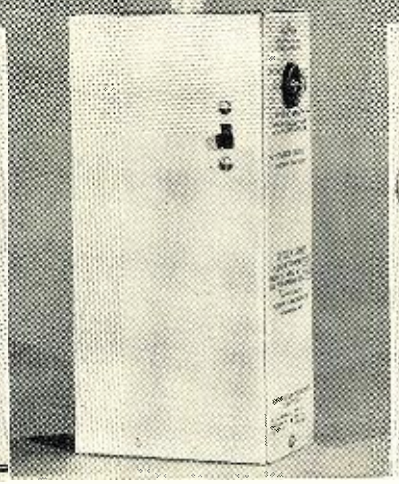
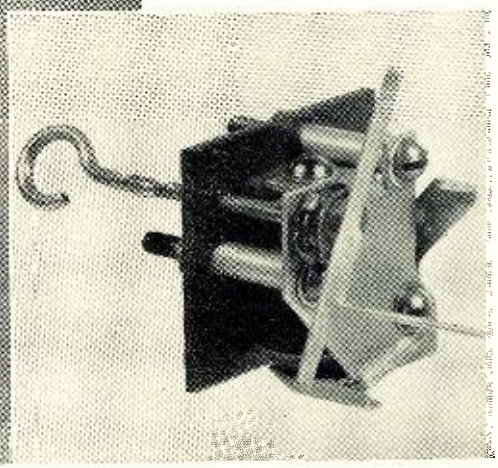


Fig. 5. The most common method of obtaining rudder control. This sequential device, known as an "escapement," moves rudder left, neutral, right.



gives left rudder, two pulses right rudder.

The work of the Good Brothers and early experimenters was done in the 5 meter ham band. The receiver was a superregenerative set which normally drew about 1.5 milliamperes. This plate current dropped to about half that value when the signal was sent to it. It was necessary, therefore, to cause a relay to function within a two-to-one change of plate current. There was another limitation; with this constant "B" battery drain, as the plate voltage fell the plate current itself declined and the relay setting might have to be changed.

Strangely enough, in spite of all the difficulties encountered in making the system operate at 465 megacycles in the Citizens Band, one advantage is outstanding. Because of the extremely high radio frequency in comparison to the low audio frequency in the conventional superregenerative circuits, the plate current increases instead of decreases, and because of the large safety factor on plate current change as mentioned before, decline in "B" voltage does not cause marginal operation of the relay. In addition, because the current is low with no transmitted signal, economy of "B" power is obtained which obviously saves weight.

Further convenience contributed by the 465 megacycles is the small dimensions of the half-wave dipole that makes the transmitter completely portable. It is only one foot long. The transmitters working on 54 megacycles require the erection of an approximate 8 foot dipole which anchors the operator to one spot.

The best example of the reliability of this equipment, which is commercially called "Citizen-Ship Radio Control," is the fact that the first production units to leave the factory were used in competition at the National Model Airplane Meet in Dallas, Texas, in July 1950, and the model builder who incorporated this equipment in his ship won first place. It is obvious that the radio alone was not the sole reason for winning, but without equipment that was absolutely reliable, it would have been impossible. Never once did the radio system fail to respond when the transmitter was actuated. There were many cases of other contestants, some of whom had homemade equipment and on the ham band, who would lose control of their planes and they would fly away, resulting in not only loss of points, but sometimes a damaged plane when recovered.

"Citizen-Ship Radio Control" equipment is virtually license-free, as no examination or code test is required. A federal form is packed with each transmitter and it is only necessary for the purchaser to fill out this form and send it to his nearest FCC Field Engineering Office and a portion of the form is stamped with a number and returned to the purchaser. This becomes the radio transmitter's license. With this license, anyone can use the transmitter. The only limitation is that any individual less than 18 years old cannot obtain a license, but it is permissible for him to use the equipment if one of his parents obtains the license.

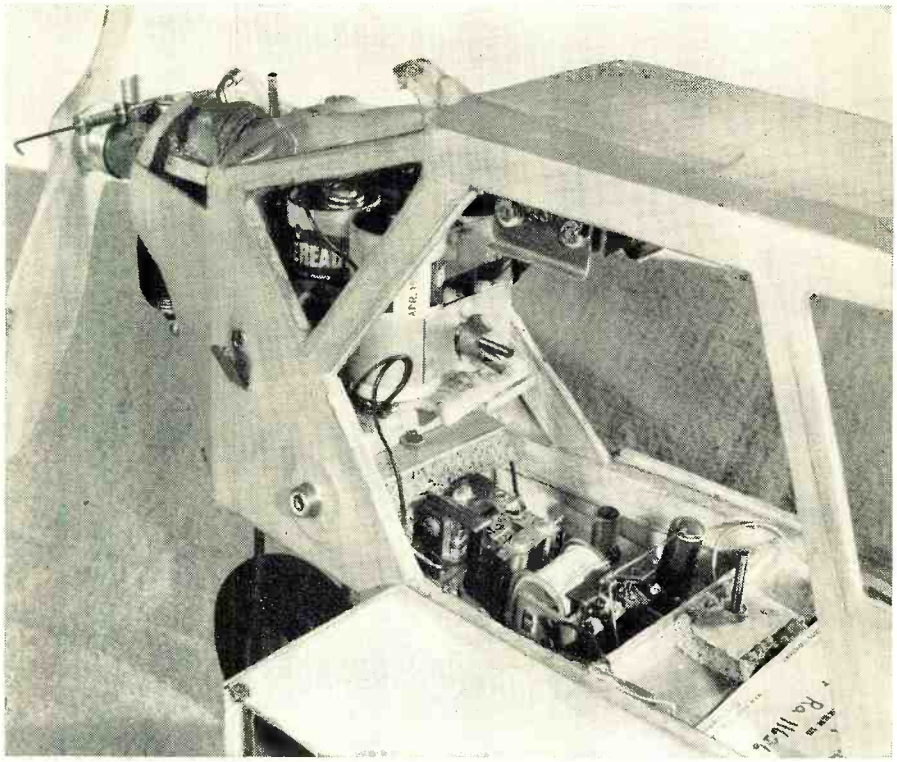
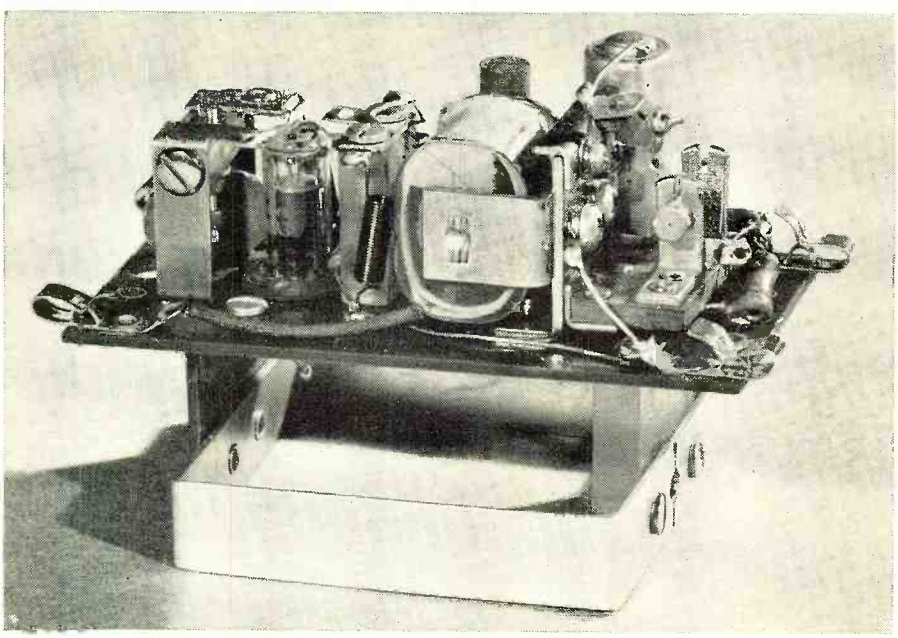


Fig. 6. Close-up view of the cabin showing the receiver installed in the plane.

This virtually license-free equipment opens up a new field to hobbyists. The equipment is designed, engineered, and manufactured so that no knowledge of radio is required to use it. If a person is capable of connecting up a simple electrical circuit, which means connecting up the batteries, the equipment is guaranteed to operate. With this equipment in the hands of ingenious hobbyists and model builders, it may soon be possible to control a model plane in as complex a manner as though a pilot were in the plane itself. One manufacturer already has a device which requires a very simple accessory to the transmitter and in place of the escapement a selective mechanism in the plane attached to the receiver, which will give as many as twenty-four (24) different functions. With this number of controls, anything is possible. The air over vacant lots may soon be filled with model planes zooming over the heads of spellbound spectators.

Editor's Note: The home construction of the transmitter described is not advisable, as FCC approval cannot be obtained for such units. —30—

Fig. 7. Receiver section with the dipole antenna folded into a non-directional square.



THE LOUDNESS CONTROL— An Aid To Higher Fidelity

By
RON PICKETT

Over-all view of the completely assembled "Loudness Control" unit.

Although quite often overlooked, compensation for the frequency characteristic of the human ear is a very important factor in better quality audio.

ONE of the factors in the design of high quality audio equipment which is all too often neglected is the frequency response characteristic of the human ear. We take great pains to see that our sound equipment is capable of flat response throughout the audible range, and that harmonic and intermodulation distortion are within reason, yet we pay little or no heed to the manner in which the ear responds to various frequencies.

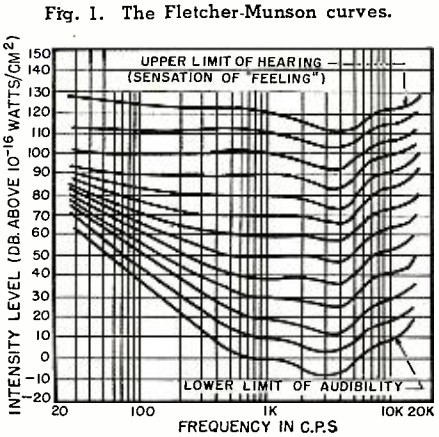
The work of H. Fletcher and W. A. Munson[1] should be familiar to all audio designers, but unfortunately, little emphasis appears to have been placed on the importance of their findings.

Fig. 1 shows some of their findings, in graphical form. These curves were prepared from averaged measurements taken with a large number of individuals, and each curve represents the intensity of a pure tone judged by the individual to be the same intensity as a pure tone of 1000 cycles, the reference frequency. The curves, then, show the remarkable *in*ability of the human ear to respond to all frequencies alike. For example, a pure tone of 1000 cycles, produced at a level of 20 db sounds as loud as a pure tone of 100 cycles produced with 30 db greater intensity.

It is easy to see why our sound equipment is unsatisfactory at low levels, appearing to lose bass response, and to a lesser degree, the high frequency response also suffers. In spite of the fact that an uncompensated amplifier and speaker system may be measured to show a uniform response from 20 to 20,000 cycles at any level, it will sound good only when reproducing at a level comparable to that of the original source. For example, a full symphony orchestra may require as much as 50 to 60 watts, and it is doubtful if many of our wives (or neighbors, for that matter) would permit us to use an acoustical power output of this magnitude for very long. But if, with an ordinary volume control, we reproduce the orchestra at the much more comfortable level of 50 to 60 milliwatts, then the loss of bass response is so apparent to our ears that the quality suffers greatly. We are thus torn between the desires of keeping the naturalness in our musical reproduction and keeping the neighborhood peace.

A little study of the curves of Fig. 1 will show that our audio equipment, particularly that used in the home, requires a great deal of compensation in the lower frequency region as well as some in the higher frequencies, if we are to have true high fidelity sound reproduction at a level we can conveniently use.

Fig. 1. The Fletcher-Munson curves.



A number of attempts at correcting this trouble have been made from time to time, but these solutions are not particularly successful as is evidenced by the assortment of bass, treble, and volume controls with which our equipment is customarily burdened. The shunt condenser type of tone control and the tapped volume control, both shown in Fig. 2 are, of course, steps in the right direction, but their effectiveness is necessarily limited. The complexity to which bass and treble compensation controls can grow is easily seen in modern audio circuitry.

Recently, a number of compensated volume controls have appeared[2,3,4] which offer advantages not previously obtainable. These are called "Loudness Controls" because they closely approach the compensation required to match the equal loudness curves shown in Fig. 1, at least in the low frequency region. Thus, the bass compensation and volume controls are combined.

In practice, however, all these controls suffer from one or more of the following defects which contribute to something less than enjoyable listening.

First, two of the three "Loudness Controls" described use switch or step-type attenuators, which are confusing to the average user, since most of us are not accustomed to handling this type of control. Second, none of the three provide any high frequency compensation, even though the Fletcher-Munson curves indicate the need for this, especially at the lower intensity levels. Third, none of the controls provide a sufficient range of attenuation so that they can replace an existing volume control directly, thus making necessary an additional control for level-setting, from which the "Loudness Control" operates.

The validity of the last point may be debatable, but most will agree that additional controls are undesirable. The range of attenuation required is dictated by both the maximum output

of the equipment in use, say 10 to 15 watts, and the minimum usable output for a comfortable background of music. The minimum usable output then determines the range of attenuation required. Some studies have shown that average residences have a sound intensity level of about 40 db above the threshold of hearing, which is the 0 db curve in Fig. 1 for normal ears. If we are to match the maximum average power output of a large orchestra at the high end of our attenuation range, say 100 db on the same scale, then 60 db total attenuation is required in a "Loudness Control" to reduce the orchestra to a level corresponding to the background which is present in our homes.

In the "Loudness Control" to be described, an attempt is made to overcome the faults of its predecessors as outlined before. Fig. 3 is the schematic of the unit, together with the values of the components used. Fig. 5 shows the performance characteristics, as measured with laboratory equipment. It can be seen that a total of 60 db attenuation is provided at 1000 cycles, while both high and low frequencies are compensated as necessary to give natural reproduction at any level.

Calculation of the values of the components in a network such as this is tedious, but can be considerably simplified by a few practical assumptions. If we consider the output of our control to be unloaded, as it is when feeding a class A grid, and further if we choose values such that each section of the complete control will not appreciably load the preceding section, it is then possible to consider each section separately.

Fig. 4 shows one section of the "Loudness Control" alone. Since there are five such sections in the complete control, a total of 60 db attenuation at 1000 cycles means that each section must contribute 12 db at this frequency. The curves of Fig. 1 show that 9 db attenuation is required in the first section at 100 cycles when we have 12 db at 1000 cycles. These attenuations correspond to voltage ratios of 2.8 and 4.0 respectively.

It can be shown, then, that in Fig. 4,

$$4.0 = \frac{\sqrt{(200K + R)^2 + X^2}}{\sqrt{R^2 + X^2}}$$

at 1000 cycles

and

$$2.8 = \frac{\sqrt{(200K + R)^2 + 100X^2}}{\sqrt{R^2 + 100X^2}}$$

at 100 cycles.

Solving these as simultaneous equations gives the values of X and R for the first section. Similarly, X and R for each succeeding section can be found, considering the additional attenuation required in each section at 100 cycles for the 12 db steps at 1000 cycles. The capacitance value is, of course, computed from the relation $X = 1/2\pi fC$.

The high frequency compensating condenser, C_1 in Fig. 3, should be chosen so that it represents a higher reactance at 1000 cycles than the portion of the potentiometer across which it is connected, but compares with or is nearly equal to the resistance at 10,000 cycles. A 3-30 $\mu\mu$fd. trimmer is adequate here, and allows enough adjustment so that the effect of stray wiring capacitance can be eliminated.

The component values, as given in Fig. 3, yield an effective input impedance for the "Loudness Control" of about 250,000 ohms, and it may therefore be used as a direct replacement for any existing grid circuit volume control whose total resistance is between 100,000 ohms and one megohm. The output of the "Loudness Control" is intended to feed the extremely high impedance we find at the grid of a class A amplifier, and the purpose of the one megohm resistor R_7 is to complete the grid circuit to ground. It would not be advisable to attempt to feed a transformer from the output of the "Loudness Control," because the reactance of the transformer is likely to upset the attenuation characteristics.

Mechanically, this "Loudness Control" is built around a standard linear taper *Ohmite* or *Allen-Bradley* potentiometer which has been modified in much the same way as one of the previously described units[4]. This type of potentiometer was chosen because of the sturdy mechanical characteristics of its resistance element. It is necessary to provide four taps on the control. These were made in the following manner. Four holes were drilled into the side of the potentiometer base at convenient points. These holes should be just large enough so that a piece of solid tinned hook-up wire can be inserted to fit snugly. The depth

(*Continued on page* 161)

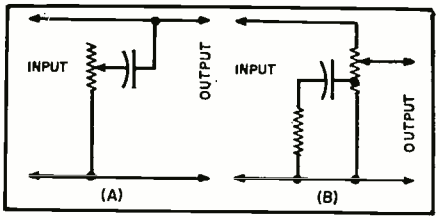
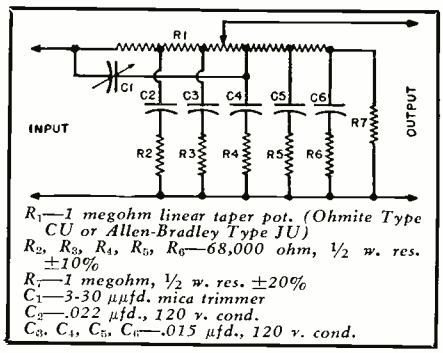


Fig. 2. (A) The shunt condenser-resistor type tone control and (B) the tapped volume control. Their effectiveness in obtaining correct compensation is limited.



R_1—1 megohm linear taper pot. (Ohmite Type CU or Allen-Bradley Type JU)
R_2, R_3, R_4, R_5, R_6—68,000 ohm, ½ w. res. ±10%
R_7—1 megohm, ½ w. res. ±20%
C_1—3-30 $\mu\mu$fd. mica trimmer
C_2—.022 μfd., 120 v. cond.
C_3, C_4, C_5, C_6—.015 μfd., 120 v. cond.

Fig. 3. Wiring diagram of "Loudness Control."

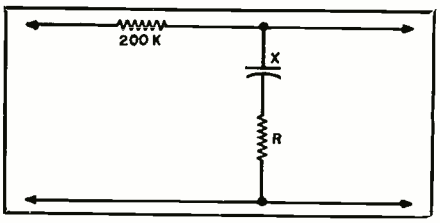
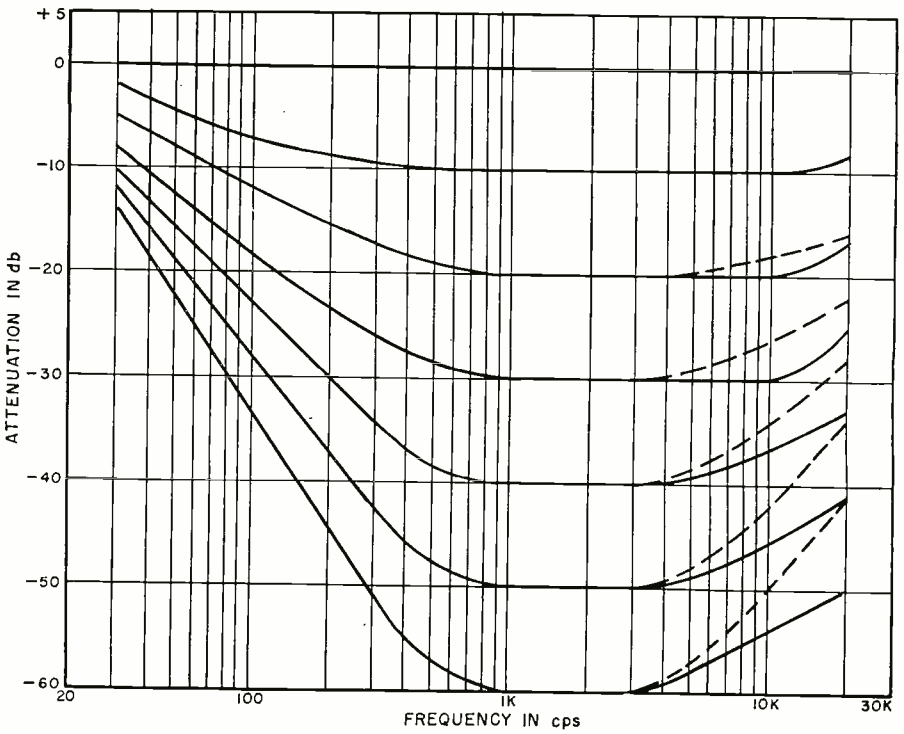


Fig. 4. One section of the "Loudness Control."

Fig. 5. Measured response curves. The solid lines indicate the high frequency compensation obtained with the variable trimmer condenser set at minimum and the dashed lines the compensation with the condenser at maximum. As mentioned in text, stray capacitance between input and output leads produced by wiring the "Loudness Control" into an amplifier will give rise to additional high frequency compensation.



SELLING MAINTENANCE— and YOURSELF

Technical "know-how" is important but don't forget those vital "extras."

By
YVON O. JOHNSON

Your livelihood depends as much on pleasing your customers as your ability to repair sets properly.

YOU may be so wrapped up in the technical aspects of radio and TV servicing that you may not realize that you are actually selling two things: maintenance and, more important, yourself.

Selling yourself implies that you are able to get along well with your customers; it means that you create a good impression for yourself and your firm; it means that customers think that you are the only one who will ever fix their sets.

You can be one of the best radio and TV troubleshooters in town but you can get into more trouble if you rub your customers the wrong way. You can make your day more pleasant and profitable by observing a few rules that are almost as important as circuit diagrams in servicing TV and radio for a living. Don't neglect your technical ability, however.

The technician who handles customers in a salesman-like way will find himself considered a valuable asset to his company; often, a firm will be willing to pay premium wages for his services. Conversely, a company will soon lose patience with a man who creates more trouble than he solves on a service call.

Technicians often bemoan the lack of confidence that the general public has in the service industry. While this situation is to be deplored and combated by every member of the industry, you will find that it can help you instead of hinder you! Here's how it works to your advantage: When a customer finds that you are thoroughly honest and competent he will come back again and will recommend you to his friends because he knows that you are trustworthy and he doesn't know that the next technician will be equally trustworthy.

A Good Impression

You are no more than your customer's impression of you. He has no meter to measure your ability to fix his set. He know only what he thinks of you. You may be tops in servicing ability but he may not think so; you may be average, but he may think you are the best. This occurs because of the fact that customers usually have no understanding of the work involved in diagnosing and repairing a set.

Your customer wants you to be honest, truthful, efficient, and competent. Your first step is to *be* these things. Your next step is to let the customer see these characteristics for himself. That is your problem. Here are some suggestions to help you solve that problem for yourself.

Be on time. You'll start off on the wrong foot if you are late for the service call. Phone the customer in advance if you know that you will be late. This may seem to be rather obvious to you, but customers will tell you of other technicians who failed to show up at all on the day of the scheduled call.

Be courteous. Courtesy begins when the customer opens the door. Have a friendly greeting announcing your firm's name. The customer will then ask you to come inside. By all means, say: "Thank you." Already the customer will think of you as a very nice person.

You should remain courteous through the entire call regardless of what the customer says that might irritate you; be above giving sharp replies. Of course, you should thank the customer pleasantly when you leave.

Be neat in appearance. Your appearance must coincide with the idea that the average customer has of a competent technician. That is, look the part and you will be playing it in the customer's mind.

What would you, if you were a customer, expect a technician to look like? Probably you'll come up with an answer like this: hair cut and combed, clean shaven, and dressed in clean work clothing. You should neither look as if you have just crawled out from beneath your car nor as if you are going out on a heavy date. You don't want to be sloppily dressed, yet you should look as if you aren't afraid of a little hard work.

Carry professional equipment. If you carry professional-looking equipment, you will have the look of a thoroughly competent technician. Tools in good shape and an attractive case in which to carry them will make the customer think well of you.

You may be pleasantly surprised to realize that the quality of your tools will impress two widely separated groups of customers: the man who works at a trade and the housewife. The man who has tools of his own that he uses in his daily work will look with a critical eye at your own collection of tools. They had better pass his inspection; if they do, he'll consider you a master craftsman like himself.

You will receive a lot of favorable

comment from housewives over attractive rolls of screwdrivers and socket wrenches. If you carry a mirror which is adjustable on a stand you'll appear to be one of the best equipped technicians who ever worked on the set. The customer may not say it, but he thinks that you have his best interests at heart when you come properly equipped.

Act decisively. Almost any TV owner can tell you about a technician who looked at the set, scratched his head and said, "I've never seen this make of set before." That technician, certainly, did not act decisively.

You should have a definite approach to the set. As you switch the set on, ask the customer: "What has it been doing?" Don't say: "What's wrong with the set?" That'll get you: "You tell me!"

Try all front controls briefly. Next, remove vases and figurines from the top of the set before you try to move it. If you don't, an accident may happen. It is wise to let the customer remove these things if he volunteers to do so. It's also best to place the indoor antenna control box on the floor out of the way. This will save getting your feet tangled in the cables and causing the unit to crash to the floor.

If possible, fold back a small part of the rug so that you can swing the set around to work inside of it. Beware of a table model TV set on a table with thin, unbraced legs. The legs will sometimes snap off if you push the set and table when the legs are on a rug. It helps to lift up slightly at the same time that you move the set.

Place your mirror in front of the TV set, remove the back of the cabinet and you are ready for work. If it turns out to be tube trouble only, don't just stick in a new tube and then run out of the house. Adjust the rear controls for a linear picture of the correct size. The customer will appreciate it. If you have removed the chassis for some reason, buff the tuner contacts with a clean, dry cloth if the tuner was a bit noisy. Wipe the inside of the cabinet's glass and clean the picture tube.

Regardless of how much or how little you do, follow a regular routine and act as if you know what you are doing. The customer will appreciate the professional way that you go about your business.

End up by leaving the old tubes and the cartons from the new ones. This helps to show your honesty to the customer.

Be neat. A good rule is to leave the customer's home as neat as you found it. Better yet, be neat as you work so that the customer does not worry about having to clean up after you have left.

Neatness as you work saves you time and money. You save time by not having to waste it cleaning up after yourself. You save money by always replacing tools in their proper places in the tool kit as you finish using each one, rather than trying to find all the tools when it is time to leave.

Choose words carefully. Every word that you say to the customer about his set and antenna will be remembered by him. It will be quoted by him, correctly or incorrectly, to your company in case of future difficulties. Customers are prone to read meanings into your words that you did not intend. Be careful and choosy in what you say. It is generally best to say as little as possible until you know the entire history of the set and of the customer's relations with your firm. Don't make commitments for your company unless you are specifically authorized to do so. If the customer wants something done that you are not certain about, it is usually best to say: "I have no authority concerning that, but I'll be glad to speak to the manager when I get back to the shop and have him call you." This gives you and the manager a chance to get in a huddle over the matter.

In connection with using the proper words, be very careful not to criticize his set. You may not like it, but he does.

Maintenance vs. Service

If you have succeeded in selling yourself by creating a good impression and getting along well with the customer, your next step is to sell maintenance. Here are some suggestions.

Talk maintenance. A customer usually wants to know how long his TV set will run until it needs repairs again. Don't make promises that will bounce back on you. It's much better to honestly say: "We've corrected all the troubles that have shown up while we've had it in the shop. It's impossible to tell when a case of trouble might occur again. All your tubes are working fine right now. I can't predict which will be the next one to go out. But you will have, on the average, 3 or 4 of the small tubes go out each year. That isn't trouble or repairs; it's just normal maintenance."

Be sure to get the point across that tube replacements are to be expected and that they are no reflection on the quality of the set. Building up the idea of tube replacements as maintenance instead of service trouble helps you in many ways: you are not criticized when you are called in to replace one tube after another; the customer expects to see you several times a year; you become a permanent fixture in the maintenance of his TV.

Today's family budgets are relatively inelastic and television servicing and maintenance must, of necessity, compete with fixed living costs like food, rent, clothing, etc.

Tactfully handled, the subject of television maintenance can be sold as an "essential" part of the family's entertainment budget.

Tell your story completely but don't over-sell as there may be financial difficulties facing the customer about which you can have no inkling. If you can sell the *idea,* you'll get the business when and if the family can afford it.

Point out troubles. Sometimes it is necessary to leave a set with some troubles in it other than the trouble you corrected. The customer may want to wait until later to have the additional work done. To protect yourself, make a note on all copies of the work tag of the fact that the set needs to go into the shop to have the additional trouble corrected. The desirable customer will appreciate your telling him of the condition of his set. This note will keep the undesirable customer from telephoning the shop the next day to say that his set has developed some new troubles because of the work you did on it.

You'll find that you will usually get the job of correcting the additional trouble as soon as the customer is able to pay for it.

How Are You Doing?

Did you check the statements in the box below before you read this article? If you didn't, it will be worth your while to do so. These statements with your checkmarks will help to indicate to you that you may need to work a little more effectively on selling both maintenance and yourself to the public.

The best answers as to how you are doing actually come from the customers themselves. If you find that they ask for your name when you leave, if they request you when they phone the shop to place a service call, and if they give you a friendly reception when you come in the door, then you know that you are doing an effective job of selling yourself. —30—

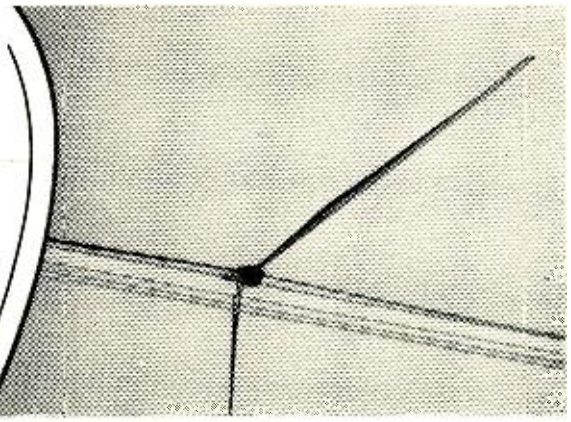
HOW ARE YOU GETTING ALONG WITH CUSTOMERS?

Place a check mark under the appropriate frequency column opposite each statement.

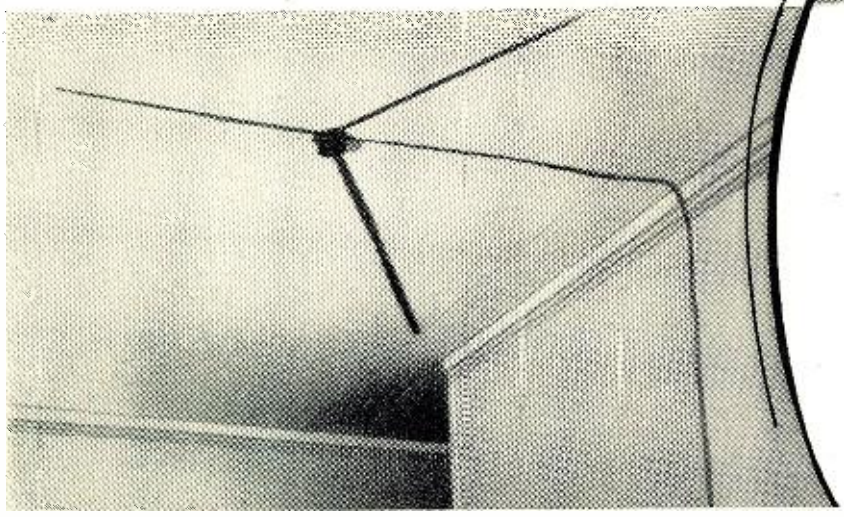
	Often	Sometimes	Never
Customers don't recognize your ability	☐	☐	☐
Customers don't thank you when you leave	☐	☐	☐
You aren't dressed as neatly as you should be	☐	☐	☐
You carry all your tools in your pocket	☐	☐	☐
You tell customers you haven't worked on that brand of set before	☐	☐	☐
You spread your tools all over the floor	☐	☐	☐
Customers accuse you of saying things you did not mean	☐	☐	☐
Customers think it is your fault when a tube burns out	☐	☐	☐

If you have all "Never's" you probably haven't been out on a service call in months; a column of checks under "Sometimes" indicates that you could do a little constructive work on yourself; several "Often's" may mean that you need to put forth some effort to sell yourself before your income suffers.

Problems of INDOOR ANTENNA RECEPTION



An alternative ceiling type mount.



Ceiling mounting position for antenna. Elements are spaced 120° apart.

By

E. M. NOLL and M. MANDL

Simple switching unit permits omni-directional reception without rotating the antenna.

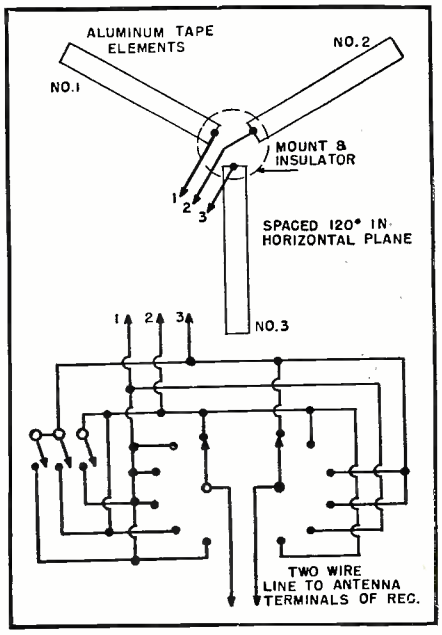
THE conventional indoor television antenna is economical and is convenient only to the extent that no outdoor antenna need be erected. However, its electrical performance and operating characteristics are, in general, *much* poorer than a proper outdoor type. An indoor antenna system is afflicted with numerous defects and problems—orientation, smear, reflections, weak signals, noise, signal interference, and instability. These inconveniences and defects mean picture quality, clarity, and stability are compromised on some and perhaps all channels. Nevertheless, there are many metropolitan and suburban sites such as hotels, apartments, and special housing projects where outdoor antennas are not convenient or are prohibited. Even in residential areas it would be nice to be able to dispense with the unsightly outdoor antenna. A convenient and effective indoor antenna would be a significant contribution to improved reception for many TV homes.

Orientation

Antenna orientation has always been a major indoor antenna problem and nuisance. The indoor "rabbit-ear" is versatile in this respect because it can be oriented and its length adjusted. However, to obtain optimum performance on each channel with stations in different directions, it is necessary to readjust orientation when switching channels. Even with stations in the same direction from a given site, the presence of multiple indoor reflections and multiple high-band lobes often requires orientation from channel to channel if peak performance is to be obtained.

Improper orientation can cause picture smear, sync instability, and ghosts. When an indoor antenna is oriented away from true direction, the picture first begins to smear (presence of weaker direct signal and slightly delayed reflections). As orientation is continued in the same direction, the picture becomes weaker and sync stability poorer (reflected signals have more influence on sync system). Finally, a number of pictures are seen on a very shaky raster (indicating multiple signal reception with sync control shifting between the now much weaker direct signal and reflected components).

Fig. 1. An indoor "Directronic" type antenna with aluminum tape adhesive elements and circuit of switching device.



Reflections

Indoor multiple reflections cause three types of picture disturbance. When the preponderance of reflected signals arrive at the antenna just slightly displaced in time with respect to the direct signal (time delay comparable to partial period of r.f. cycle) the resultant signal delivered to the receiver input can be additive or subtractive as a function of phase relations between r.f. cycles of reflected and direct signal. Consequently, as the antenna is moved about the room there are definite points of strong and weak picture for each channel. It is quite difficult to locate one spot where peak performance is obtained on each channel.

In the case of a built-in antenna or indoor antenna with just a few feet of line between it and the receiver, it means the receiver has to be moved to

(*Continued on page* 111)

A MIDGET V.F.O.

By
W. W. PURVIS, W3QQA

Covers 20, 40, 80 meters, is compact, and features clickless, chirpless keying and narrow-band FM phone.

Over-all view of variable frequency exciter unit. In addition to fixed station use, it is suitable for many mobile applications.

IN VIEW of the difficulties involved in building extremely small variable frequency exciters with good inherent stability, most designers of amateur portable or miniature sized radio transmitters have employed crystal control and the equipment was, therefore, limited to single or fixed frequency operation. Crystal controlled carriers are of course rendered practically useless at times, due to the crowded conditions on the ham bands. Every amateur radio operator recognizes the variable frequency oscillator as an essential part of the modern ham station, for the purpose of shifting the transmitter carrier away from interfering signals and into clear channels. The v.f.o. is also used for spotting DX; in other words for shifting the carrier so as to zero-beat it with the incoming signal of the distant station. The latter method of signal spotting is also used for local contacts, as practically all hams are now in the habit of tuning their receivers so as to hear only those stations calling on the exact frequency to which their transmitters are tuned.

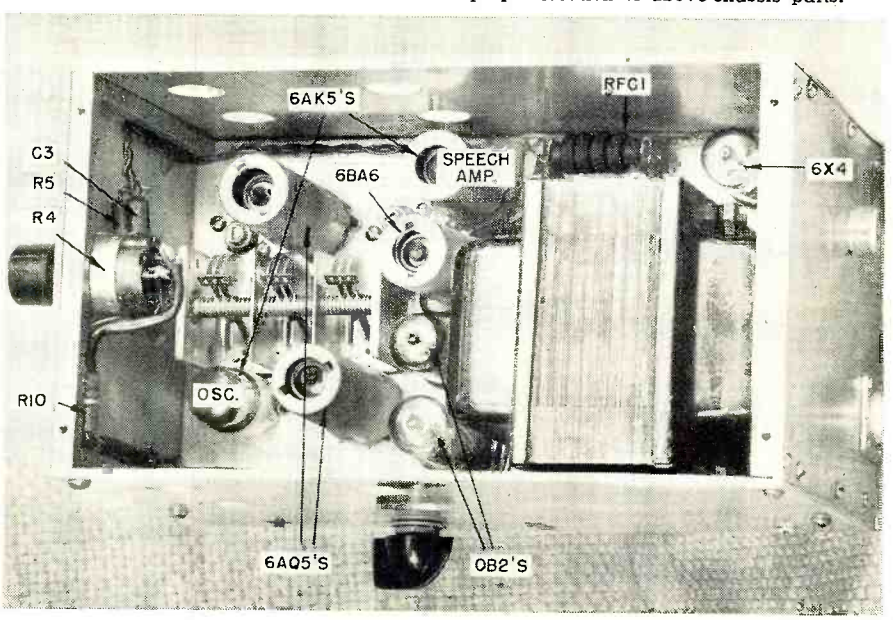
In designing the v.f.o. herein described, the writer has solved some of the problems relative to building midget sized equipment. Approaching the handie-talkie in size, this unit incorporates slightly new and different methods of construction and it is hoped that these methods will prove helpful to amateurs desiring to build equipment perhaps even smaller than that shown here.

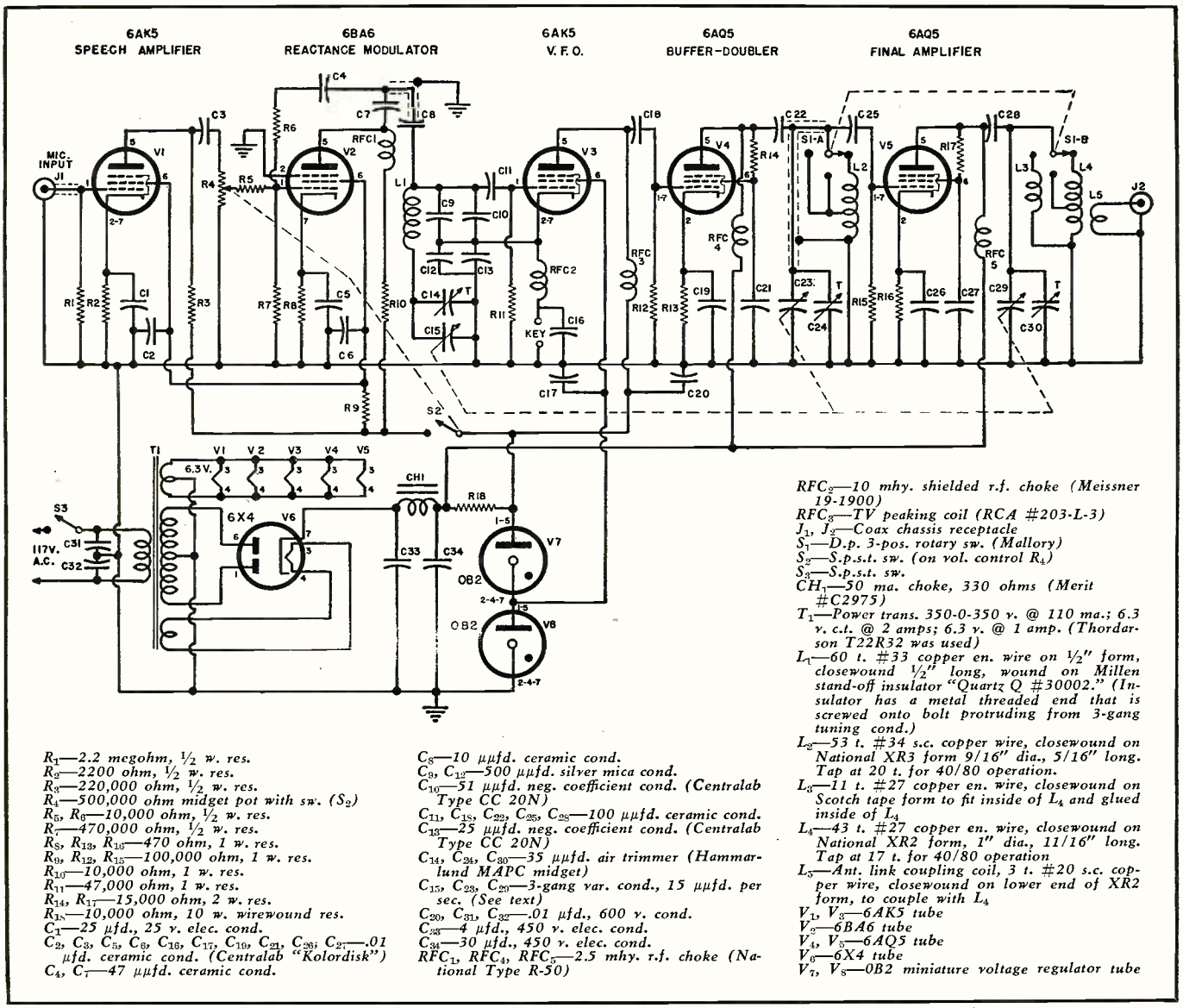
A good compact unit, with regulated power supply, this v.f.o. operates well on three bands. It is a complete exciter/transmitter and is a handy unit for those who want to transport their equipment from place to place. The unit operates on 20, 40, and 80 meters (the old reliable bands where DX is ever-present), and will drive the necessary frequency multipliers, making it possible to double to almost any other amateur frequency.

Unique in design, this unit uses a 3-gang receiving type of midget tuning condenser. Without regard for certain established methods of construction, this set has a power output on the three bands comparable to that obtained with almost any other type of design. The cabinet measures only 5¾" high, 4⅝" wide, and 8½" long and the entire set weighs 11¼ pounds, including the eight miniature type tubes. Should another type of power supply be employed and if the power transformer is replaced by selenium rectifier voltage doublers, a considerable reduction in the size of this unit would be possible. The entire transmitter/exciter minus the power supply would measure only one-half of its present length, or 4¼ inches.

Contrary to the general practice of spacing the stages far apart to avoid interaction or feedback, this exciter's stages are jammed as closely together as possible. The r.f. feedback is eliminated entirely by shielding the lead from the tuning condenser C_{2a} (Figs. 1 and 2), throughout its entire length, from the stator side of C_{2a} to the switch S_{1A}. Also of importance is the method of supplying the screens of the 6AQ5's

Top view with cover removed to show the proper location of above-chassis parts.





R_1—2.2 megohm, ½ w. res.
R_2—2200 ohm, ½ w. res.
R_3—220,000 ohm, ½ w. res.
R_4—500,000 ohm midget pot with sw. (S_2)
R_5, R_6—10,000 ohm, ½ w. res.
R_7—470,000 ohm, ½ w. res.
R_8, R_{13}, R_{16}—470 ohm, 1 w. res.
R_9, R_{12}, R_{15}—100,000 ohm, 1 w. res.
R_{10}—10,000 ohm, 1 w. res.
R_{11}—47,000 ohm, 1 w. res.
R_{14}, R_{17}—15,000 ohm, 2 w. res.
R_{18}—10,000 ohm, 10 w. wirewound res.
C_1—25 μfd., 25 v. elec. cond.
C_2, C_3, C_5, C_6, C_{16}, C_{17}, C_{19}, C_{21}, C_{26}; C_{27}—.01 μfd. ceramic cond. (Centralab "Kolordisk")
C_4, C_7—47 μμfd. ceramic cond.
C_8—10 μμfd. ceramic cond.
C_9, C_{12}—500 μμfd. silver mica cond.
C_{10}—51 μμfd. neg. coefficient cond. (Centralab Type CC 20N)
C_{11}, C_{18}, C_{22}, C_{25}, C_{28}—100 μμfd. ceramic cond.
C_{13}—25 μμfd. neg. coefficient cond. (Centralab Type CC 20N)
C_{14}, C_{24}, C_{30}—35 μμfd. air trimmer (Hammarlund MAPC midget)
C_{15}, C_{23}, C_{29}—3-gang var. cond., 15 μμfd. per sec. (See text)
C_{20}, C_{31}, C_{32}—.01 μfd., 600 v. cond.
C_{33}—4 μfd., 450 v. elec. cond.
C_{34}—30 μfd., 450 v. elec. cond.
RFC_1, RFC_4, RFC_5—2.5 mhy. r.f. choke (National Type R-50)
RFC_2—10 mhy. shielded r.f. choke (Meissner 19-1900)
RFC_3—TV peaking coil (RCA #203-L-3)
J_1, J_2—Coax chassis receptacle
S_1—D.p. 3-pos. rotary sw. (Mallory)
S_2—S.p.s.t. sw. (on vol. control R_4)
S_3—S.p.s.t. sw.
CH_1—50 ma. choke, 330 ohms (Merit #C2975)
T_1—Power trans. 350-0-350 v. @ 110 ma.; 6.3 v. c.t. @ 2 amps; 6.3 v. @ 1 amp. (Thordarson T22R32 was used)
L_1—60 t. #33 copper en. wire on ½" form, closewound ½" long, wound on Millen stand-off insulator "Quartz Q #30002." (Insulator has a metal threaded end that is screwed onto bolt protruding from 3-gang tuning cond.)
L_2—53 t. #34 s.c. copper wire, closewound on National XR3 form 9/16" dia., 5/16" long. Tap at 20 t. for 40/80 operation.
L_3—11 t. #27 copper en. wire, closewound on Scotch tape form to fit inside of L_4 and glued inside of L_4
L_4—43 t. #27 copper en. wire, closewound on National XR2 form, 1" dia., 11/16" long. Tap at 17 t. for 40/80 operation
L_5—Ant. link coupling coil, 3 t. #20 s.c. copper wire, closewound on lower end of XR2 form, to couple with L_4
V_1, V_3—6AK5 tube
V_2—6BA6 tube
V_4, V_5—6AQ5 tube
V_6—6X4 tube
V_7, V_8—0B2 miniature voltage regulator tube

Fig. 1. Schematic diagram of the variable frequency exciter. The circuit is straightforward and easy to duplicate.

directly from the tube plates through the 15,000 ohm, 2 watt resistors, R_{14} and R_{17}.

This v.f.o., when keyed, transmits a signal of excellent quality. Many radio amateurs have reported its signals to be the best quality heard on the air. Every *critical* report on its reception claims the signals sound crystal controlled.

After more than a year and a half of daily operation this unit continues to be trouble free, transmitting very stable, clickless and chirpless signals. The frequency modulated signals are also exceptionally good. This exciter performs in a smaller space and on more frequencies than other amateur v.f.o.'s seen heretofore.

No television interference has been encountered, even when this exciter is operated right on the top of a TV receiver. At several locations, this unit is used by the writer to drive 2E25 and/or 2E26 type tubes which, in turn, drive the output stages of medium powered transmitters. Over two hundred watts input is used at these locations with class B modulation, without TVI. The narrow band FM works well, but AM causes no TVI and is used in preference.

The output of the 6AQ5 final stage on 40 and 80 meters is sufficient to light a seven watt lamp brightly and on 20 meters the seven watt lamp shows slightly less brilliance. With a half-wave dipole antenna indoors, operating on 40 meters, very good results were obtained while using this unit solo, and on 20, employing a flat-top beam, distances up to 3600 miles were worked with little difficulty.

Although it may appear that feeding the screens as described would cause the 6AQ5's to operate as triodes, this is not the case because resistors R_{14} and R_{17} act as r.f. chokes. The screens of these tubes are bypassed to ground through condensers C_{21} and C_{27}. Fig. 2 shows the chassis layout with reference to the d.c. plate and screen leads to the tubes.

A tuning condenser of the type used in the old FM broadcast tuners with 15 μμfd. per gang section and with 3 rotor and 2 stator plates per section is employed. A condenser of this type can be obtained from *All Star Products Inc.*, Defiance, Ohio.

An electro-zinc plated, open-ended chassis measuring 4½" by 7¾" by 1½" is used. The steatite tube sockets, shielded type, are riveted to the chassis and all grounds connected to the socket center posts which are, in turn, grounded to the chassis with soldered connections. Panels are of 1/16 inch aluminum. The front and rear panels measure 4½" by 5½" and are fastened to the chassis with small self-tapping screws. One quarter inch square brass rods are used to fasten the top and side covers. The brass is drilled and tapped to accommodate 6-32 screws. Vent holes, shown in the photographs, are punched into the side and top covers with the aid of a small tube socket punch. Large rubber shock mounts (large grommets ¾" round, one end of which has been molded to fit a ½" hole, 1/16" deep), are glued into ½" holes drilled into the bottom panel.

If the parts are arranged as shown in the photographs and in Fig. 2 there should be no r.f. feedback problems.

Only two leads in addition to the one to C_{23} mentioned previously are shielded, *i.e.*, the speech input lead from the microphone jack and the one from the phase modulator to the oscillator (6AK5) grid. Shielded cable, such as is used for phonograph pickups, is employed throughout, with the shielding grounded to the chassis as often as possible. RFC_1 in the plate circuit of the reactance modulator, is mounted on the top of the chassis as shown in the photograph on page 43. In order to avoid further crowding of parts beneath the chassis, the 500,000 ohm potentiometer R_1 resistors R_5 and R_{10}, and condenser C_3, are mounted on the top of the chassis.

The frequency range of the oscillator is wide enough to permit coverage of most of the amateur bands, since it tunes from 3.3 mc. to well above 4.0 mc. The TV peaking coil RFC_3, shown in Fig. 1, in the plate circuit of the oscillator appears small, but when larger chokes were tried, there was no noticeable change in the output or stability of the unit. By keying the oscillator cathode circuit (keying pin jacks shown in photographs, lower left hand corner of front panel), the latter is silenced when the key is opened, thus making break-in operation possible.

A *Millen* stand-off insulator #30002 "Quartz Q" is sawed off to fit under the 1½" chassis and is used for the oscillator coil form L_1, Fig. 1. Although this type of insulator resembles lucite in appearance and cannot be used for the other stages due to the low temperature at which it melts; it was found to work satisfactorily for the oscillator coil. Other coil forms were tried, such as *National* XR2, and various kinds of wire were used. However, the *Millen* form, wound with #33 copper enameled wire produced the most stable results when the turns were covered with several thick coats of *Duco* household cement. (*Duco* was found to be a very good insulator when thoroughly dried.) When checking the fourth harmonic of the oscillator on 15 mc., beating it with WWV, there was no audible drift in frequency after the tubes were allowed to warm up. The amount of drift during the warm up period is almost negligible. Stability was found to be slightly improved by leaving the oscillator tube shield can off.

With 360 volts on the plates of the 6AQ5's, the plate current never exceeds 26 milliamperes input to each tube. Thus by putting 9.3 watts into them, their maximum plate dissipation is not exceeded. The 6AQ5's get very hot which is characteristic of the tubes, but nothing inside the small cabinet becomes overheated. The plate voltage of the 6AK5 oscillator tube is approximately 212 volts, while the screen voltage remains 100 volts, as regulated by the OB2 tubes.

While operating on 80 meters, the oscillator, buffer/doubler, and output stages are all on the same frequency, but no chirps are picked up in the monitor when the unit is keyed. The "Q" of the coils is kept high with the lengths of the windings measuring less than the diameters of the coil forms.

A phase-modulated type 6BA6 tube is coupled to the oscillator through the 10 $\mu\mu$fd. condenser C_8. Larger condensers, when used for this purpose, tend to overload the oscillator and cause too much frequency deviation; while a smaller capacity gives insufficient modulation swing. The switch, S_2 Fig. 1, on the FM volume control, cuts the plate supply to the speech amplifier and modulator tubes when the FM is switched off.

Bandswitching is accomplished by means of switch S_1, which is shown in photographs mounted on the right side of the cabinet. Both the doubler/buffer and final plate coils are center-tapped, so as to work on either 40 or 80 meters. With S_1 in the first position, or for 80 meter operation, L_2 and L_4 full coils are switched into the tube circuits. In the second, or 40 meter band position, the switch connects the lower taps of L_2 and L_4 to the 6AQ5 plates when L_2 doubles to the 40 meter band and L_4 acts as a straight amplifier. The third position of S_1, for twenty meter operation, places the lower tap of L_2 in the plate circuit of the second stage, which is doubling to 40 meters, and L_3 is switched into the final stage so that the output stage is also doubling. The plate coil L_3 is wound on a Scotch tape form, just large enough to make a tight fit inside of L_4 and is glued inside of the latter after it has been adjusted for maximum transfer of r.f. energy to the antenna link coil L_5.

After the r.f. stages are lined up cold with a grid dip meter to track with the oscillator tuning they are retuned after the metal cabinet cover plates are screwed on. It will be noted from the photograph, below, that the oscillator trimmer (C_{11}) plates are tuned half way out, or half of maximum capacity while C_{24} and C_{30} are almost all the way out, or minimum capacity. By holding a small neon lamp near the tuning condensers, on the top of the chassis, each r.f. stage is tuned for maximum brightness of the neon by adjusting C_{24} and C_{30}. C_{30}, the output tuning trimmer, can be reached through the hole in the right side of the chassis. C_{21} can be reached from the top of the chassis. Fine tuning adjustments are made with the aid of a field strength meter.

—30—

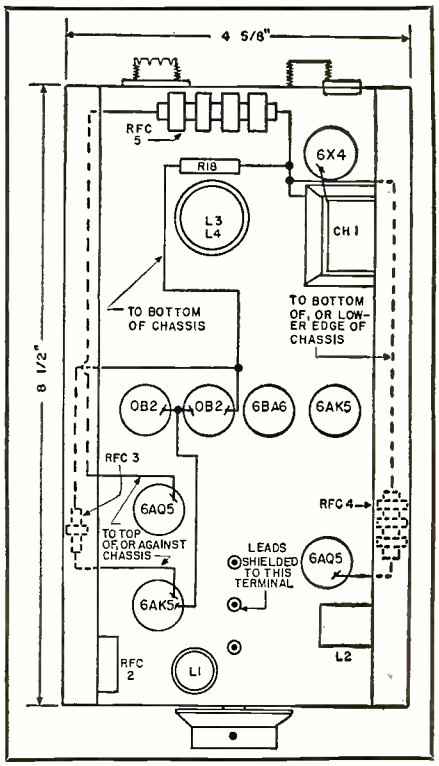
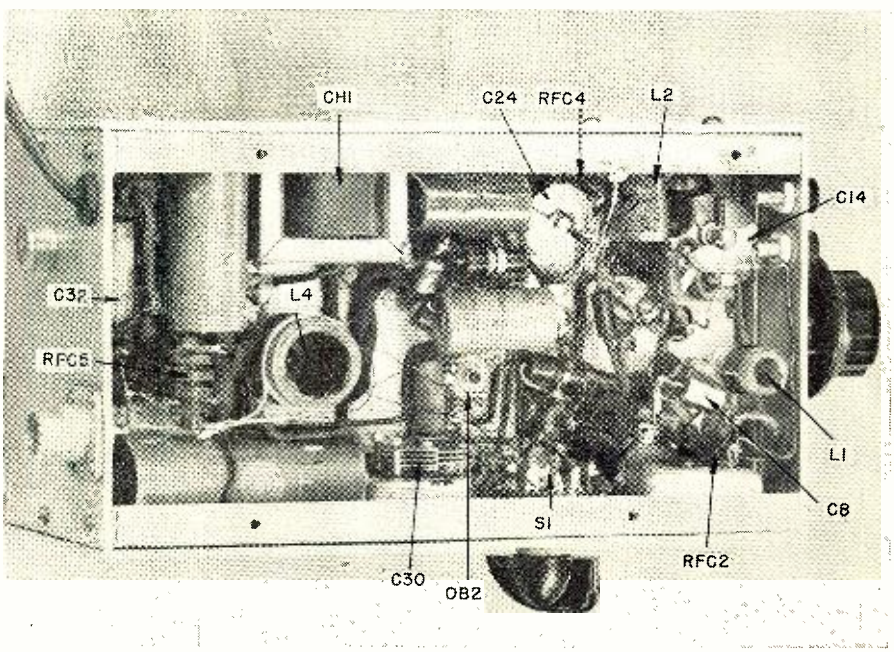


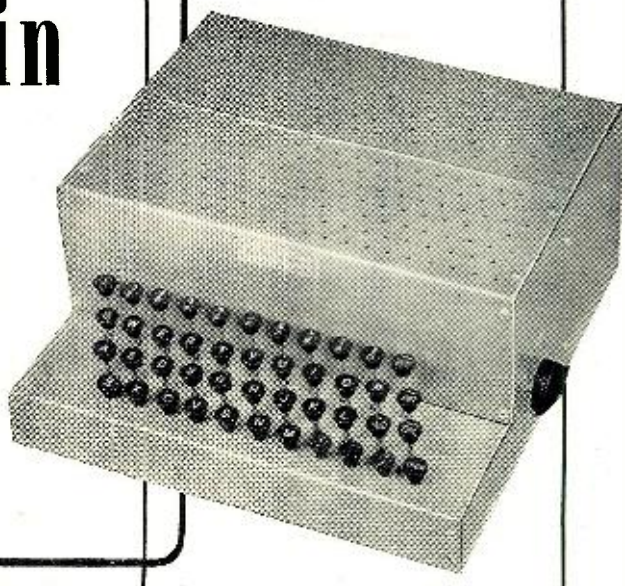
Fig. 2. Underchassis diagram showing location of the d.c. leads and r.f. chokes.

Underchassis view of variable frequency exciter. For parts identification, see Fig. 1.

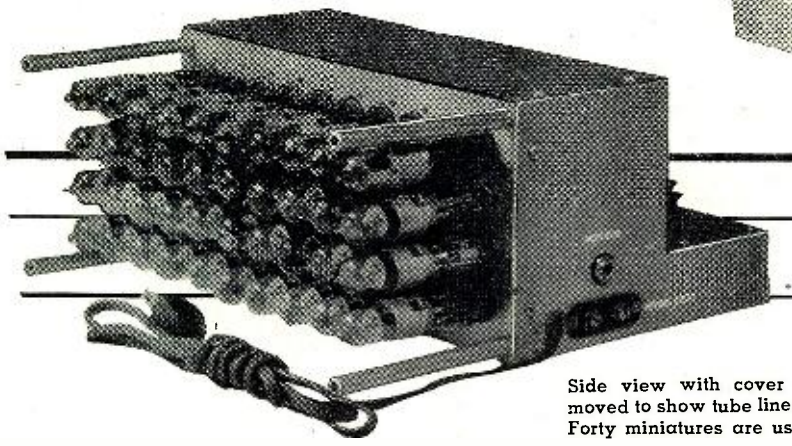


The Electronic Brain "CODETYPER"

Details on a completely automatic unit which requires no knowledge of code nor typing yet permits transmissions of from 10 to 75 wpm.



Front view of the "Codetyper" showing the typewriter-type keyboard with telegraphic symbols.



Side view with cover removed to show tube lineup. Forty miniatures are used.

By NATHANIEL G. A. DORFMAN
President, Codetyper Laboratories*

ANOTHER advance in the field of automatic and semi-automatic communications equipment has been made with the development of the "Codetyper." This new instrument provides a method whereby Morse code signals can be transmitted automatically by pressing the correct key on a typewriter-like keyboard.

This new device eliminates two of the bugaboos of transmitting, *i.e.,* "glass fist" and "signature" sending. While the first of these drawbacks is a handicap to the sender, "signature" sending can be of utmost importance in military transmissions where the enemy can use the distinctive sending style of an operator to identify troop units.

While there have been attempts in the past to eliminate the human element in code transmissions most of the instruments devised for the purpose have been complicated and costly. With equipment of this type the use of automatic code units was more or less confined to large or permanent installations.

There are, however, many thousands of transmitters being operated by individuals, and it is for persons such as these that the new "Electronic Brain Codetyper" was developed. It is operated simply by depressing a letter on a standard typewriter keyboard which forms part of the machine. When the key is depressed the "electronic brain" thinks up all the various timing combinations that are needed, assembles the correct number, puts them in the proper sequence, and then sends them out so that they can be used to key the transmitter. The "Codetyper" directly replaces the usual hand key and is simply clipped across the key that is normally in use, or rather that was in use as it won't be needed with this new unit.

An instrument of this type must be suitable for use at all of the code speeds normally employed, so accordingly this unit is adjustable for speeds from 10 to 75 words-per-minute. No knowledge of code or typing is required to use the "Codetyper." One finger is adequate for the most commonly used code speeds but if the machine is to operate into some recording device at the receiving end, the operator can use touch typing and send speeds of 50, 60, or 75 words-per-minute and up. The unit can also be supplied with speeds from 75 to 125 wpm. Two models cover the machine's range of from 5 to 125 wpm—the slow speed model from 10 to 75 wpm and the high speed model from 50 to 125 wpm.

The design of the "Codetyper" presented a number of interesting problems. The random nature of the International Morse code makes it difficult to supply all of the various waveforms that are needed. The information which is contained in Morse code characters varies in many ways. In all of the letters, numerals, and punctuation marks there are different over-all time intervals involved in forming the characters. Since the characters are composed of dots and dashes, the number of dots and dashes within the over-all time interval will vary considerably. The sequence of dots and dashes within a character also varies widely.

To meet these problems, this system works on the principle of a single information-forming channel which may be instantaneously triggered into many different states depending on which part of its memory connections is activated. In the static condition the channel is non-operative, but it can assume any random combination of time units in a dynamic state which can be used to generate the proper number and arrangements of pulses which are then used to activate a relay to key the transmitter. This method eliminates many of the complexities that would be imposed by a system which called for intermixing marking and spacing intervals as well as controlling the length of the letter. With this system letter length timing is automatic and no dash marking generators are required as the unit automatically scales the dash marking intervals down as controlled by dot marking intervals and the intermixing operation does not have a timing component.

There is a basic code for the arrangement of the units of the Morse code. The system by which this is done has been reformulated into a system

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suitable for use by the "Codetyper." The Morse code, made up of dots and dashes, can be considered to consist of different time intervals within the character to be formed. The dot has the smallest interval. It can, then, be used as a base and assigned the number 1. Counting up all the other characters, there are 19 units in all, figuring all spaces within the character to be formed as 1 unit. If a "unit code" is set up, each character will have a different number of units. Under the system by which the "Codetyper" operates there has to be a common reference point irrespective of the length of the letter. The first step is to set down the Morse code according to "units" but instead of starting from the number 1, it was decided to start from number 19 and work backwards. For example, the letter "E" is represented by the number 19. The letter "S," on the other hand, is represented by three units, 19, 17, and 15. The spacing interval within the character is figured into the over-all units so that the letter "S" would be a 5 unit letter—3 marking and 2 spacing intervals. The letter "S" as well as all other letters irrespective of length, will terminate on unit 19. The basic principle of the "Codetyper" is to take a single information-forming chain and derive from it as many units as are needed to complete the letter.

In addition to this information-forming chain, which collectively is known as the "unit interval generators," there are several other parts to the circuit. The "unit interval generators" are 19 in number since it is necessary to generate 19 intervals. The output of these generators consists of pulses which are fed to a keying relay which operates the transmitter. It is necessary that the keying relay be activated by all of the "unit interval generators" in time series yet be able to receive pulses from all of the "unit interval generators" at a common point. In order to accomplish this there are keyers in the "Codetyper" consisting of a series of tubes arranged with their inputs in series and their outputs in parallel. Since no dash markers are generated, a definite system for forming dash markers is needed in the keyer section, thus this section is used for that purpose as well.

To form the dash markers on the keyers, there has been incorporated another section which has been designated "sequence selectors." These units are used to gate on any number or combination of keyers so that whenever the "sequence selectors" are operated they are able to provide dash markers as needed within the train of pulses constituting the character. The operation of the "sequence selectors" which help to form the dash markers is under the control of the keyboard. The keyboard will turn on as many of the "sequence selectors" as are needed by means of the associated "phantom switch network."

The "phantom switch network" consists of a group of resistors and neon bulbs arranged in such a way as to allow an extremely simple single-pole, momentary-contact switch to initiate as many as six circuits simultaneously, which means in effect that a single-pole switch acts as a six-pole switch because of the action of the circuit of the "phantom switch network." This network has two functions. The first is to turn on as many of the "sequence selectors" as are needed to form the dashes required by a particular character. The second function is to take a voltage from the network and trigger the proper "unit interval generator" so as to provide the total number of pulses needed.

When the keyboard is depressed, the proper number of "sequence selectors" operated, and a particular "unit interval generator" triggered, the character starts to form, travels down the chain of "unit interval generators," and activates the keyers. The complete code character has now opened and closed the keying relay so that the Morse code is formed.

In analyzing the operation of the "Codetyper" it is well to examine the functioning of the "unit interval generator" (UIG) of which there are 19. Normally, the entire chain is held at cut-off, that is, all the pulse generators are biased so that there is no pulse output. The pulse generators incorporate 6J6 tubes in a univibrator circuit and all of the generators are identical. Triggering the first univibrator in the chain gives two output pulses. One pulse is used to feed the keyer and the other is used to trigger the next UIG. These two pulses are of two different waveforms—the one that activates the keyer is substantially a square wave of a time duration that is under the control of the speed control, the other pulse which is used to trigger the next UIG is a sharp spike which is caused by differentiating the trailing edge of the square wave pulse appearing across the cathode resistor of the UIG. This pulse is applied to the grid of the next "unit interval generator."

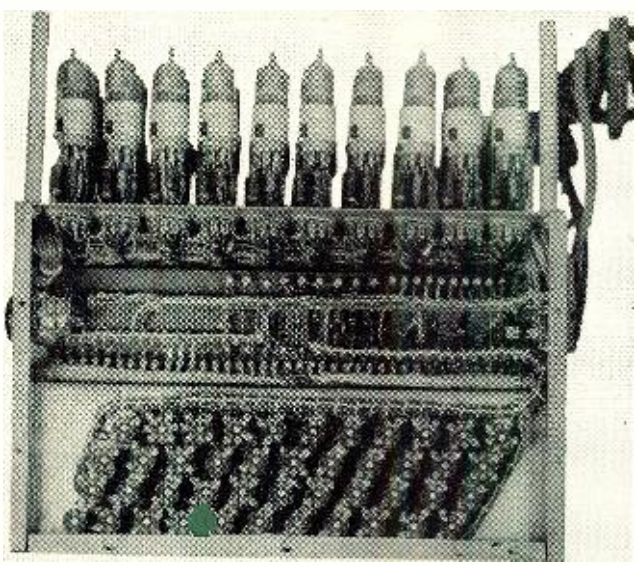
The pulse which is taken off the plate of UIG #1 is coupled directly, through an isolating resistor, to the grid of keyer #1 by d.c. coupling in order to avoid time constants.

To allow UIG #1 to deliver its pulse

(*Continued on page* 163)

Top view with cover removed to show mechanism.

Under chassis view with the base plate removed.



CORNER LOUDSPEAKER ENCLOSURE

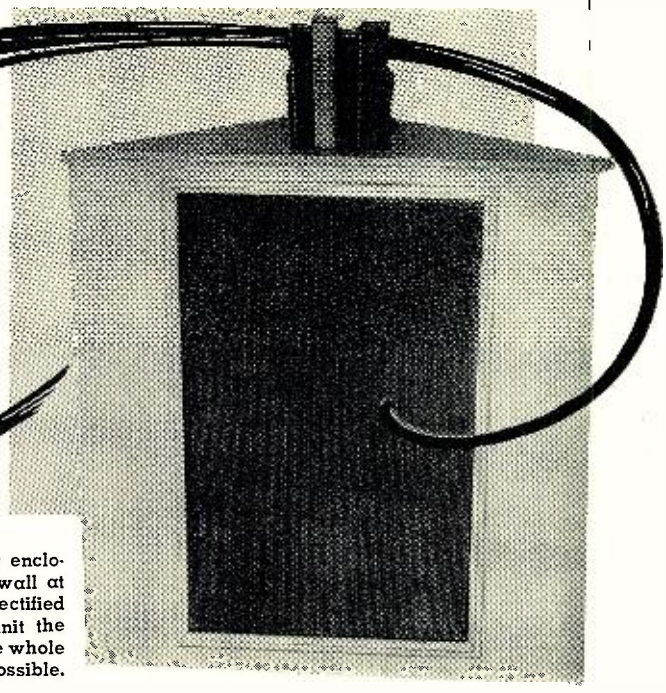


Fig. 1. Completed corner speaker enclosure. It is carefully fitted to the wall at edges where any errors can be rectified with a little plaster. Paint the unit the same color as the wall to make the whole installation as inconspicuous as possible.

By
RICHARD H. DORF
Audio Consultant

Designed to accommodate both woofer and tweeter speakers — cabinet can be home-built for $10.00.

EVERY audio authority agrees that placing the speaker of a high-quality system in a separate cabinet from that in which the amplifier and record player are mounted is the best practice. But a good reason why it is not done more often is that the lady of the house objects to having *another* big piece of furniture in a room already full of furniture. Another reason is that very few cabinetmakers will make a really good enclosure for less than about $100, including a genuine furniture finish.

There is, however, a good way to get around both difficulties. First, however, to convince the lady that a separate enclosure is needed, you can cite the following facts;

1. If the system is any good at all, the sound coming from a speaker in the same cabinet will vibrate the wood; the phonograph pickup (or perhaps a microphonic tube) will pick up the vibrations, feed them into the amplifier again, and create a continuous and nerve-wracking steamboat-whistle effect. The only two solutions to that are (*a*) to build the cabinet of concrete or (*b*) to play the instrument so softly you can't hear it.

2. You need a big cabinet to get good bass, unless you want to play with tuned ports, a trick that may make a symphony orchestra sound as though it were playing in a barrel. To get 10 cubic feet of air behind the speaker and *also* mount turntable, amplifier, power supply, and tuner in the same cabinet, you will need a box big enough to live in.

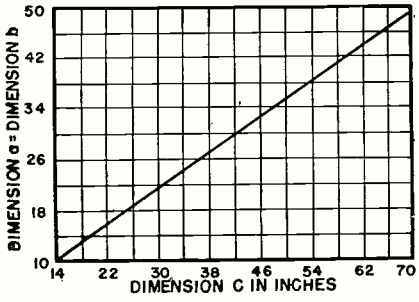
3. This one is a little more subtle and must be explained just right. When the sound comes from the same place where you know the record to be, you have a mental picture all during the music of a disc whirling around. As a result, your own mind gives the music a "canned" feeling, no matter how good it really sounds. On the other hand, when the speaker is in a different place, that effect is no longer present. With your attention on the music, you can ignore the whirling record because the music and the disc are no longer in the same place. This may sound fantastic if you've never heard a separately placed speaker, but the first time you try it, the meaning will hit you with a bang!

4. Everybody says the speaker should be separate. (This argument is only a last resort, to be used when your own prestige has failed and you need to call on the "Authorities.")

A good deal of the pain and expense can be taken out of the separate cabinet idea, however, by the simple device of using a corner for it. A speaker system placed in a corner is in the best possible position to cover the entire room with sound, especially at the higher frequencies.

The simple corner cabinet shown in the photo requires exactly two pieces of wood, ¾-inch plywood. One is cut out for the woofer and tweeter and placed across the corner to form the front of the enclosure. The other is triangular and forms the top. The two intersecting walls are the remaining two sides and the floor of the room is the bottom. Total cost of the unit pictured, including having a local cabinetmaker cut the two pieces (and the speaker holes) on his rotary saw, was about $10. Soundwise, you couldn't buy a better enclosure. And almost any living room has a corner that isn't doing anything.

Fig. 2. Graph for determining dimension "c" when "a" and "b" (Fig. 4) are equal. Three-place accuracy is not necessary if instructions are followed. Errors are compensated.



The basic requirement for an "infinite" baffle is infinite isolation between the front and the back of the speaker. Since that isn't possible, the idea is to get as much air as possible behind the speaker and still isolate the front from the back. As a rule of thumb, 10 cubic feet of air within the enclosure is about the minimum for really good reproduction.

That makes calculation of the measurements simple. Fig. 4A is a mechanical drawing of a corner enclosure like the one in the photo. The three important dimensions for calculation purposes are *a*, *b*, and *d*. Note that *c* does not count at this time. Dimension *c* is just the board width but unless you want to get more complicated than necessary, don't use it in figuring the volume. The following simple formulas give volume in terms of the *a*, *b*, and *d* dimensions and also each dimension when the others are known:

$$V = abd/2 \quad . \quad . \quad . \quad . \quad . \quad (1)$$
$$d = 2V/ab \quad . \quad . \quad . \quad . \quad . \quad (2)$$
$$b = 2V/ad \quad . \quad . \quad . \quad . \quad . \quad (3)$$
$$a = 2V/bd \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Suppose $a = 3$, $b = 3$, and $d = 3$. Then $V = 3 \times 3 \times 3/2 = 13.5$ cubic feet, the volume of the enclosure. Or suppose you want a volume of 10 cubic feet; a is 2, b is 2. What is d? Using formula (2), $d = 2 \times 10/2 \times 2 = 5$ feet. And so on.

You may be afflicted, as I am, with corners that look like that in Fig. 4B. If so, make the calculations as before, just as if the gadget in the corner weren't there. To do that use the measurements shown in Fig. 4B with the formulas above. For a substitute $a' + b''$, and for b substitute $b' + a''$. Then figure the volume of the corner projection and subtract it from the total.

The next order of business is to get or cut the two pieces of wood. For the front the height is simply dimension d. The width of the front can be found by the empirical method if you have long enough arms but a graph (Fig. 2) is given to save you the trouble. It is based on the fact that, according to Euclid, the square of the hypotenuse of a right triangle is equal to the sum of the squares of the other two sides. This graph will work only if dimensions a and b are identical in Figs. 4A and 4B. You will get the best coverage of the room if they are, but sometimes you will have to make them unequal because of the way the room is built. Don't try to read between the graph calibration marks too exactly; it isn't necessary, especially if you figure the enclosure for a little more than the volume you want.

When you have dimensions c and d, cut the board for the front. Do not cut the side edges straight, however, but at a 45-degree angle so that when the board is placed against the wall its edges will blend into the wall.

For the top, the safest way to cut is illustrated in Fig. 4C, if you have provided for equal lengths for a and b. First cut a board to the width of dimension c and match it to the already prepared front piece to see that they are the same. Then set the tri-square for 45 degrees and draw a line from each end of the front inward until they intersect, as shown. Cut along the lines and you have the top. If your corner looks like Fig. 4B make the necessary cutout in the top, as indicated by the dashed lines in Fig. 4C. Complete the heavy work by cutting out holes in the front piece for the woofer and tweeter. The holes need not be smooth, for they will be hidden.

There are two ways to fasten the front piece to the wall. The easiest is to place it in position, then drill through both board and wall the four holes indicated at S in Fig. 4A. Long toggle bolts can then be pushed through the wood and plaster and tightened. The other method is to nail or bolt long strips of 1-inch-square wood to the wall and, in turn, fasten the front board to them.

The top piece sits on top of the front board, which then supports its front edge. The other two edges are supported by two pieces of 1 x 1 fastened to the wall at the right height. It is not necessary to fasten the top in place. Three-quarter-inch plywood is heavy enough to stay put and the top is easy to remove when adjustments are to be made inside.

If, as in the enclosure pictured, the woofer and tweeter holes are near enough to the top, the speakers can be mounted after the front is in place. If there is any doubt, however, fasten them in before the board is fastened to the wall. In any case, line the entire surface of the enclosure's inside—wall and floor as well as the two pieces of wood—with soft padding. *Ozite,* usually used as a base for rugs, is perfect for the job, but cotton batting from the drug store will do, too.

If there is any possibility that children, dogs, or careless adults may poke something through the woofer cone, get some galvanized screening with about ½-inch spacing and place it between woofer and cabinet. To complete the construction job, get a piece of molding ¾ inch wide and nail it in place across the outer edge of the top piece. (See Fig. 1.)

Now the finishing touches. Get either a can of plastic wood or a bag of plaster. The latter, mixed to about the consistency of cold cream, seems to be easiest to handle. With a wide putty knife work it in along the side edges of the front piece so that when you are finished the front blends in smoothly with the wall. If your wall has very fancy woodwork along the bottom edge as did the writer's, the front piece will have been cut roughly to conform with the shape of that woodwork. Plaster is then used to fill any gaps between board and woodwork.

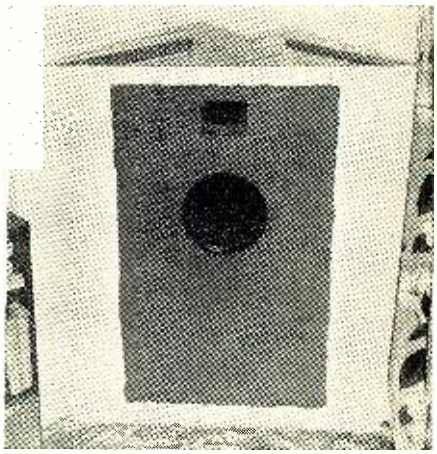
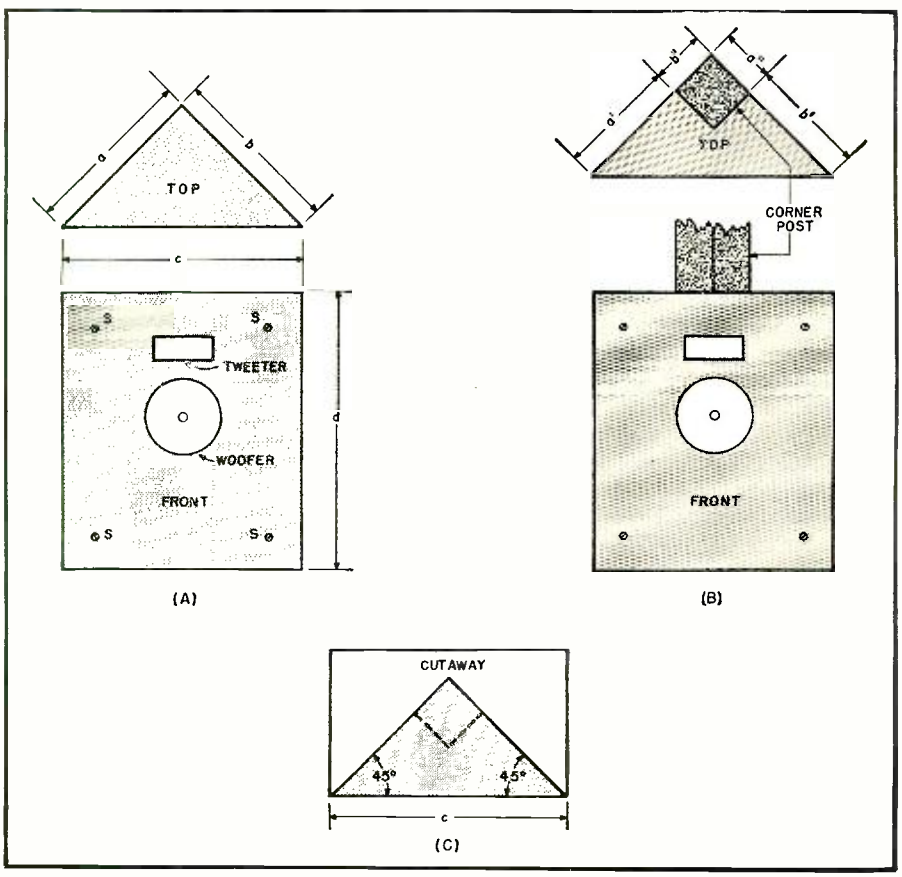


Fig. 3. After the front board is in place, nail a pair of 1 x 1 inch strips to wall to support the top, then paint the area to be covered by the grille cloth with a dark paint so holes do not show through the cloth. Dark green was used by author.

The next job is to make a simple frame of four lengths of molding. The size should be enough to more than cover the two speaker holes. Now put the frame in place over the front and

(*Continued on page* 126)

Fig. 4. (A) Sketch of enclosure for a clear corner showing dimensions of two pieces required. (B) When corner has a post, the top must be cut out. Dimension (a) becomes (a′) plus (b″) and (b) becomes (b′) plus (a″). (C) To make top, cut a rectangular piece of wood to dimension (c), then draw lines at 45 degrees from each corner with carpenter's square. If lines are correct, intersection will be a right angle.



A Low-Cost AUDIO AMPLIFIER

Fig. 1. Top and under chassis views of the low-cost amplifier. Entire unit is built in 4" x 3" x 5" box.

By
FREDERIC T. C. BREWER

Less than ten dollars for a complete audio amplifier that boasts a frequency range of from 50-20,000 cps.

AUDIO holds a fascination for a variety of enthusiasts, including the engineer, musician, and the hobbyist. Any and every phase of the art seems to interest them as evidenced by the increasing number of audio articles appearing in magazines. However, many are not content to just read about the new devices and circuits, but long to try them out. You have probably picked up this magazine many times and found a super hi-fidelity amplifier described and have had to be content with reading superlatives about its performance simply because the necessary parts would cost a small fortune—not to mention the time that would have to be spent duplicating it. Do not interpret this to mean that I am against such articles—far from it—for I am one of those self-same enthusiasts. This article is written with the purpose of presenting an audio amplifier that can not only be talked about but that can be duplicated in about an hour's time for less than ten dollars.

Even though the circuit incorporates three feedback loops, it will give no trouble. Even the novice can anticipate results comparable to those obtained by persons more experienced in electronics.

Construction Hints

As can be seen from the photograph of Fig. 1, the amplifier is compact, being entirely constructed in a 4"x3"x5" steel utility cabinet.

None of the parts is critical and wide variations in values can be tolerated without loss in performance. Most, if not all, of the parts can be found in the proverbial junk box. Even if all new parts are used, the cost should be under ten dollars.

Remove the top plate of the utility cabinet. Then make the holes for the three tubes, the filter condenser can, and the input and output jacks. Next mount those parts. The electrolytic condenser can we used was a *Mallory* four-section, 20 μfd.-per-section condenser, rated at 450 volts. Of course 150 volt condensers may be used. We used the 450 volt condenser because it was on hand, and by using it we were sure of the wide safety margin that we wanted in order to insure continuous, uninterrupted service. We mounted the can condenser so that it was insulated from the top plate. This was accomplished by placing the fiber mounting template on top of the top plate making sure that the prongs did not touch the top plate when the condenser was inserted.

Two sections of this condenser are wired in parallel in order to obtain a value of 40 μfd. for the filter-input condenser. The tubes, a 12SH7, 50L6, and 35Z5, because of their wide use, are relatively cheap. Male, non-shorting chassis mounts were used for the input and output jacks. Again, any type of jack might be used.

The fiber washers that keep these mounts from shorting to chassis were removed from the input mount, and it became the only ground point for the amplifier. A bus wire was run from this ground point to a prong on the insulated electrolytic can, and all grounds were brought to this bus.

With the top and bottom plates of the utility cabinet removed, it is relatively easy to mount the filter choke, output transformer, pilot light assembly, loudness control, power switch, and fuse holder. The output transformer is mounted on the left face of the utility cabinet directly below the output jack. The filter choke is mounted on the right face of the utility cabinet under the rectifier tube and filter condenser. This arrangement keeps leads short and fields to a minimum. The power cord is brought in through a rubber grommet on the back face next to the fuse holder. We wired the top plate, leaving until last leads that went to the components inside the cabinet. After all wiring was done, except the connections between the top plate and the parts mounted in the cabinet, we mounted the top plate. Since these connecting wires were already wired to their respective points on the top plate, the remaining connections were made with ease.

All the components in the parts list are standard items and judicious substitution of parts on hand can be made without fear of complications. As an example, the output transformer is listed as a *Stancor* A3876; however, an output transformer from any radio or amplifier using a 50L6 or equivalent output tube will do just as well.

To keep hum to the vanishing point, it is recommended that the pilot light be connected as shown in Fig. 2 (instead of the usual method employed when a 35Z5 rectifier tube is used). While we are on the subject of hum, it might be pointed out that by having the feedback loops connected as they are, practically all hum in the output due to "B+" ripple is canceled out. Since the loudness control is returned to ground through the secondary of the

output transformer, especially good results are obtained when the amplifier is operated at low levels in extremely quiet surroundings.

Certain precautions should be taken when this amplifier is put into use. The amplifier is of the a.c.-d.c. type, and since no power transformer is used, a certain danger exists. We recommend that the entire amplifier be enclosed in, or behind, a cabinet or partition of some insulating material, *i.e.*, wood or plastic. No metal parts which are connected to the chassis should be exposed, since the chassis is connected directly to one side of the line. One method of overcoming this problem would be to use a polarized plug, so that the chassis would always be at ground potential. Another would be to connect the chassis directly to a good external ground, and then connect only the "hot" lead to the appliance plug. The amplifier would not operate if the plug were inserted with the wrong polarity.

Feedback Loops

To get the feedback loops working correctly does not require instruments. It can easily be accomplished as follows: ground either side of the secondary of the output transformer and wire it as shown in Fig. 2. Should the amplifier begin to squeal when you first turn it on, turn it off and interchange the two leads from the secondary of the output transformer. Turn on the amplifier again, for nothing more need be done. The positive feedback loop does not require any change or adjustment.

The feedback loop provided by connecting the volume control in series with the secondary of the output transformer is somewhat unorthodox, but produces exceptionally good results. The amount of feedback varies with the setting of the volume control, being maximum at the minimum setting of the control. With the control set at the point where a 1 volt input produces a 1 watt output at 1000 cps, there is 30 db of negative feedback. Connecting the cathode of the 50L6 in series with the output transformer secondary adds about 2 db, and the 12SH7 screen bypass connection adds another 4 db of negative feedback. The resistor between the cathodes of the 12SH7 and the 50L6 provides 10 db of positive feedback.

Performance

I would like to describe first the results of testing with instruments. I know those of you who believe in listening tests are saying, "Here we go again!" However, most of us like to see in the form of graphs, etc., what our "golden ears" tell us is perfection.

The frequency response at moderate power levels, adequate for normal room listening, is shown in Fig. 3, both with a 5-inch speaker load and with a 4-ohm resistance load. At lower power levels, the response is essentially a straight line from 40 to 40,000 cps, while at higher power levels the response drops off somewhat at the higher frequencies and drops off quite rapidly at lower frequencies, due to saturation of the small output transformer. Greater power output at the lower frequencies could readily be obtained by using a larger and more expensive output transformer. It was not felt that the slight improvement in performance justified the additional bulk and expense in this case, since performance with the transformer indicated was so highly satisfactory on the basis of listening tests. Maximum power output at reasonable distortion is about 1.2 watts.

Before you pass judgment on what seems like inadequate power output, remember the millions of sets using the same output tube and a small 5 inch speaker, or re-read James A. Mitchell's article "Loudness and Power in Audio Systems," which appeared in the February, 1951, issue of this magazine.

The internal impedance is 0.27 ohm at 60 cps, and since at this frequency the output, as shown by the frequency response curve, is near its lowest value, it is evident that at higher frequencies the internal impedance will drop even lower. However, we are more interested in the damping out of the large cone excursions of our speaker at low frequencies. We believe the low internal impedance partly accounts for that intangible "presence" effect experienced when listening to this amplifier.

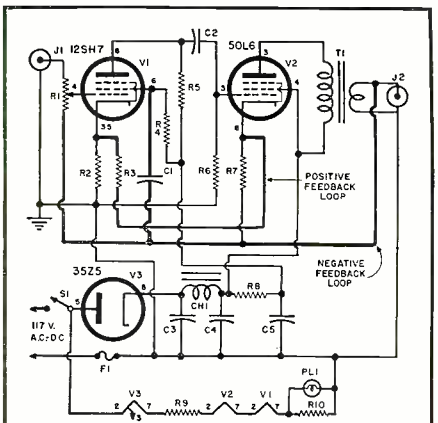
Listening tests were made with speakers ranging in size and quality from a single 4 inch unit to an elaborate *Tru-Sonic* two-way theater system. When the amplifier was used with the *Tru-Sonic* system and fed with program material from an FM tuner the results were exceptional. Results from other combinations were also completely satisfactory.

As a further test of the hum content (our instruments did not register any value at hum frequency) we turned the loudness control up full, with an open input, and listened at close range to an efficient speaker. It was absolutely dead. When used with a tuner, if there is any hum, reverse the power plug of the tuner or amplifier socket.

The 12SH7 input tube was chosen because of its high gain. However, in some cases it is possible to secure a slight reduction in hum by substituting a 12SJ7 for the 12SH7. This will result in some decrease in over-all gain, but in most cases this reduction will be insignificant. By connecting pins 3 and 5 of the 12SH7 socket together, the 12SJ7 may be inserted directly without further changes.

Conclusion

The construction hints given in this article are just that; it is not necessary to follow them exactly. The author, over a period of time, has constructed numerous amplifiers based on the design outlined in this article with variations as to shape and size but all of them have worked exceptionally well. I know that those who take the time to duplicate this amplifier will be well rewarded by its performance.



R_1—*500,000 ohm pot.*
R_2—*2200 ohm, ½ w. res.*
R_3—*25,000 ohm, ½ w. res.*
R_4, R_6—*470,000 ohm, ½ w. res.*
R_5—*100,000 ohm, ½ w. res.*
R_7—*150 ohm, 1 w. res.*
R_8—*6800 ohm, ½ w. res.*
R_9—*100 ohm, 5 w. wirewound res.*
R_{10}—*100 ohm, ½ w. res.*
C_1, C_2—*.1 μfd., 400 v. cond.*
C_3, C_4, C_5—*20/20/20/20 μfd., 450 v. elec. cond. (Two sections used to provide 40 μfd. for C_3)*
CH_1—*13 hy., 60 ma. filter choke, 500 ohms (Stancor C1708 or equiv.)*
T_1—*Output trans., 2000 ohm pri. to 4 ohm load (Stancor A3876 or equiv.)*
J_1, J_2—*Microphone jack*
F_1—*Line fuse*
PL_1—*Pilot Lamp, #40 or #47*
V_1—*12SH7 tube*
V_2—*50L6 tube*
V_3—*35Z5 tube*

Fig. 2. Schematic diagram and parts list for low-cost amplifier. The several feedback loops that author used are quite novel. The positive loop is used to increase over-all gain of the unit. Negative feedback to the screen grid of the 12SH7 maintains over-all negative feedback when the volume control is in its maximum position. The feedback circuit to the lower end of the volume control serves a dual purpose. It is relatively ineffective when volume control is at maximum position. Maximum gain is therefore obtained where it is required. As the volume control is decreased, the effect of feedback is increased, thus providing maximum feedback at the minimum setting of the control.

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Cooper, George Fletcher, "Audio Feedback Design," Radio-Electronics, October, 1950 through November, 1951.

Terman, F. E., "Radio Engineering," Third Edition, McGraw-Hill Book Company.

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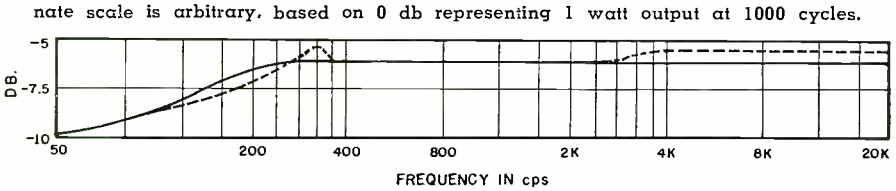
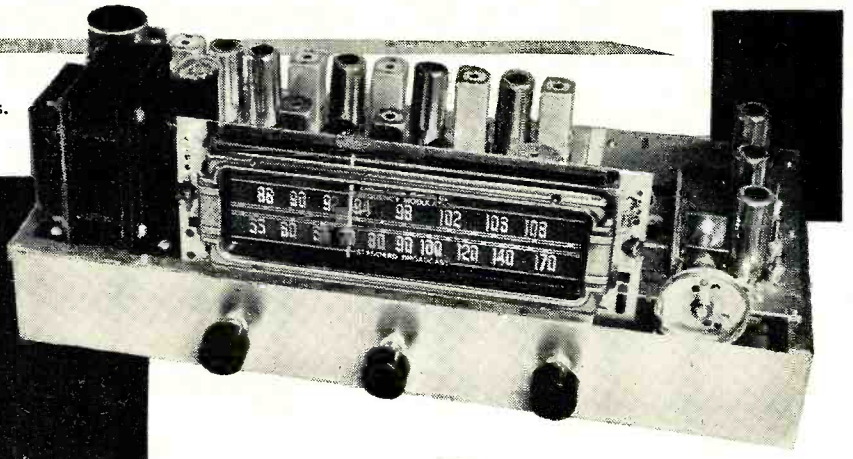
Fig. 3. Frequency response at medium power levels. Dotted line is response with 3.2 ohm, 5" speaker load. Solid line shows response with 4 ohm resistance load. Ordinate scale is arbitrary, based on 0 db representing 1 watt output at 1000 cycles.



Completed assembly built from "Pre-Fab" units.



"PRE-FAB" TUNERS

By
W. H. COLLINS
Collins Audio Products Co. Inc.

Pre-assembled units simplify construction, particularly for the inexperienced radio builder.

PACE with the rapid advances television has made in the past five years, radio too has forged ahead, ably supported by high-fidelity FM reception and topnotch programming by the stations. An innovation in the radio field is the *Collins* "Pre-Fab" tuner, recently introduced as an FM tuner kit and later expanded to include AM. This design represents an entirely new approach to kits in that the tuner is broken down into its basic circuits for ease and accuracy in manufacture, as well as facility in assembly for the user.

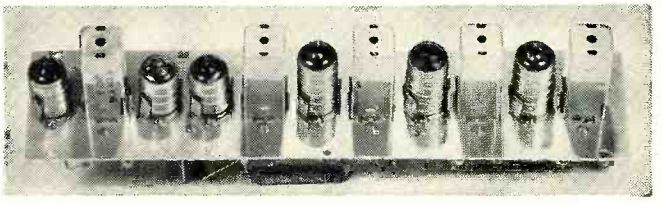
Current design for home listening of high-fidelity reception prescribes an integrated system composed of a radio tuner (FM and AM), a wide-range audio amplifier, quality record changer, and separate loudspeaker unit. People interested in providing their homes with fine entertainment equipment are rapidly turning toward this new medium. Much standardization has taken place in recent years and it is a relatively simple matter for even an inexperienced person to assemble the units of his selection without specialized technical knowledge.

Modern design in the contemporary living room dictates that the radio and phonograph equipment be "built-in" wherever possible or installed in choice furniture pieces. In addition, much fine audio equipment has been made available and is being purchased in an ever increasing volume by an eager and interested public. At last they have found what they have been seeking—true and faithful audio reproduction in the home!

Purchasing completed components can be costly if one's taste demands perfection. In this connection though, *Collins Audio Products* figured that it was possible to provide high grade equipment at moderate cost if the purchaser were willing to do a little work himself. Since there is only a relatively small group of people in the country who understand the technical aspects of radio, *Collins* kept this in mind in designing the "Pre-Fabs."

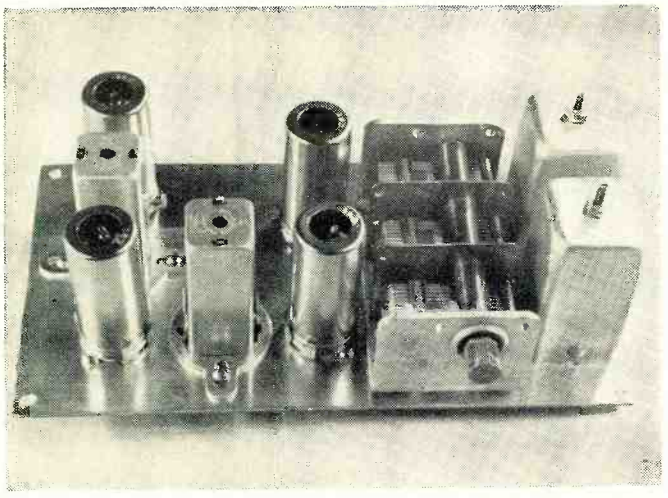
By making up the basic circuit components separately, an inexperienced person can put them together, connect an absolute minimum of wires, and obtain performance comparable to that available from a factory-built, completely assembled job. By so doing, the builder saves many dollars in addition to having the satisfaction and feeling of accomplishment which comes from contributing personally to his radio system.

The "Pre-Fab" kit is composed of four basic units: (1) The FM r.f. tuning unit, (2) the FM intermediate frequency amplifier, (3) the AM tuning unit, and (4) the chassis kit, which includes the power supply, dial assembly, and necessary hardware (*Continued on page* 124)

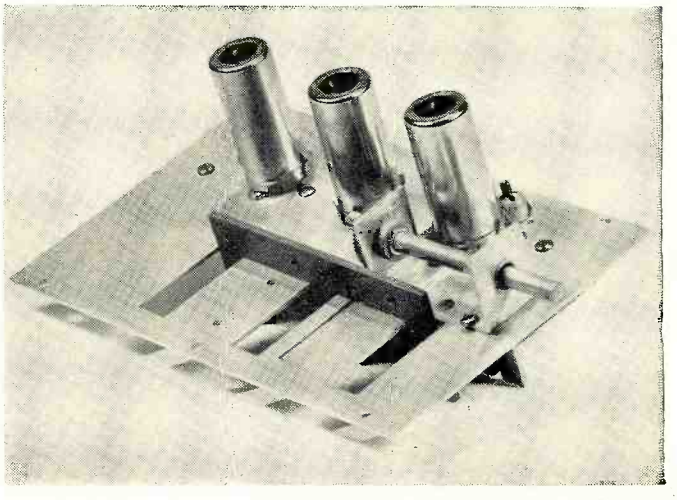


Chassis strip carrying the FM i.f. amplifier unit.

View of the AM tuner and its accompanying i.f. unit.



The Collins "Pre-Fab" FM tuning unit chassis strip.



150-Watt Universal R. F. Amplifier

Front view of amplifier, shown with the exciter unit described by the author in last month's issue. The power supply for the amplifier is also used to operate the exciter section.

By
JOHN F. CLEMENS,
W9ERN

Take your pick of C.W., FM, AM, or SSSC—this unit handles them all on any band—and without any TVI.

A MODERN amateur transmitter must meet a variety of specifications. It must operate over a wide frequency range as a first requirement and practically every amateur desires a transmitter which will give him the choice of phone or c.w. Experience has shown that it is usually unwise to try to incorporate too many features into one piece of equipment. It is necessary instead to compromise somewhat, retaining those features which operating experience has shown to be desirable, and eliminating the "gingerbread" features. The design of this equipment was an attempt to follow this policy and in over a year of use on the air, on all bands from 80 to 10 meters, on phone and c.w., it has justified its builder's confidence.

The amplifier is "universal" in the sense that it will amplify any sort of r.f. signal of approximately one-fourth watt to two watts on any of the commonly-used bands. Instead of the usual class C amplifier, the two stages are operated as class A and class B linear amplifiers. Thus, the unit may be used to amplify any type of signal, whether it be c.w., AM or FM phone, or single-sideband. Don't let that "linear amplifier" idea scare you—this transmitter is no more difficult to adjust than any conventional class C rig. The tube electrode voltages are set to the proper handbook values and from there on it is merely a matter of setting the input signal level and the output coupling. Two dials on the front panel make these adjustments and the plate meter is all you have to watch in tuning up.

All bands are covered by means of plug-in coils. Bandswitching was not included in the interest of compactness, efficiency, and good layout from the TVI suppression standpoint.

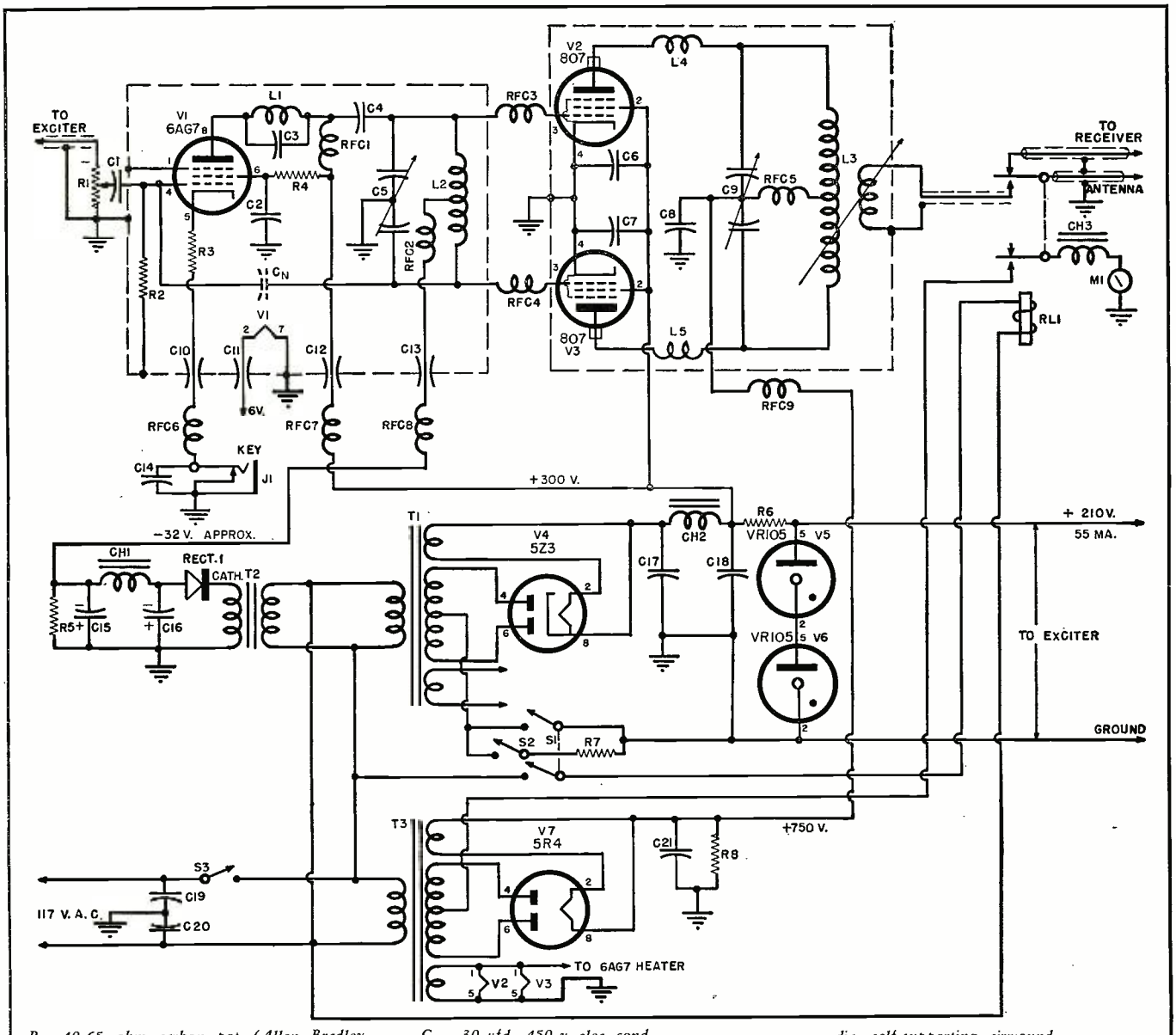
A great deal of attention was given to the very important problem of eliminating spurious radiations which cause BCI and TVI, with the result that careful measurements show the strongest harmonic to be 72 db below the carrier when operating on ten meters. This is considerably better than the FCC requirement of —60 db for a transmitter of this power. This harmonic suppression has been achieved without *tuned* traps or filters which would be effective at only one frequency. Shielding has been the principal means of reducing unwanted radiations plus a mode of operation which generates weak harmonics.

An elaborate shielding job usually requires a great deal of special sheet metal work which the average ham cannot perform with hand tools. Standard utility boxes are used in this design with a standard chassis and a standard-size cabinet. The cabinet shown is from a *Hallicrafters* S-56 receiver, which has the same nominal dimensions as the *NC*-100X receiver. The chassis measures 11" x 17" x 2" and a heavy-duty plated (not painted) steel type is recommended. After the shield boxes have been laid out on the chassis, the mating areas of the chassis are masked with tape to keep them clean and the chassis is painted to improve its appearance and prevent rust. The two shield boxes are steel utility boxes, the one housing the final amplifier tubes and tank circuit measuring 9" x 5" x 6" and the smaller one which houses the 6AG7 stage components measuring 3" x 4" x 5". The flanges of these boxes should be sanded bright before they are mounted on the chassis with self-tapping screws. The two 807 sockets are submounted approximately one inch below the chassis by means of inverted *Eby* base-mounting shells. This drops the tube plate caps about ¾ inch below the copper screen over the top of the box. Aluminum shields are used inside the box around each 807 to reduce feedback to the grids. Neutralization of the final amplifier has been found unnecessary. A small aluminum panel was used to replace the steel lid supplied with the smaller shield box to avoid the labor of sanding off the heavy crackle finish. An aluminum coil shield is used over the plug-in coil which is the final amplifier grid coil as well as the driver stage plate coil.

To make the shielding effective it is important that no ungrounded metal shafts pass through the shield wall. Insulated shaft extensions are used on all the controls to the dials on the front panel.

The front panel controls, as seen in the amplifier pictured above, include output coupling, plate tuning, final grid tuning, and r.f. excitation. The switches on the front panel control power "on" and "off," exciter "on" and "off," and high voltage "on" and "off." The keying jack is located below the r.f. excitation dial.

Push-pull 807's are unbeatable in a transmitter of this type. The driving power is very low, the tubes are inexpensive, and the push-pull connection reduces harmonic content in the plate circuit. Class B operation has other



R_1—40-65 ohm carbon pot (Allen Bradley, 50 ohm linear)
R_2—22,000 ohm, ½ w. res.
R_3—56 ohm, 1 w. res.
R_4—27,000 ohm, 1 w. res.
R_7—400 ohm, 10 w. wirewound res.
R_6—1000 ohm, 10 w. wirewound res.
R_7—4700 ohm, 2 w. res.
R_8—1 megohm, 2 w. res.
C_1, C_2, C_4—.005 μfd. ceramic cond.
C_3—30 μμfd. ceramic cond.
C_5—100/100 μμfd. var. cond.
C_6, C_7, C_{14}, C_{19}, C_{20}—.01 μfd. ceramic cond.
C_8—.005 μfd., 2500 v. mica cond.
C_9—170/170 μμfd. var. cond.
C_{10}, C_{11}, C_{12}, C_{13}—50 μμfd. ceramic feedthrough cond. (Erie type 321)
C_{15}—30 μfd., 150 v. elec. cond.
C_{16}—60 μfd., 150 v. elec. cond.
C_{17}—30 μfd., 450 v. elec. cond.
C_{18}—10 μfd., 450 v. elec. cond.
C_{21}—8 μfd., 1500 v. oil-filled cond.
C_6—See text
M_1—0-500 ma. meter
RL_1—D.p.d.t. ceramic insulated antenna relay, 117 v, a.c. coil
$Rect._1$—200 ma. selenium rectifier
T_1—Power trans. 325-0-325 v. @ 125 ma.; 5 v. @ 3 amps.; 6.3 v. @ 3 amps.
T_2—50-110 volt bias trans. (Sola)
T_3—Power trans. 900-0-900 v. @ 210 ma.; 5 v. @ 3 amps; 6.3 v. @ 4 amps. (Frampton)
J_1—Key jack
CH_1, CH_2—10 hy., 150 ma. filter choke
CH_3—10 hy., 200 ma. filter choke
RFC_1—2.5 mhy. r.f. choke
RFC_2, RFC_5—30 t. #30 en. wound on 1 megohm, 2 w. res.
RFC_3, RFC_4—15 t. #22 en., closewound ¼" dia., self-supporting, airwound
RFC_6, RFC_7, RFC_8, RFC_9—15 t. #28 en. wound on 1 megohm, 2 w. res.
L_1—Approx. 15 t. #28 en. wound on C_3 (to resonate with C_3 at 58 mc.)
L_2—80 m.-42½ t. #24 en. c.t.; 40 m.-24½ t. #24 en. c.t.; 20 m.-12½ t. #24 en. c.t.; 10 m.-6½ t. #24 en. c.t. All coils wound on Millen 1" dia., 5-prong forms, 1" long.
L_3—Bud RLS series of coils (150 w.) with swinging link.
L_4, L_5—8 t. #14 en., ⅜" dia., 1" long, self-supporting, airwound
S_1—D.p.d.t. switch
S_2, S_3—S.p.s.t. sw.
V_1—6AG7 tube
V_2, V_3—807 tube
V_4—5Z3 tube
V_7—5R4 tube
V_5, V_6—VR105 tube

Complete schematic diagram of the 150-watt universal r.f. amplifier unit.

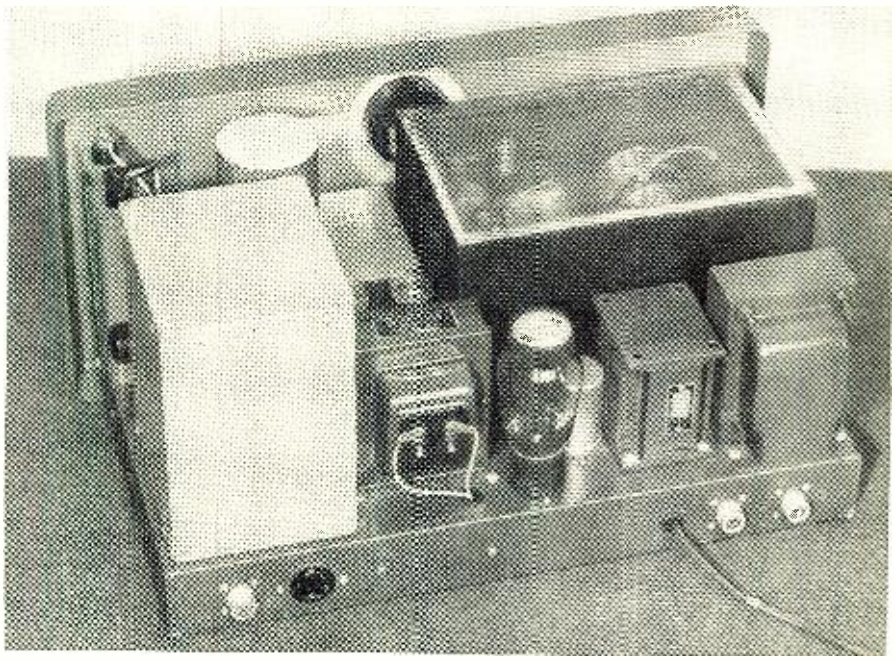
advantages than the ability to amplify modulated signals. The harmonic content of the class B stage (even without push-pull connection) is lower than in a class C stage, an important consideration in reducing TVI. Also, the class B stage amplifies a keyed c.w. signal without acting as a pulse-sharpener and key click generator. A keying jack on the front panel is arranged to key the cathode of the class A driver stage and the keying is truly beautiful. Parasitic chokes are used in both grid and plate leads of the final amplifier tubes rendering them completely stable on all bands, key up or key down.

The 6AG7 driver is operated in rather unorthodox style. The tube is neutralized, not to prevent self-oscillation which is virtually impossible under the operating conditions, but to reduce the strength of the backwave radiated when the key is up. The neutralization condenser is merely a piece of well-insulated hook-up wire connected to the stator plate of C_5 and brought near or wrapped around the grid terminal of the tube socket. This adjustment may be made before the 6AG7 subassembly is mounted on the chassis. While listening to the signal in a receiver with an exciter driving the 6AG7 and all voltages applied to the 6AG7, *but with the keying circuit open,* the capacity of the hook-up wire condenser is varied by moving it closer to the grid terminal by means of an insulated stick. As the neutralized point is passed, a definite null will be noticed

in the receiver. The wire should be secured in this position and the adjustment is complete. L_1 and C_3 form the one resonant trap in the unit. They are tuned to approximately 58 mc. to reduce the harmonic output of the 6AG7 in this region. If a grid dip meter is available it may be used to trim this coil and condenser combination to resonance at this frequency, although this adjustment is not essential. Inverse feedback improves the stability of this stage due to the unbypassed cathode resistor, R_3, a further deterrent to oscillation or parasitics in the 6AG7 stage. This type of inverse feedback has the effect of increasing the output impedance of the tube which is undesirable in driving a class B amplifier. To stabilize the load on the 6AG7 and compensate for this increased plate impedance, a resistor may be shunted across L_2. The value of this resistor should be chosen so that the 807's will be fully driven (to 300 ma. or so off-resonance plate current) with the r.f. gain control about three-quarters on. The value of this resistor will vary from about 15,000 ohms on 80 meters to about 50,000 ohms on 20 meters and will probably not be needed on ten meters at all where circuit losses will replace it. Suitable resistors may be mounted on the coils and changed with the coils.

The r.f. gain control is a carbon potentiometer of about 50 ohms which terminates the coaxial cable from the exciter. This resistor dissipates all the driving power supplied by the exciter since the 6AG7 requires only voltage drive. R_1, therefore, functions as the r.f. gain or excitation control and is a continuously variable transmitter power control so that the output may be set at any desired value from zero to the full power capability. Since the exciter cable is always terminated in its characteristic impedance, no reflections from the amplifier occur with the result that amplifier tuning adjustments are completely separate from the exciter tuning. A change in the length of the coaxial interconnecting cable between exciter and amplifier has absolutely no effect on the tuning of either. One watt of r.f. input will be more than enough on any band to completely excite the 6AG7. The r.f. gain potentiometer is mounted on a small plate of aluminum on the side of the small shield and is therefore outside the shield. C_1 connects the potentiometer arm to the grid of the 6AG7 through a feedthrough bushing in the shield. Break-in operation is not possible with this rig because the driver stage is keyed, but this seems to be the price that must be paid for perfect keying. The keying of the 6AG7 may be easily controlled by adding a small inductance in series with the key lead and a small capacity across the key, to produce any desired softness. Backwave radiation is undetectable a few hundred yards from the transmitter, thanks to the neutralization in the keyed stage.

(*Continued on page* 138)



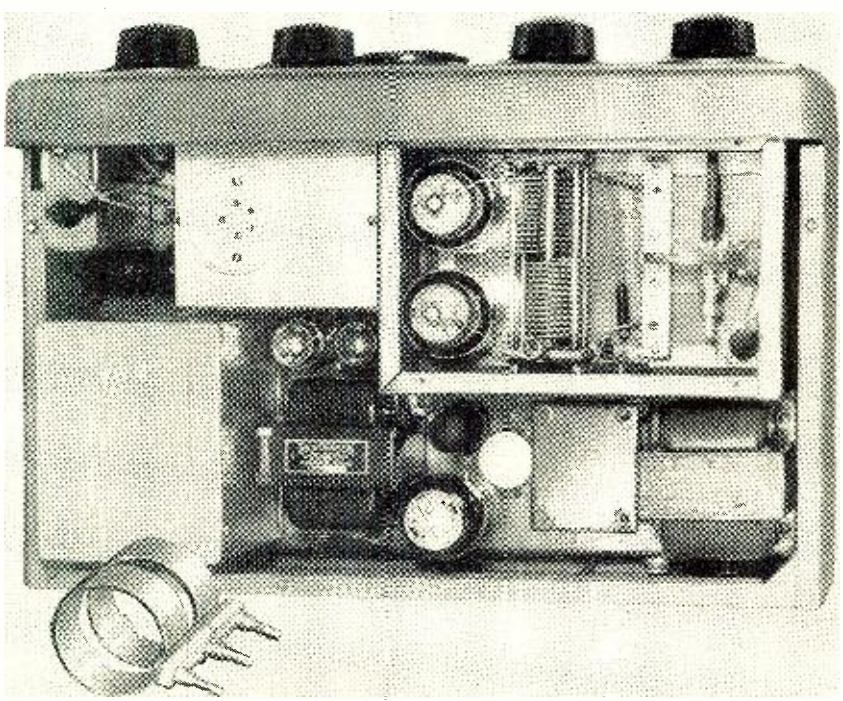
Rear chassis view. The r.f. input is to the coaxial connector on the left. The antenna and receiver connect to the two coax connectors on the right. The exciter power supply connections are made through the five-prong socket on chassis lip.

TYPE OF EXCITATION	807 TOTAL PLATE MA.	WATTS INPUT	APPROX. OUTPUT WATTS	PLATE MA. WITHOUT MODULATION
C.W.	240	180	100	60 (key-up)
FM	200	150	90	200
AM	120	90	30	120
SSSC	240 (on peaks)	180 (on peaks)	110 (on peaks)	60

Note: 807's: Plate—750 volts, Screen—300 volts, Bias Adjustment for 60 ma. total resting plate current.

Table 1. Operating conditions for the 150 watt universal r.f. amplifier unit.

Top view. The copper screen wire shield has been removed to show interior of final amplifier compartment. The 6AG7 is mounted horizontally on small shield compartment.



CRYSTAL DIODES In Modern Electronics

By
DAVID T. ARMSTRONG

Part 6. Covering the use of crystal diodes in d.c. restorer circuits as found in modern TV receivers.

One of the test stages through which all diodes pass. This operation separates diodes into eight classifications according to forward and back resistance limits.

LAST month we noted in connection with the elimination of one-half the 6AL5 that there is a problem of eliminating the other half in some simple manner. Many design engineers have found it convenient to use a second germanium diode for d.c. restoration and thus eliminate the 6AL5 entirely from the circuit.

The function of the d.c. restorer is to re-establish the correct d.c. operating level of the video signal arriving at the picture tube grid in order to maintain a uniformity of background illumination in the picture. Capacity coupling of the video amplifier to the detector removes the d.c. level of the signal that was established at the transmitter. When a germanium diode is designed into a circuit as the peak rectifier in the grid circuit of the picture tube, as illustrated in Fig. 1, it will add a d.c. bias dependent upon the peak voltage of the synchronizing pulses and maintain the tips of these pulses at some fixed d.c. level. The operating point of the picture tube is then established by the brightness control.

In the absence of the germanium crystal diode, the video signal would vary about an a.c. axis. Inserting the diode into the circuit will permit the .05 μfd. condenser, C_1, to charge to a voltage proportional to the synchronizing pulse voltage; this adds a d.c. voltage to the video components and maintains a constant reference level.

In the operation of this circuit best performance will be obtained with a diode that has low forward resistance and high back resistance. We noted before that this is characteristic of diode crystals; when the back resistance is high the forward resistance is low. The *G-E* 1N65 or the *Sylvania* 1N55 and 1N58 are specifically adapted for this particular use. Because the forward dynamic resistance of germanium crystal diodes is lower than the forward dynamic resistance of vacuum tubes, there is the possibility of improvement in the performance of crystals over tubes in this application.

It should be borne in mind, however, that only those diodes selected for high back resistance will perform properly. For the *G-E* 1N65 it is recommended that a resistor of approximately ½ megohm be used in parallel with the diode to minimize the effect of variation of the back resistance between individual diodes in order to maintain uniform performance for all receivers on a given assembly line. The individual experimenter may ignore this for he will achieve the best d.c. restoration by securing a diode with a very high back resistance characteristic and low forward dynamic resistance.

As pointed out in the section on the video detector it is possible to use the d.c. component at the detector output to fix the light cut-off point of the picture tube at the blanking level. To achieve this it is necessary that d.c. coupling be used between the detector and the video amplifier as well as between the video amplifier and the control electrode of the picture tube. Since it is not always convenient to design a d.c. coupled amplifier, some other method of d.c. insertion is desirable. The use of the d.c. component at the detector output produces the best results, but it is possible to achieve good results with a special d.c. reinsertion diode.

The term "d.c. restoration" is applied to the circuit which sets the brightness level for any given scene. The average of the picture signal, which determines the average brightness, is the d.c. component; the signal variations are referred to as the a.c. component. Whenever the video signal must pass through coupling or blocking condensers, such as those present in typical *RC* video amplifiers, the d.c. component is lost; the entire signal is averaged around the a.c. axis. Blanking and sync pulses will not line up and the background lighting will be darker. It is the purpose of the d.c. restorer circuit to eliminate these defects. It does so by selecting, automatically, either the blanking pedestal or the sync pulse level for use as a reference axis.

There are several methods of d.c. restoration. Among the more common are the grid leak restorer, the diode tube, and the germanium crystal. The grid leak restorer method is economical in that the amplifier tube is used as the diode; however, the results obtained with either a diode tube or germanium crystal are believed to be superior.

The presence of the d.c. component in the video signal makes it possible to distinguish between a black line on a gray field, and a gray line on a white field, although the a.c. component is exactly the same for both. Preservation of the d.c. component at the control element of the picture tube is essential if the transmitted scene is to be reproduced with the correct photographic gamma, contrast, and shading.

In the present standardized negative

system of transmission the black level corresponds to 75% modulation; the tips of the sync pulses extend to 100% and are what is known as "blacker than black." The camera signal usually lies between 15% modulation (maximum white), and 75% modulation (black level). Thus, d.c. reinsertion resolves itself into maintaining the blanking level contained in the transmitted signal at the light cut-off point (75% modulation, or black level) of the picture tube. Hence the camera signal components act against a fixed point in such a manner that their long time average level causes the over-all background illumination to vary in accordance with the background illumination of the transmitted scene. The d.c. reinserter reproduces accurately only those changes in video level which occur at a rate slower than approximately 50 cycles-per-second.

A reinsertion diode functions essentially as a peak detector with a long time constant load circuit. The condenser charges during the sync pulses and discharges into the load resistor during the line scanning interval. When operating conditions in a diode circuit are correct, not only is there d.c. reinsertion, but the tips of all the sync pulses are of the same amplitude, regardless of irregularities in the transmitted signal. This lining up of the tips of the sync pulses at the grid of the picture tube materially improves the operation of any sync separating circuit connected at this point. When d.c. reinsertion diode circuits are used this is the best point at which to connect the sync circuit.

Fig. 1 shows a typical d.c. reinsertion circuit. Here it is possible to substitute the crystal for the diode directly since the other component values remain the same for either crystal or diode. The ratio of the load resistor R_5 to the diode resistance of the tube or crystal should be as large as possible because the larger the ratio the more constant the blanking level and the sync pulse amplitude. With a crystal this ratio is very good because the diode resistance is low. But the value of the load resistance may not usually be greater than one megohm because larger resistance values are apt to introduce gas current difficulties into a cathode-ray tube. For this reason, in order to obtain a high ratio of load to diode resistance, the diode should have as low a dynamic resistance as possible. This is one reason why a crystal is better than a vacuum tube for this application.

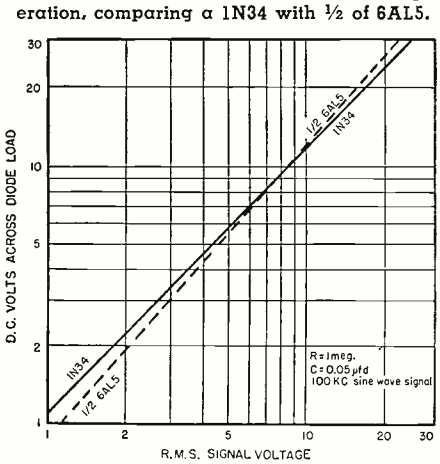
A comparative set of curves for a 1N34 crystal and one-half a 6AL5 are relatively the same for d.c. volts across the diode load plotted against rms signal voltage, see Fig. 2. With a one megohm load the rectification efficiencies for these components do not differ greatly. The crystal has a slightly greater output at low levels. Use of a germanium diode for d.c. reinsertion results in general over-all improvement of the circuit. This is due to the fact that the dynamic resistance of the diode is materially lower than the dynamic resistance of a vacuum tube. Further, with the crystal there is more secure clamp at the blanking level and more even alignment of the sync pulses.

The action of the circuit in Fig. 3A is as follows. With a positive-going signal on the plate of the video output amplifier the cathode of the diode becomes positive and passes no current. When the output signal swings negative, the cathode of the diode becomes negative and current flows through the diode and the 1 megohm resistor, R_2. This causes the cathode of the diode to become positive and condenser C_1 is charged. The positive voltage, determined by the signal, is applied through resistor R_1 to the grid of the picture tube. The one megohm load resistor for the diode is in series with the 100,000 ohm grid return resistor of the picture tube; therefore, any bias set up by the reinserter diode acts in conjunction with whatever grid bias is already present.

This positive voltage is added to the grid across resistance R_k and, since it is proportional to the signal, the sync tips will be aligned and the d.c. component, or the average brightness, will be automatically restored to the picture. So that the average brightness of the picture will not change so rapidly as to affect the eyes, the time constant of C_1 and R_{diode}, R_2 is made many times longer than the duration of one horizontal line, say 500 times, or approximately one frame. In this manner, scene lighting will be truthfully reproduced and extremely rapid changes making up the detail of the picture will be faithfully reproduced. Note that in this basic circuit the diode may be either ½ a 6AL5 or a germanium crystal such as the 1N34, 1N55, 1N58, or 1N65.

This is a difficult circuit to explain simply. Here is a slightly different approach to analysis of the functions of the separate components. With a positive-going signal on the plate of the video output amplifier, the cathode of the diode is positive and passes very little current. This small current, however, is sufficient to charge C_1 and C_2 eventually to the lowest plate voltage

Fig. 2. Curves showing d.c. reinserter operation, comparing a 1N34 with ½ of 6AL5.



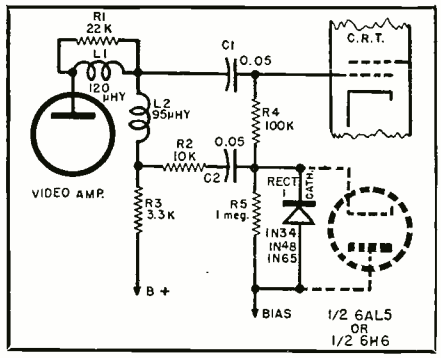


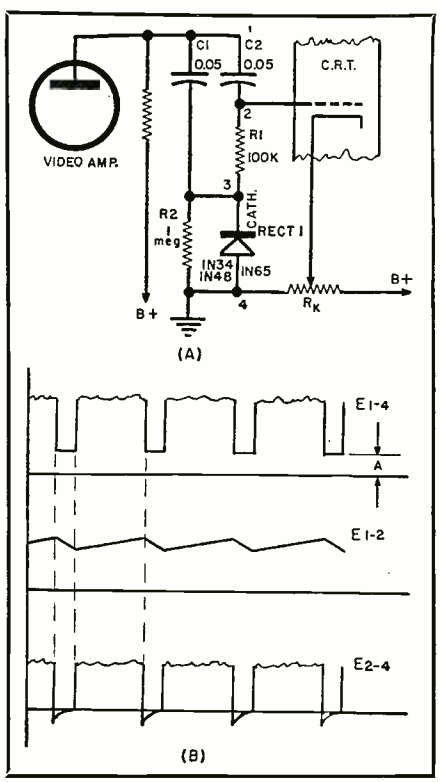
Fig. 1. A crystal d.c. restorer. The capacitive coupling, C_1, between the video amplifier and picture tube makes d.c. reinsertion necessary. The value of C_2 depends on the value of R_5 since R_5C_2 has a time-constant relationship. The diode may be a crystal, ½ a 6H6 or ½ a 6AL5. R_5, the diode load resistance, is 1 to 2.2 megohms, depending on the crystal and gas current difficulties in picture tube.

(equal to the sync pulse tips) of the video output tube.

When the output signal swings negative to the height of the sync pulses, the cathode of the diode becomes negative and the diode conducts. Because the forward resistance of the diode is low, condensers C_1 and C_2 quickly discharge any extra charge accumulated during the positive voltage swing. The current through R_1 and the diode therefore quickly becomes zero, and hence the voltage applied to the picture tube grid during the sync pulses is always held at zero. The CRT bias is then set so that with zero input volt-

(*Continued on page* 127)

Fig. 3. Operation of a d.c. restorer. (B) Signal voltages which exist in (A). E_{1-4} represents the voltage across points 1 and 4 in the circuit, E_{1-2} across points 1 and 2, and E_{2-4} across points 2 and 4.



Amplifier and preamp units.

High Quality 50-WATT AMPLIFIER

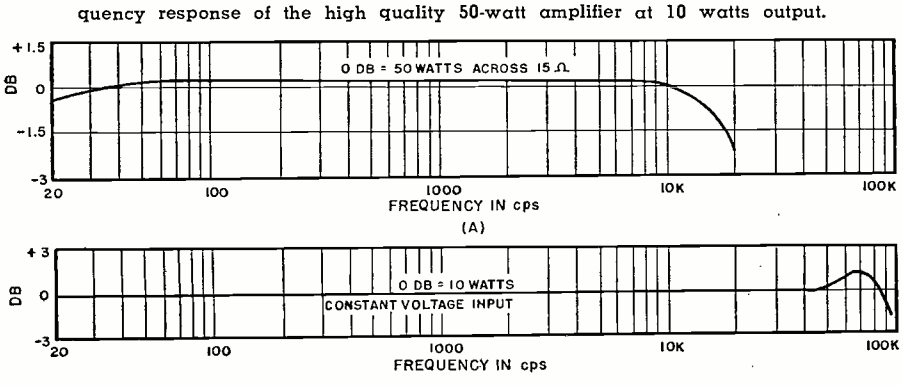
In addition to amplifier unit, author covers construction of an accompanying preamplifier.

By
JAMES BAUMGARDNER

THE faithful reproduction of music places many stringent requirements on the equipment designed for this purpose. In particular, the audio amplifier must be capable of meeting certain definite specifications. An ideal amplifier for driving a loudspeaker may be characterized as follows: It should supply ample power to the load at any frenquency in the audible range with negligible distortion and uniform gain, and should have a low internal impedance to provide good damping of the loudspeaker cone. To further qualify these statements, the audible range can be set at from 20 to 20,000 cps, and the gain should be sufficient to provide full power output from the currently available sources of high quality program material, such as low level magnetic phonograph pickups and tape playback heads, and FM tuners. Negligible distortion is not as easy to qualify, due to discrepancies in test procedures and methods of rating amplifier output and distortion. The usual procedure is to rate the power output for a total harmonic content of 5% at a frequency of 400 or 1000 cps. With most amplifiers, however, this is the point of maximum output and minimum distortion. The ratings do not usually specify the amount of power available or the distortion percentages at the extremes of frequency where it is most difficult to obtain high power with low distortion. One of the notable exceptions to this is the *McIntosh* unit, which delivers full rated power at any frequency within the above mentioned range with low distortion.[1] To accomplish this, however, special output and interstage coupling transformers are required which are costly and not available to the individual builder.

The purpose of the design to be described in this article was to obtain as nearly an ideal unit as possible using standard components. It is based on the principle of obtaining the maximum power possible from a given power supply so as to insure low distortion at moderate power levels. An efficiency of 50% was required in the power amplifier with a power input of 100 watts available, providing 50 watts output. It should be pointed out that this power output is taken to mean the power that can be delivered to a load placed across the secondary of the output transformer and includes losses from this source. This efficiency dictates the use of a push-pull class AB power stage employing tetrodes, while the requirement for low internal resistance indicates the use of negative voltage feedback. Accordingly, it was decided to use two 6L6 beam tetrodes in the output circuit, operating with a plate voltage of 450 v., screen voltage of 300 v., and a grid bias of –30 v. To insure adequate grid driving signal at low distortion, a push-pull cathode follower is direct-coupled to the 6L6 grids. A separate negative power supply of about –80 v. supplies fixed bias for the output stage and the cathode-follower driver. To keep the d.c. resistance in the 6L6 grid circuits to a minimum, a center-tapped coil is used as the cathode follower load. Plate voltage for the driver as well as the 6L6 screen voltage is regulated at 300 v. by the use of two VR150 voltage regulator tubes connected in series. The cathode follower is driven by a split load phase inverter using one half of a 6SL7. Adequate output voltage swing is insured by the fact that this stage operates into the high impedance of the cathode follower input and further by virtue of the high plate supply voltage made available to this stage by the circuit arrangement. The grid and cathode resistors for this section of the 6SL7 are returned to the negative supply voltage, while the plate load resistor is connected to 420 volts. The remaining section of the 6SL7 is operated as a straightforward voltage amplifier and completes the basic circuit. To provide 20 db of negative feedback, the 16 ohm output winding of the output transformer is connected through a suitable resistor to the cathode of the first section of the 6SL7. With this

(A) This curve shows the maximum power output across a 15 ohm resistive load without departure from the sine wave as a function of frequency. (B) The frequency response of the high quality 50-watt amplifier at 10 watts output.



amount of feedback, about 8 volts signal is required at the input grid to provide full output.

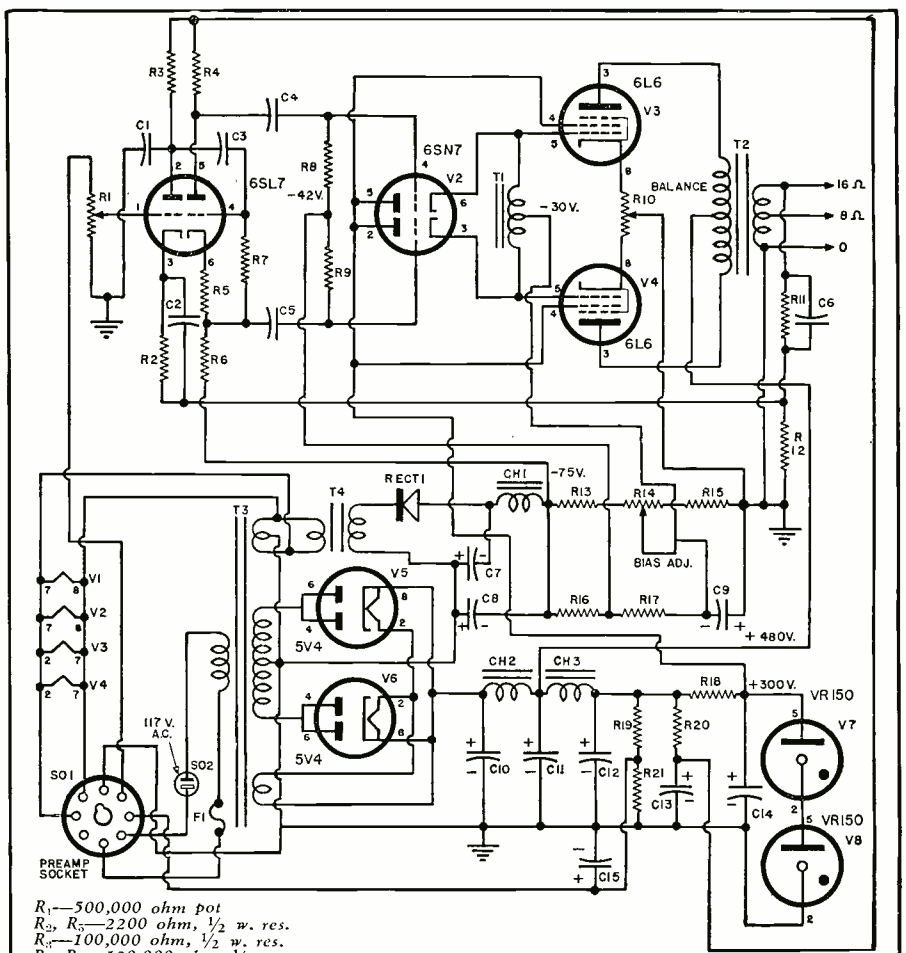
Several features of the circuit outlined combine to place severe demands on the output coupling transformer. The requirement for a relatively large amount of feedback means that the output transformer should have minimum phase shift in order to avoid instability at the extremes of frequency. Good primary-to-secondary efficiency is required to provide 50 watts output with a minimum of coupling loss. Leakage inductance must be small to minimize distortion caused by switching of the plate current from one half of the primary to the other—an inevitable condition of class AB operation.[2] An investigation of the various transformers available disclosed that the *Stancor* A-8050 series appeared to be the most promising. The A-8053 unit was tried and has proved very satisfactory.

The preamplifier designed for use with this circuit employs three miniature duo-triodes. The first is used as a preamp for magnetic pickups, tape playback, and microphone input. Feedback equalization is used to provide bass-boost for the two former functions, while the latter is arranged to provide flat response. Suitable switching of components in the feedback circuit is accomplished by a section of the input selector switch. Either a 12AX7 or a 12AY7 may be used in this position, the latter providing somewhat lower noise and less microphonics. The second duo-triode is a straight two-stage amplifier with the tone controls in the plate circuit of the first stage. In the units built so far, 12AX7 tubes have been used for this position. With the gain thus provided, however, considerable attenuation of high level inputs (FM, etc.) as well as some attenuation of phono inputs is necessary to bring them down to the level of the tape input with the particular tape playback head used. Output level data is not readily available on tape heads, and there is considerable variation among the units on the market. If a tape input is not required, a 12AU7 may be substituted for the 12AX7 in this second position, leaving ample gain for magnetic phono pickups and tuner inputs. No circuit value changes are necessary. The third duo-triode has its two sections in parallel and serves as a conventional cathode follower. Either a 12AX7 or 12AU7 may be used in this position. If the cable to the main amplifier is over 20 feet in length, or is of excessively high capacity, a 12AT7 may be used to provide somewhat lower impedance to drive the higher capacity. The latter tube has a higher mutual conductance and will, therefore, provide a lower output impedance when used as a cathode follower. A step-type equalized volume control is employed to assure proper tonal balance at low volume levels. The pots connected to the various input jacks should be adjusted to provide the same volume level from all of the input positions on the selector switch. The tone controls are arranged to give independent boost or attenuation of lows and highs. The bass control varies the level at 40 cps from —18 to plus 16 db, while the treble control changes the 10 kc. response from —14 db to plus 16 db, all relative to the response at 1000 cycles. The theory of operation of these controls has been described elsewhere.[3]

To provide for feeding the selected program source to a tape recorder amplifier, a jack is connected to the input terminal of the volume control and may be connected to any high impedance recording amplifier input. Since the level at this jack is not affected by the setting of the volume control, the amplifier may be used for monitoring at any desired volume level while recording proceeds.

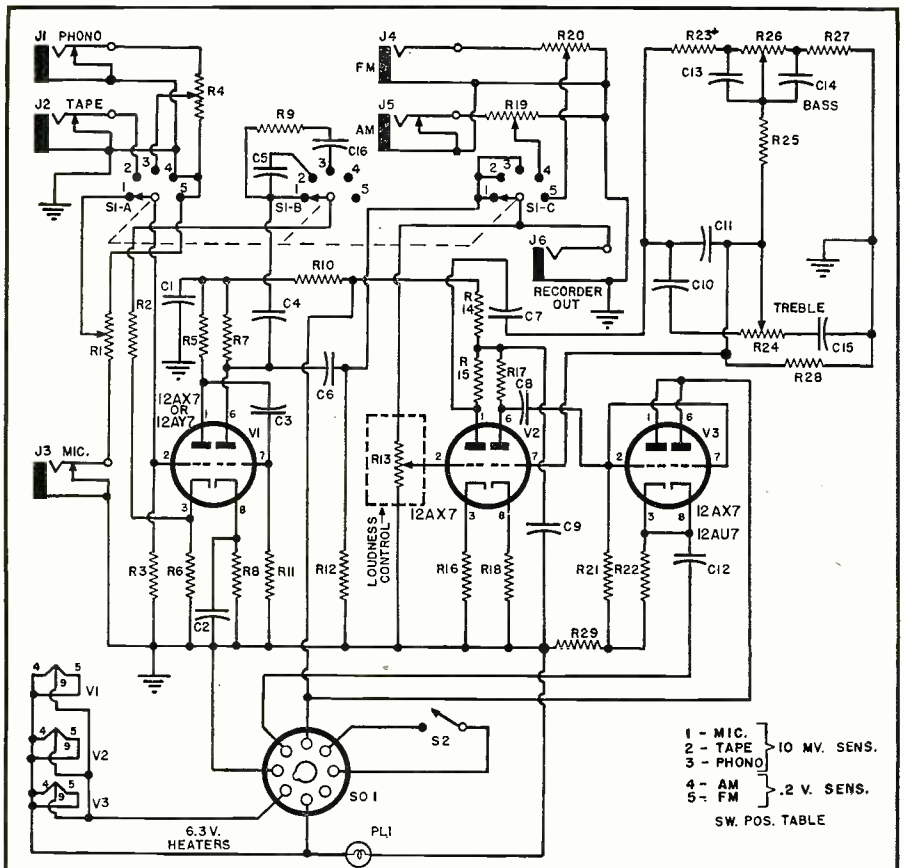
As may be seen in the photographs of the unit, the main amplifier and power supply are housed in a 6" x 7" x 12" metal cabinet, with all transformers, except the input coil, mounted inside. The top of the cabinet, containing the tube sockets and the input coil, is hinged at the rear for easy access to all components. The preamplifier is built in a 3" x 5" x 9½" chassis with controls along the front drop and tube recess, and input connections as well as power cable connection on the rear drop. The compact construction thus obtained makes the preamplifier easy to mount in cabinets with a minimum of space requirements.

Complete wiring diagram and parts list for the 50-watt amplifier. Although the author used push-pull 6L6's in the output stage, 807's could be substituted. It may be advantageous to do so in view of the fact that 807's have higher ratings.



R_1—500,000 ohm pot
R_2, R_3—2200 ohm, ½ w. res.
R_4—100,000 ohm, ½ w. res.
R_5, R_6—120,000 ohm, ½ w. res.
R_7, R_8, R_9—1 megohm, ½ w. res.
R_{10}—50 ohm, 5 w. wirewound pot
R_{11}—2500 ohm, ½ w. res.
R_{12}—820 ohm, ½ w. res.
R_{13}—1500 ohm, 5 w. res.
R_{14}—1000 ohm, 5 w. wirewound pot
R_{15}—500 ohm, 5 w. res.
R_{16}—68,000 ohm, ½ w. res.
R_{17}—10,000 ohm, ½ w. res.
R_{18}—2500 ohm, 20 w. wirewound res.
R_{19}—15,000 ohm, 2 w. res.
R_{20}—10,000 ohm, ½ w. res.
R_{21}—100,000 ohm, 2 w. res.
C_1—100 μμfd. mica cond.
C_2—25 μfd., 25 v. elec. cond.
C_3—.05 μfd., 600 v. cond.
C_4, C_5—.1 μfd., 600 v. cond.
C_6—500 μμfd. mica cond.
C_7, C_8—50 μfd., 150 v. elec. cond.
C_9—50 μfd., 50 v. elec. cond.
C_{10}, C_{11}, C_{12}—16 μfd., 600 v. elec. cond.
C_{13}, C_{15}—20 μfd., 450 v. elec. cond.
C_{14}—8 μfd., 450 v. elec. cond.

CH_1, CH_3—3.5 hy., 50 ma., 200 ohm filter choke (Stancor C-1080 or equiv.)
CH_2—4 hy., 250 ma., 60 ohm filter choke (Stancor C-1412 or equiv.)
T_1—Output trans. push-pull plates, 4000 to 14,000 ohms to v.c., primary only used. (Stancor A-3823 or equiv.)
T_2—Output trans. 5000 ohm pri., 8, 16 ohm sec. push-pull 6L6's. (Stancor A-8053 or equiv.)
T_3—Power trans. 400-0-400 v. @ 250 ma.; 5 v. @ 4 amps; 6.3 v. c.t. @ 5 amps. (Stancor PC-8413 or equiv.)
T_4—Fil. trans. 6.3. v. @ 3 amps. (Stancor P-5014 or equiv.)
SO_1—Octal socket
SO_2—117 v. power line socket
F_1—3 amp. line fuse
$Rect._1$—75 ma. selenium rectifier
V_1—6SL7 tube
V_2—6SN7 tube
V_3, V_4—6L6 tube
V_5, V_6—5V4 tube V_7, V_8—VR150 tube



R_1, R_{19}, R_{20}, R_{24}, R_{26}—*1 megohm pot*
R_2, R_9—*120,000 ohm, ½ w. res.*
R_3, R_{11}—*1 megohm, ½ w. res.*
R_4—*Res. of this pot should equal recommended load res. for pickup cartridge used*
R_5, R_7, R_{15}, R_{17}, R_{23}, R_{25}—*100,000 ohm, ½ w. res.*
R_6, R_8, R_{10}, R_{18}—*2700 ohm, ½ w. res.*
R_{10}—*22,000 ohm, ½ w. res.*
R_{12}, R_{28}—*2.2 megohm, ½ w. res.*
R_{13}—*Livingston loudness control (Model MB)*
R_{14}, R_{27}—*10,000 ohm, ½ w. res.*
R_{21}—*680,000 ohm, ½ w. res.*
R_{22}—*1000 ohm, ½ w. res.*
R_{29}—*47,000 ohm, 1 w. res.*
C_1, C_9—*40/40 μfd., 450 v. elec. cond.*
C_2—*10 μfd., 25 v. elec. cond.*
C_3, C_6, C_7—*.05 μfd., 600 v. cond.*
C_4—*.5 μfd., 400 v. cond.*
C_5—*.0025 μfd. mica cond.*
C_8—*.01 μfd., 600 v. cond.*
C_{10}—*150 μμfd. mica cond.*
C_{11}—*20 μμfd. mica cond.*
C_{12}, C_{14}—*.02 μfd., 600 v. cond.*
C_{13}—*.002 μfd., mica cond.*
C_{15}—*.0015 μfd. mica cond.*
C_{16}—*.001 μfd. mica cond.*
S_1—*5-pos. 3-gang selector sw., shorting type*
S_2—*S.p.s.t. toggle sw.*
PL_1—*6.3 v. pilot light*
J_1, J_2, J_3, J_5—*Shorting type jack*
J_4, J_6—*Open circuit jack*
SO_1—*8-prong socket*
V_1—*12AY7 or 12AX7 tube*
V_2—*12AX7 tube*
V_3—*12AX7 or 12AU7 tube*

Wiring diagram and parts list covering the preamplifier used with 50-watt amplifier.

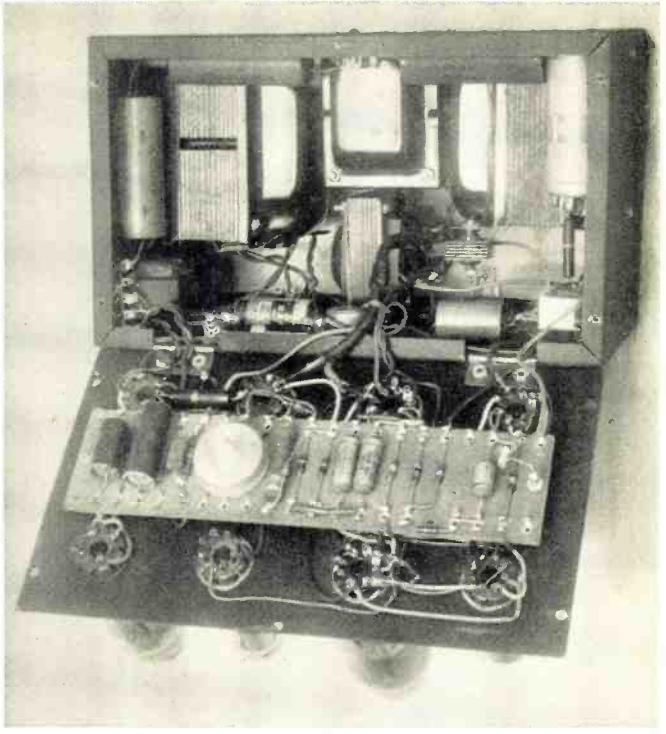
Since the photographs were taken, a row of ¾ inch diameter holes has been added near the top of the cabinet containing the amplifier. Small rubber feet have also been placed on the bottom of the unit, with several holes cut in the bottom. This gives a chimney effect and aids materially in cooling the power transformer and other components.

The circuit described was carefully checked for performance. Preliminary measurements were made of power output, frequency response, total harmonic content at various output levels and at various frequencies, linearity between input and output signals, and damping factor. The maximum power output depends upon the full-load power supply voltage, which, in turn, depends on the line voltage. Measurements were made at a line voltage of 114 v. At 400 cycles, the maximum power output is 50 watts at 1% total harmonic content. The same is true at 40 cps, while at 50 watts output at 10,000 cps the total distortion is about 3%. At an output level of eight watts, the frequency response is flat from 20 cps to 50 kilocycles. No departure from linearity is observed up to 50 watts output, using either sine wave input or music. Square wave tests indicate that the circuit is free from ringing or overshoot. Several units built thus far have displayed no instability due to the feedback loop, even with the secondary winding of the output transformer unloaded. The effective internal resistance measured at the 16 ohm output terminals is 1.5 ohms, providing a damping factor of 10. This measurement was made at 40, 400, and 10,000 cps with the same result. The zero signal plate current of the two 6L6's is about 60 ma., providing a plate dissipation of 15 watts per tube. At 50 watts output, the total plate current is 180 ma., plus 20 ma. of screen current, providing a total input power of 86 watts. This represents an efficiency of 58%, while the plate dissipation at full output is only 18 watts per tube.

Perhaps the most significant of the tests made were the listening tests in which the amplifier was used to drive a high quality speaker system and was supplied with live FM programs and the best available LP and tape recordings. Initial listening tests quickly indicated that the quality was excellent at all volume levels up to the maximum that could be handled by the particular speaker system employed (25 watts). Therefore, a comparative test was set up in which two amplifiers could be bridged to the same input line and their outputs fed to a selector switch connected to the speaker system so that instantaneous switchover from one amplifier to the other could be accomplished. With the volume controls of the two units set to provide the same volume level, it was then possible to compare the two units directly. In all cases one of the amplifiers was the one described here, while the other was one of several high quality units selected for comparison on the basis of excellence of published data and popularity. Among them was the *Williamson* unit and another highly regarded circuit using push-pull 6B4G triodes in class A. Results showed that at low and moderate volume levels there was no detectable difference when switching from one unit to the other. At higher volumes, however, the difference was marked, particularly at low frequencies where considerable power peaks are encountered. The clean, solid reproduction of the circuit described at high volume levels is remarkable and is only possible where relatively large reserves of sine wave handling power are available. The speaker system used for the tests consisted of a *Stevens* two-way reproducer employing a 15" cone woofer and a coaxially mounted multicellular high frequency horn, with electrical crossover at 1200 cps. This unit is mounted in a corner type enclosure employing horn loading of the low frequency cone to provide response down to 40 cycles.

While considerable attention has been given recently to the problem of transient or "switching" distortion caused by leakage inductance in the output transformer when class AB operation is employed, it does not appear to be too serious when high quality output transformers are used. In the circuit described, this effect is observable as a notch in the sine wave as can be seen at either plate of the output stage, occurring at relatively high output levels and at frequencies above about 8 kc. It should be noted, however, that this distortion must become very severe before there is any noticeable departure from a sine wave in the combined signal as observed at the secondary winding of the output transformer. This may be noted by the photograph showing the output waveform at 50 watts and 10 kc. It should also be noted that frequencies of this order are not found in music except as harmonics and overtones which are considerably down in power from the average level. Listening tests indicate that the quality of reproduction depends to a far greater extent upon the ability

Over-all view of the high quality 50-watt amplifier. The power supply and main amplifier are housed in a 6" x 7" x 12" metal cabinet. All transformers, except the input coil, are mounted inside the cabinet. In later models the author added a row of cooling vents at the top and bottom of the housing.



Internal view of the main amplifier-power supply cabinet. By using a hinged-type cabinet easy access to all component parts is provided, making any changes and servicing easy to handle.

of the amplifier to deliver full power with low distortion at low frequencies than at extremely high frequencies, and this is borne out by tests showing linearity between input and output signals of an amplifier handling music at high power levels.

Some readers may question the need for a fifty watt amplifier for home use. Although many tests have shown that the majority of home listening is done at an average level of one-tenth of a watt, the peak passages can be as high as forty watts, even though this is an instantaneous figure.

Amplifiers of ten watt rating can give very satisfactory performance in the majority of listening tests, but it is the few occasions when the peak power of the amplifier is exceeded, where the reserve power of this amplifier tends to separate the men from the boys.

If the full benefit is to be derived from this amplifier, a speaker system to handle the peak power must be used. Unfortunately, good speaker systems to handle fifty watts are rather expensive, but in any event it is advisable to buy the best you can afford.

In selecting a speaker system from the catalogues, remember that the majority of manufacturers rate their speakers at the maximum power they can handle without serious distortion and the music will sound much cleaner if the speaker is not pushed to its limit.

If the optimum results are desired, it is advisable to use a speaker system or a group of speakers having a power rating equal to the maximum output of the amplifier, or fifty watts.

Another factor that must be considered in a high quality installation is the proper speaker enclosure. Many different types of speaker enclosures have been designed, and all have certain advantages.

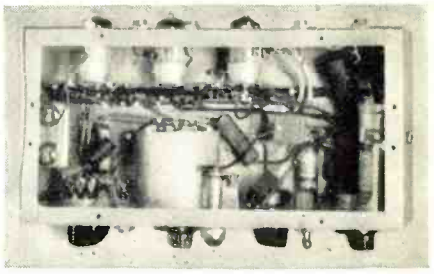
Speaker enclosures of various types have been described in past issues of this and other magazines.

The room acoustics will also have a considerable bearing on the ultimate results, and due consideration should be given to this factor in judging any sound system. The only fair way to compare systems is under identical room conditions.

Other mechanical arrangements will undoubtedly suggest themselves to the constructor; but in any event it is desirable to take every precaution to avoid hum by the use of a single ground bus to which all ground returns are made. This precaution, more than any other, will eliminate hum.

In the event that there is objectionable hum when all precautions are taken, this can frequently be reduced or eliminated by careful selection of tubes in the preamplifier portion.

To sum up, this design represents an opposite approach to the problem of designing a high quality music amplifier from that used in the *Williamson* circuit, in which tubes having comparable power ratings are used with a similar power supply to provide less than one third the useful power output. The circuit is not complex, and



Bottom view of the preamplifier chassis. Unit is built on a 3" x 5" x 9½" chassis.

the components are relatively inexpensive. The most costly single item is the output transformer, which can be purchased for less than $12. Several units using this circuit have been built, and all have proved highly satisfactory, more than justifying the effort that has gone into the design, construction, and testing of this amplifier.

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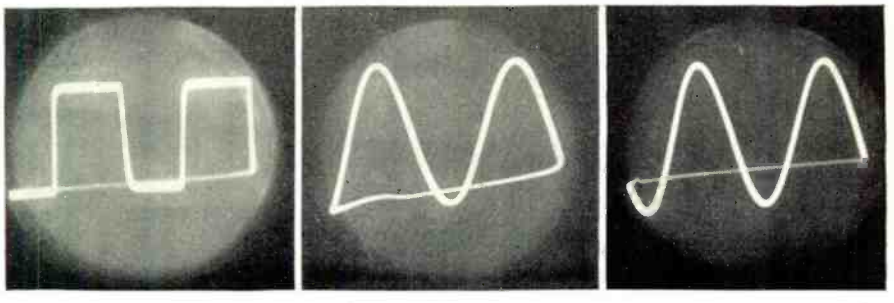
Scope patterns. (Left) 25 watt output, 2 kc. square wave. (Center) 50 watt output at 10 kc. with 15 ohm resistive load. (Right) 50 watt output at 40 cps with 15 ohm load.



ELECTROSTATIC FOCUS For Picture Tubes

By
WALTER H. BUCHSBAUM
Author, "Television Servicing"

Born of necessity, this new focusing system is, in most cases, equal or better than old method.

IN MOST 1952 TV receivers one familiar major component is missing. Most of the new picture tubes operate without a focus coil or PM focusing ring. Although this important device is omitted, focus on the screen will be excellent, much better in many instances than with the conventional magnetic focusing system. Starting January 1st, all major picture tube manufacturers have swung over to the new, electrostatic focus type tube.

Born of the impending shortage of copper and cobalt for magnetic devices, the use of electrostatic focus is an important stride towards simplifying TV receivers. The old type focus coil used about 3 pounds of copper and at least 100 ma. of d.c. to focus the picture sharply. A large wattage potentiometer and some series resistors were needed to provide focusing adjustment. The position of the focus coil on the neck of the picture tube was fairly critical, requiring an elaborate set of brackets, mounting bolts, etc. The PM type of focusing ring did not use any current from the receiver, but its adjustment was often tricky and mounting it required special brackets. The PM material, usually a high grade of Alnico, used cobalt which is one of the most critically needed materials in our defense effort. All these expensive and cumbersome features are eliminated in the newest electrostatic focus tubes. Small screen picture tubes and most oscilloscope cathode-ray tubes have always used electrostatic focusing, but until the beginning of 1951 it had not been considered practical to apply the same system to large picture tubes. In small cathode-ray tubes the accelerating anode serves as the focusing element, but for present day large screen picture tubes a separate element in the electron gun does the focusing. The first electrostatically focused picture tubes designed in early 1951 used a focusing potential of 3000 to 5000 volts and are referred to as high voltage focus tubes. A later model used no external focusing voltage but employed an internal connection from the focus element to the cathode. The most widely used type is really a compromise design which allows for small errors in gun structure and variations in the voltages in the TV receiver. This last type is called a low voltage focus tube. Before discussing the merits and application of each of these three types of picture tubes a short description of the operation of an electrostatically focused tube seems to be in order.

Principle of Electrostatic Focus

Five separate elements make up the electron gun inside the picture tube. The filaments heat the cathode so that its coated surface will emit electrons. The control grid surrounds the cathode with a negative field, reducing the number of electrons that can travel towards the anode. Placed next to the cathode-grid structure is the accelerating anode, often called the accelerating grid because its function is similar to that of the screen grid in a pentode amplifier. The accelerating grid, G_2, is at a fixed positive voltage and it helps to keep the electron beam constant during slight variations in second anode voltage. The second anode contains the highest potential, usually over 10 kv., and is the final goal of the electrons after they have bounced off the screen. Aside from deflecting the electron beam to "paint" a raster on the screen, a focusing device is required to concentrate the electrons into one small spot on the screen. In magnetic focusing systems the electrons enter a magnetic field at a certain angle and are deflected by this field to converge in one spot on the screen. This magnetic field is at right angles to the center of the electron path and only those electrons in the center of the beam cross the field at a right angle and therefore are not deflected. All other electrons enter at some other angle and are then deflected so as to hit the screen close to the center.

A system of electrostatic focusing is shown in Fig. 1. In addition to the elements listed in the preceding paragraph the focusing element is now part of the electron gun structure. Instead of a magnetic field the electrostatic field between two elements of different potential is used to converge the electron beam. The focus element and the second anode in Fig. 1 have a potential difference between them just as two opposite charges in electrical theory. One, the focus element, has a negative potential and the other a high positive potential. Between these two potentials electrostatic lines of force exist. These lines vary in both density and in force as shown in Fig. 2. Any electron passing in the center will not be affected in its path, but those electrons entering the field at some angle will be forced back towards the center of the field. That, in principle, is the operation of electrostatic focusing or any other electron lens.

As we see in Fig. 1, the electron gun structure really contains two separate electronic lenses. The first is the field between the control grid and G_2. The second is the field between the focus anode and the second anode. The first lens is relatively fixed although, on close observation, it is apparent that the focus and the spot size change with changes in control grid voltage. In a picture the bright portions of a single line will appear thicker than the darker parts and this is due to the variation in the voltage difference in the first lens, control grid, and G_2. The second lens is adjusted by varying either of the two voltages. Since it would not be practical to vary the second anode voltage, the potential on the focusing element is adjusted. It might be pointed out right here that no substantial change in focus is obtained by this method, simply because, compared to the 12 kv. of the second anode, a 400 volt change in the focus element does not greatly change the electrostatic field between the two elements.

In actual operation the voltages between cathode, control grid, and G_2 are the most critical ones. Once they are adjusted, slight variations in focus or second anode voltage will have little effect on the electron beam and it would be possible to set them all to a fixed potential. Unfortunately it is not economical to mass-produce picture

tubes so accurately that the spacing of all the elements in the electron gun is held to zero tolerances. Voltages may vary in TV receivers, even among identical models. For this reason most of the new electrostatic tubes permit some adjustment of the focusing voltage. It is apparent from the electron optics presented here that the spacing, especially of the focus anode, is quite critical. Electrically, a high potential difference exists between the focus anode and the second anode, but the actual metal sleeves are placed fairly close together and are mounted on the same ceramic sleeve which holds all other elements together. The major difficulty with earlier models was the arc-over from the focus anode to the second anode through the mounting sleeve. This has now been overcome by placing glass beads at the most likely arc-over points. The limitation of arcing still remains, however, and none of the low voltage focus tubes can be operated at more than 16 kv. If this is exceeded, internal arcing is likely to occur.

Of the three types of electrostatically focused picture tubes only the low voltage and zero voltage focus tubes are easily used in place of an old style magnetic focus picture tube. The HV focus tubes require a focus voltage which is approximately 22% of the second anode voltage. For a 12 kv. second anode voltage the focus voltage must be about 3 kv., with some adjustment provided. Several different TV receivers made in 1951 are using this HV focus type picture tube with special circuits and parts to obtain and vary the focusing potential.

HV Focus Picture Tubes

The 17GP4 and the 21DP4 are both HV focus tubes having a rectangular metal shell and are most widely used in the 1951 *RCA* TV receivers. Other HV focus types are the 17FP4A, 20GP4, and 20FP4, all rectangular glass picture tubes. The focusing anode is brought out at the kinescope socket on pin #6, which is an isolated pin, not found in any of the magnetic focus type tubes. The socket used for these tubes must be a circular one and the inexpensive half round type used in many older receivers cannot be used. Since the voltage on pin #6 will be about 3 kv. a HV insulation wire must be used.

Fig. 3A shows a simple but effective circuit for obtaining focusing voltage for a HV focus tube. In this circuit, which is used in the *RCA* and some other sets, the high positive pulse on the plate of the horizontal output tube is applied to the plate of an additional HV rectifier, usually a miniature type like the 1V2 or the 1X2. A second filament loop for this rectifier is wrapped around the flyback transformer core. The output of this rectifier is usually about 4500 volts d.c. which is reduced through a bleeder network to the desired focusing voltage. The focusing control forms part of the bleeder network and a 500 μμfd. HV condenser

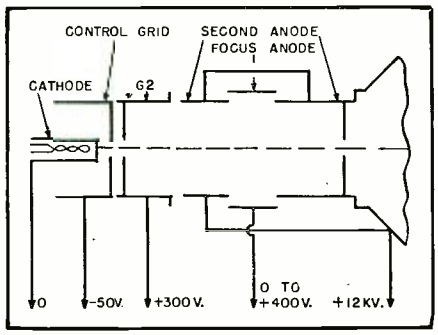


Fig. 1. Detailed plan of an electron gun for a low-voltage electrostatic focus tube.

provides the filtering action. Conventional potentiometers have a grounded case and shaft and are not designed to withstand several thousand volts from the resistance element to the case. To give adequate focusing range a bleeder of about 25-30 megohms is used with the focus control ranging to about 15 megohms. A special potentiometer was developed for this purpose, featuring a molded plastic case and insulated shaft and having a diameter of almost 2 inches.

In the *RCA* models featuring HV focus the entire circuit is mounted inside the HV compartment with the focus control shaft protruding at the rear of the chassis. This elaborate system eliminates the focus coil or focusing magnet, but provides no economy because the additional tube, condenser, and resistors add up to as much as the conventional focus coil. Since it was found practical to manufacture low voltage focus tubes by mass production, HV focusing has been largely abandoned in favor of the former method.

Low or Fixed Voltage Focusing

Compare the circuit in Fig. 3A with the circuit in Fig. 3B, and the advantages of low voltage focus tubes will be obvious. All that is required is a conventional potentiometer of about 1 megohm, ½ watt which costs only a few cents. The "B plus" voltage available in the TV receiver and the cathode voltage of the picture tube are important factors but in almost all present TV sets correct focusing voltage can be obtained. Before going into details on low voltage focus the difference between it and fixed or zero voltage focusing merits attention. The latter type requires extreme accuracy in manufacturing, and shrinkage among this type is quite high. As a result the cost of a zero focus tube is over a dollar more at the manufacturer's level than a low voltage focus tube. The price of a potentiometer and wiring often is less than the additional cost of a zero voltage tube. In addition, the zero voltage types will not give good focus if any of the other voltages on the picture tube are off by more than about 5%. For these reasons many TV manufacturers have swung over to the low voltage focus tubes. The only zero voltage types available, which require no adjustment at all and have no external connection for the focus element, are the 17KP4, 20JP4, and 21KP4, all rectangular glass picture tubes.

As mentioned before, different TV receivers use different voltage values in their "B plus" supply and when it is desired to replace an old magnetic focus type with a low voltage focus tube, the correct voltages and the right tube type must be chosen. Table 1 shows various values commonly found in present TV models. The second anode voltages are measured with respect to chassis, but all other voltages are with respect to the cathode of the picture tube. If the cathode receives the picture signal it is frequently at the potential of the video amplifier plate which will be slightly lower than the video amplifier "B plus" supply and the cathode voltage will vary with the picture signal. In this instance the value of the cathode voltage should be taken as half way between the zero and maximum signal value. From Table 1, it appears that occasionally a "B plus" higher than the

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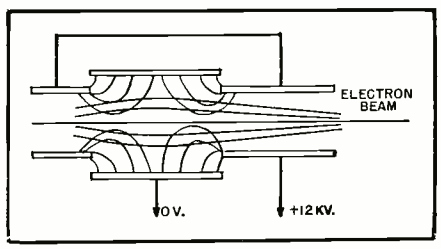
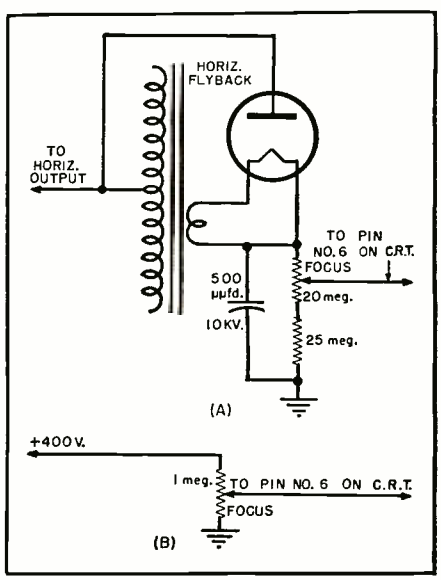


Fig. 2. Symbolizing an electrostatic lens.

	17HP4 or 20HP4	17RP4 or 20LP4
Second Anode	11-12 kv. 12-14 kv.	10-12 kv. 12-14 kv.
G_2	300 300-420	250-300 300-420
First Anode	200±200 100±100	0 ± 100 0 ± 400

Table 1. Voltage range of most TV models.

Fig. 3. Diagram of (A) high-voltage and (B) low-voltage electrostatic focus control.



INTERLACING TROUBLES and VERTICAL SYNC CIRCUITS

By
JOHN K. FRIEBORN

The causes of interlacing troubles, methods of tracing them, and details on improved vertical separator which is impervious to such troubles.

INTERLACING troubles and their correction are becoming more important to the technician than they once were. Imperfect interlacing has always existed to some extent on most receivers, but it is not particularly noticeable on small picture tubes. With larger picture tubes becoming common, set owners are more likely to be aware of it.

This article will examine interlacing problems more thoroughly than is usually done in general treatments of synchronization. In particular, it will show how imperfect interlacing may occur even with a normal signal being obtained from the integrator, suggest means of identifying and tracing faults, and bring to the reader's attention several circuits which avoid the faults of the integrator as a vertical sync separator.

The general nature of interlacing and the part played by the integrator and the equalizing pulses have been discussed in many books and magazine articles (for example, the articles in RADIO & TELEVISION NEWS by Solomon Heller and Peter Orne, "Servicing TV Sync Circuits," August and September 1950, and "Servicing Intersync Circuits," March 1951). This discussion of principles is intended to supplement such treatments.

On the television picture, the basic effect of interlacing is to double the number of scanning lines which would otherwise appear. That it does this can be verified by switching from a raster to a picture while keeping approximately the same horizontal and vertical scanning frequencies. For reasons which are explained in standard textbooks, if a saw-tooth oscillator is synchronized by a direct application of sync pulses, the free-running frequency is equal to or less than the synchronized frequency, but not greater. On the other hand, a saw-tooth oscillator controlled by flywheel synchronization (also called automatic frequency control) has about the same frequency when controlled as it has free-running. In most receivers the horizontal oscillator has flywheel sync while the vertical is directly synchronized. Therefore, in making the check mentioned, the vertical oscillator must be specially adjusted to have a frequency of about 60 cycles on the raster as it does on the picture, but it probably will not be necessary to take any precautions with regard to the horizontal oscillator.

The most convenient method of adjusting the vertical oscillator to a free-running frequency of 60 cycles-per-second is to set the vertical hold control for a normal picture, readjust it so the picture rolls downward (frequency higher than 60 cycles), then turn the control back just enough to make the picture stationary again (frequency just 60 cycles). With the vertical hold control adjusted, adjust the other controls on the receiver to obtain an unsynchronized raster and count the scanning lines in one inch or half an inch. Readjust the controls to obtain a picture and count the number of lines in the same space. It may be found that by moving the vertical hold control very slightly the number of lines and the spacing between them can be changed, without causing the picture to roll. The proper adjustment is for the greatest number of lines, spaced as nearly equally as possible. If the number of lines on the picture cannot be made twice as great as on the raster, interlacing is not being accomplished in the receiver and the experiment should be repeated on another set.

The reason for twice as many lines appearing on the picture is that the horizontal and vertical frequencies are maintained in the ratio of 262.5 to 1, so that the lines of each field are scanned half-way between those of the previous field and the last two fields scanned are visible simultaneously at any given time. On the raster there is nothing to keep the two frequencies in exactly that ratio, but there will be a tendency for the vertical oscillator to be triggered at the end of a line on every field by a horizontal retrace pulse coupled to the vertical circuit. The ratio between the two frequencies will, therefore, be a whole number, each field being scanned over the previous one, and only the last field scanned will be visible at one time.

If the interlacing is not perfect, that is, the ratio of the horizontal and vertical frequencies is not always 262.5 to 1 and the fields are alternately longer and shorter than normal, lines in one field will be shifted up or down with respect to the lines in the other field. Instead of the spaces between lines being equal, they will be alternately large and small. In an extreme case, complete loss of interlacing, the fields are alternately longer and shorter than normal by a sufficient amount to cause the lines of one field to be superimposed upon the other.

If the scanning lines are not equally spaced, but overlap more or less, there is obviously a loss of vertical resolution. There are fewer separate horizontal lines, so fewer changes in brightness are possible from top to bottom of the picture. It is less obvious, but equally true, that imperfect interlacing may cause a loss of horizontal resolution. This may be seen by considering what would happen in the special case where a dark spot followed by a bright one along a line in one field were directly above a bright spot followed by a dark one along a line in the other field. If the two lines became superimposed, a line would result in which the two spots were each a combination of bright and dark spots, that is, the two spots would be of about the same brightness, so that both of the original brightness changes along the individual lines would be lost.

Imperfect Interlacing

Many things can disturb the synchronizing of the vertical oscillator, such as: misadjustment of the vertical hold control; faulty components or improper applied d.c. voltages in the vertical oscillator circuit changing the free-running frequency so much that it cannot be corrected by the hold control; distortion of the video signal before sync separation by overloading in an amplifier stage causing clipping and reduction of sync pulse amplitude, or by loss of low frequencies so that the vertical oscillator can be triggered by the blanking pulse instead of the synchronizing signal; hum due to heater-cathode leakage in a vertical deflection, sync, or video channel tube, or to insufficient power supply filtering; picture signal interference due to a fault in the sync separator over-

loading in the video channel, or coupling between sections of the receiver through the power supply or by stray fields; noise interference due to a fault in the sync limiter or vertical separator circuits, or unwanted coupling; horizontal sync interference due to fault in vertical separator, or unwanted coupling; horizontal deflection signal interference due to coupling through the low voltage power supply, by stray fields, or in the case of receivers in which the vertical oscillator plate voltage is obtained from the damper tube, by signal coupling between the two tubes through the d.c. wiring; audio interference due to unwanted coupling or microphonics, that is, vibration of a microphonic tube or other component in the vertical deflection of sync channel by sound waves from the speaker; and finally, weak signal, which is not a cause in itself, but may allow any of the other factors mentioned to have a more noticeable effect than they would have in the presence of a normal signal. The specific type of vertical synchronizing fault, loss of interlacing, however, can be caused only by interference from horizontal synchronizing or deflection signals, although a slight amount of such interference may produce a more noticeable effect when the vertical synchronizing signal is weak or clipped or the vertical hold control is misadjusted.

Tracing Path Interference

General loss of vertical synchronizing may often be corrected by such simple means as tube substitution, but the quickest method of correcting imperfect interlacing begins with finding the path of the interference into the vertical oscillator, using an oscilloscope. The sync pulse input to the oscillator may be observed with the receiver tuned to a station, but with the vertical oscillator disabled so that pulses produced by it will not confuse the oscilloscope pattern. If horizontal sync interference is seen as a ripple on the vertical sync pulse, it would of course indicate trouble in the integrator or other vertical separator.

Next, the plate voltage of the vertical oscillator can be examined, with the oscillator disabled, for the presence of horizontal signals, with and without a station tuned in, and with and without the horizontal circuits operating, to determine whether the interference is due to horizontal synchronizing or deflection signals. When the source of the interference has been determined, the appropriate components can be checked.

Integrator Circuits

In some makes and models of television receivers, imperfect interlacing is found which cannot be corrected by any ordinary servicing operation. The cause may be a slight amount of stray coupling or coupling through the power supply or damper, with its effect magnified by the fundamental defect of the integrator as a vertical sync separator.

An integrator is a low pass filter with a cut-off frequency somewhere between 60 and 15,750 cycles, so as to pass the vertical sync signals, and reject the horizontal. However, no filter has a perfectly sharp cut-off, so that one which reduces signals of 15,750 cycles almost to zero will also reduce those of 60 cycles somewhat. Furthermore, the vertical signal, being a pulse, contains high harmonics of 60 cycles which will be attenuated even more than the fundamental, so the shape of the output will be different from that of the input. The best compromise between rejection of the horizontal signal and retention of the shape of the vertical is obtained with a sharp cut-off filter, so most receivers use a three-stage *RC* filter. More stages of shorter time constant would give the same size vertical pulse with better shape and less horizontal interference, but three stages is the usual limit. At any rate, reducing the amount of horizontal interference applied to the vertical oscillator grid will not reduce the effect of horizontal interference entering the vertical circuit by other paths, and no integrator can produce an output pulse as sharp as the input.

Since the output voltage of the integrator does not change very rapidly, the voltage applied to the vertical oscillator grid is about the same value for a considerable period of time before and after the exact instant of triggering. Triggering takes place when the bias and sync signal combined become less negative than cut-off bias for the tube used and the plate voltage applied. If the required cut-off bias was changed slightly, the time of triggering could be changed considerably. This would occur if the vertical oscillator plate voltage was changed by a pulse from the horizontal section. On one field a horizontal pulse would come at the beginning of the vertical sync pulse, on the other it would be a half line after the beginning of the vertical pulse.

Fig. 1 shows the effect on vertical synchronizing of irregularities at the grid and plate. Fig. 1A is a conventional waveshape of grid voltage on the discharge tube. Fig. 1B is an enlargement of the part of the cycle in a circle, around the time of triggering, showing the effect of a variation in the amplitude of the sync pulse. Fig. 1C shows the effect of ripple on the sync pulse, due to horizontal sync pulses, the solid and dashed lines representing two successive fields. Fig. 1D shows the effect of ripple in the plate voltage due to horizontal pulses, changing the cut-off bias of the tube.

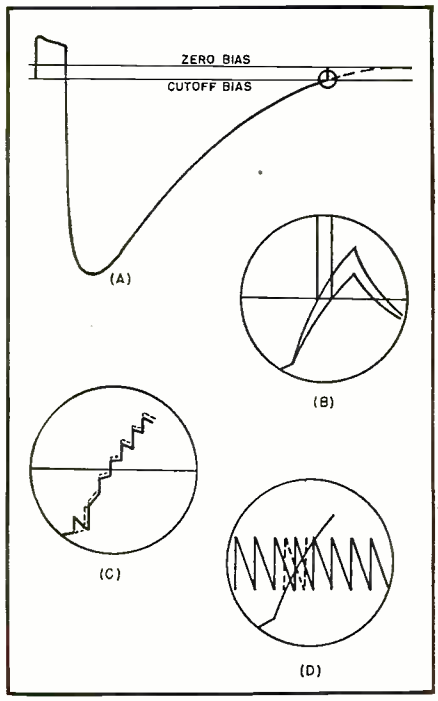
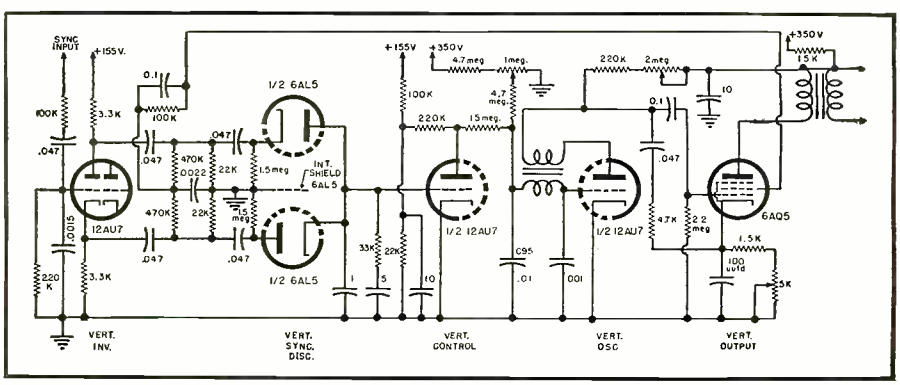


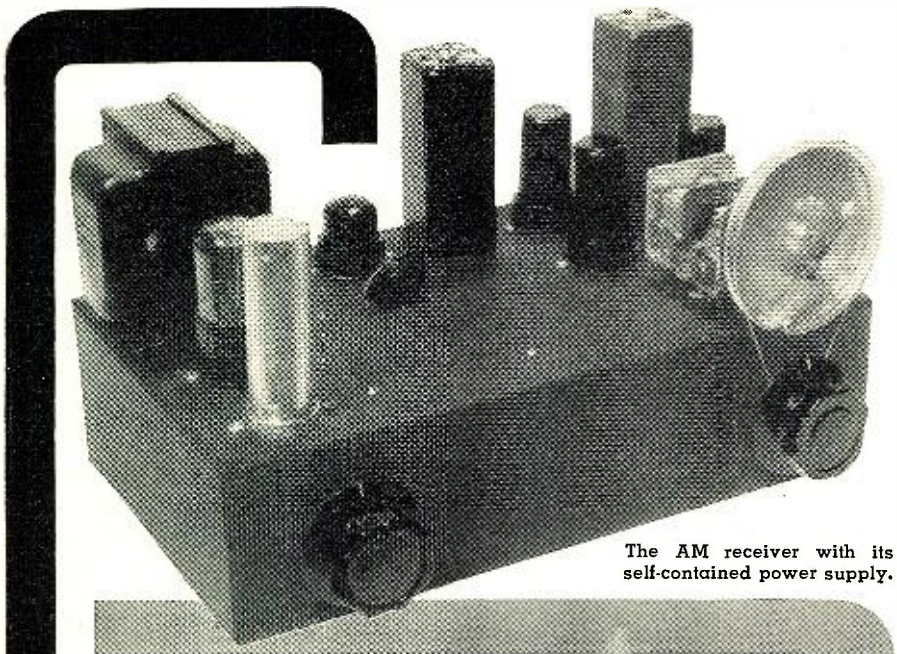
Fig. 1. Grid voltage waveforms in saw-tooth oscillators. See text for complete details.

Accuracy of vertical synchronization with an integrator can be improved by the use of an effective sync pulse limiter before it and by thorough decoupling of the vertical oscillator from its plate voltage supply and careful placement of parts and wiring. If all practical means along these lines prove insufficient, it may be necessary to replace the integrator by another type of vertical sync separator. It is not a part of ordinary servicing to redesign a receiver, because such work is seldom necessary and usually not worthwhile financially. Improvement of a receiver, of course, should not be undertaken by anyone not competent to restore it to the point where its performance is the best possible within the limits of its design. However, improvements in receivers may be made by competent technicians under appropriate circumstances and several cir-

(*Continued on page* 152)

Fig. 2. The vertical deflection circuit used in the Radio Craftsmen Model RC-100.





The AM receiver with its self-contained power supply.

A DUAL-CHANNEL AM RECEIVER

By
GLEN SOUTHWORTH

Designed specifically for reception of high quality musical programs—this receiver is a conventional superheterodyne employing two separate i.f. channels. One channel has high gain and good selectivity for distant stations while the other has low gain and broad tuning for local reception.

A NUMBER of characteristics are desirable in broadcast band receiving equipment designed to be used primarily for the reception of high quality musical programs. Among the most important of these is the ability of the equipment to accurately reproduce the full range of audio frequencies present in the transmitted signal. Similarly, unwanted distortions of the audio envelope should not be introduced in the high frequency or detector portions of the receiver. Of like importance is the ability of the set to discriminate against interference from stations other than the one tuned in, the ability to reduce static and atmospheric disturbances, and the presence of a low noise level inherent in the receiver's own circuits.

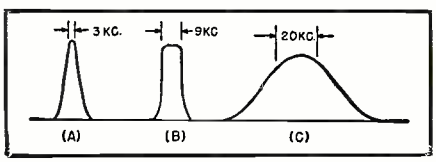
The audio frequency response of a receiver is most frequently determined by the selective tuned circuits of the radio frequency and intermediate frequency stages. In conventional, sharply peaked, superheterodyne receivers, this may mean a high frequency roll-off commencing at about one or two thousand cycles, with consequent adverse effect in the quality of even those broadcast stations limiting their modulation ranges to about five thousand cycles. This loss of high frequency intelligence may be compensated in three ways; the use of audio equalization to restore attenuated highs, the use of fewer tuned circuits in the path of the signal, and the broadening of the response of the tuned circuits in the receiver, either by stagger tuning or by lowering the effective "*Q*" of the coils through use of shunting resistances.

Although great interest has been shown recently in the reduction of harmonic and other distortions to a very low level in equipment designed to handle audio frequencies, a similar interest hasn't developed in the design of equipment for the amplification and detection of modulated radio frequencies. Probably the most important potential sources of audio distortion in the conventional AM receiver are the last intermediate frequency amplifier stage and the diode detector. The combination of these two factors may tend to produce a receiver with a distortion *vs* input signal level similar to that shown in Fig. 2. At low signal intensities the contact potential developed by a thermionic type of diode, such as the 6H6, may cause the detector to fail to fully rectify the incoming signal, with resultant distortion or even failure to detect very weak signals. At high input signal intensities, such as produced by local stations, the last or even the preceding i.f. stages may be overloaded, thus producing a limiting action which may greatly distort the modulation envelope and result in poor audio quality.

Distortion in the tuner circuits may occur in a variety of other ways. These include misalignment, unwanted regeneration in the i.f. or r.f. circuits, hum or noise modulation of the signal by the receiver elements, and the presence of serious non-linearity in the high frequency amplifier stages. In addition, sometimes serious problems may be encountered due to the use of certain types of associated audio equipment, notably power amplifiers, in which case ultrasonic feedback may occur between the audio system and the tuner input. Distortions of this nature may be produced due to high frequency parasitic oscillations in the amplifier output stages (in the case of either triodes or beam power tubes), however it might be noted that the 455 kc. intermediate frequency of the conventional superheterodyne may feed through to the input of the first stage of the audio amplifier and care should be taken to filter out stray radio frequency components from the amplifier input.

Adjacent channel interference and excessive noise or static can mar the enjoyment of the program being received, and both are closely related to the selectivity of the receiver. Fig. 1 shows typical selectivity curves for three different types of tuners: the sharply peaked superheterodyne, the stagger-tuned superheterodyne, and the t.r.f. The more selective the receiver, the greater its ability to reject unwanted adjacent signals. Similarly, the greater the selectivity of the receiver, the greater is the ratio between the response to the peak amplitude of random noise compared to the response to a continuous carrier frequency. Unfortunately, both superior selectivity and consequent improved

Fig. 1. Selectivity curves for different types of receivers. (A) Sharply peaked superheterodyne. (B) Stagger-tuned superhet. (C) Tuned radio frequency or t.r.f receiver. The width of the top of the curve determines the h.f. response of receiver.



signal-to-noise ratio are accompanied by the attenuation or loss of the higher audio frequencies impressed upon the carrier.

In general, the requirements of a good receiver indicate a system with high gain and good selectivity for the reception of distant stations, where interference rejection and noise reduction are of great importance, while for the reception of local stations capable of overriding both interference and noise a broadly tuned receiver of low gain is desirable in order to reproduce the full range of modulation frequencies with minimum distortion. A number of solutions to these requirements have been devised, including superheterodynes with variably selective i.f. circuits and the use of two separate tuners, one a broad tuning t.r.f. and the other a sharply peaked superheterodyne. A simple and uncomplicated design, favored by the author, uses a conventional superheterodyne circuit employing two separate intermediate frequency channels. One of these consists of four tuned i.f. coils and provides a highly selective branch of the circuit. The other channel consists of only two i.f. coils in combination with a untuned amplifier stage, and the coils of this channel may be loaded by means of parallel resistances to provide additional broad tuning.

A circuit diagram of a two-channel tuner is shown in the schematic and is such that a conventional receiver may be easily adapted, providing sufficient chassis space is available for the additional components. Alignment procedure is relatively simple and consists of placing a d.c. voltmeter across the second detector diode load, R_3, which is fed by the high selectivity channel and adjusting the four tuned i.f. circuits for maximum deflection of the meter. This process aligns both channels simultaneously and makes it possible to switch from the high selectivity channel to the low selectivity channel without the necessity of retuning the set. The alignment process may then be completed by adjusting the oscillator trimmer condenser for proper high frequency tracking and the antenna coil trimmer for correct resonance at about 1400 kc.

A number of slight variations from conventional practice are found in the tuner circuit. Among these is the use of lower than normal filament voltage on the heater of the 6H6 dual diode in order to reduce possible unwanted cathode emission. The i.f. coil in the plate circuit of the 6SA7 mixer tube is shunted by a 75,000 ohm resistor in order to broaden the tuning slightly and to reduce noise and instability which might occur in the circuit. No automatic volume control is used in the design for two reasons. The first reason is that most circuits of this nature cause the direct current resistance in the amplifier grid circuits to be on the order of several megohms and can aggravate the tendency of the tubes to gas up, with resultant instability. Likewise, a.v.c. voltage may tend to aggravate distortion occurring in the last i.f. amplifier stage when a strong signal is being received and it is generally more desirable to reduce the effective length of the antenna than to depend upon a.v.c. action. However, if desired, a.v.c. voltage may be easily obtained from the detector output of the sharply tuned channel and applied to the preceding stages. It should be noted though, that this will cause a sudden decrease in audio output from the broadly tuned channel at the point of exact resonance.

An alternate form of second detector, known as the "infinite impedance" type, is illustrated. This type of detector has good characteristics and loads the associated radio frequency circuits to a lesser degree than the diode detector, however, it is more susceptible to overload from strong signals and a.v.c. voltage is not easily derived from it. With either type of detector it was considered desirable to use a separate detector for each channel in order to minimize switching complexity and prevent possible pops or clicks which might result from switching other portions of the circuit.

In constructing the tuner, the main precaution to be taken is to insure good shielding and separation of circuits carrying high frequency voltages. Leads should be kept as short as practical, and it should be noted that ground loops are often as serious a problem in r.f. circuitry as in audio construction. The writer prefers to use a separate ground system, when practical, with the various shields con-

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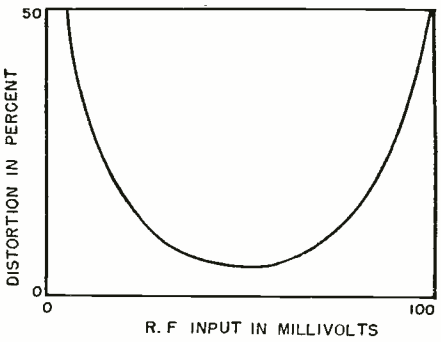


Fig. 2. Typical distortion vs input signal intensity of a receiver. Large amounts of audio distortion occur on either very weak or very strong signals.

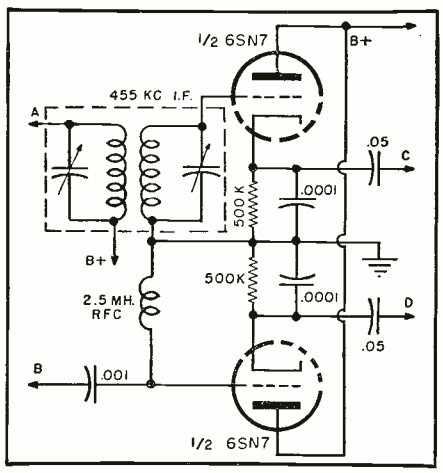
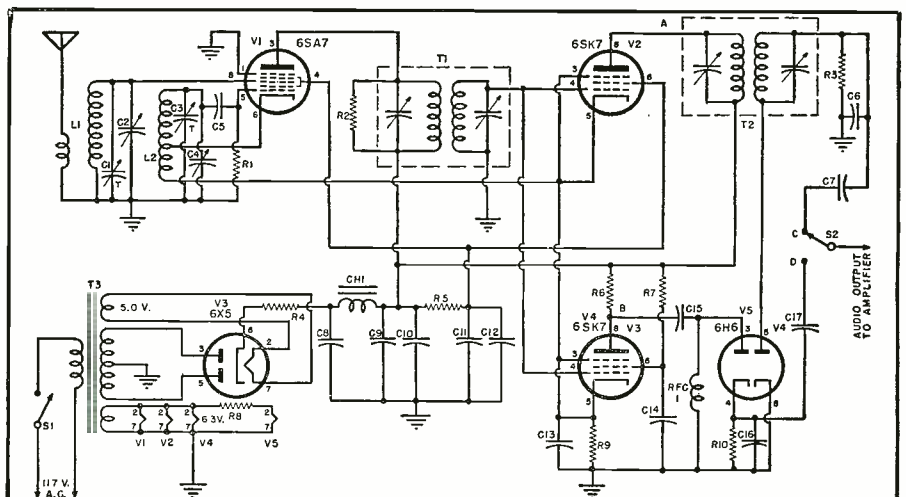


Fig. 3. Alternate form of second detector that may be used in the tuner circuit. Terminals A, B, C, and D connect to corresponding terminals shown in diagram of Fig. 4.

Fig. 4. Diagram of two-channel receiver. A loop antenna may be used in place of antenna coil shown. Note that the 6H6 heater is operating below its normal 6.3 v. This is done to minimize spurious cathode emission under no-signal conditions. The 6X5 is operated at a lower heater voltage because the power transformer used had a separate 5 volt winding. The 6X5 may be operated at 6.3 volts if desired.



R_1—15,000 ohm, ½ w. res.
R_2—75,000 ohm, ½ w. res.
R_3, R_{10}—500,000 ohm, ½ w. res.
R_4—500 ohm, 2 w. res.
R_5—20,000 ohm, 10 w. wirewound res.
R_6—20,000 ohm, ½ w. res.
R_7—50,000 ohm, ½ w. res.
R_8—5 ohm, 10 w. wirewound res.
R_9—100 ohm, ½ w. res.
C_1, C_3—Trimmer cond. (on C_2, C_4)
C_2, C_4—2-gang b.c. var. cond. to match ant. and osc. coils
C_5, C_6, C_{16}—100 μμfd. mica cond.
C_7, C_{17}—.05 μfd., 400 v. cond.
C_8, C_9—20/20 μfd., 450 v. elec. cond.
C_{10}, C_{11}, C_{11}—.1 μfd., 400 v. cond.
C_{12}—12 μfd., 450 v. elec. cond.
C_{13}—.25 μfd., 200 v. cond.
C_{15}—.001 μfd., 400 v. cond.
L_1—Standard b.c. type antenna coil
L_2—455 kc. osc. coil
T_1—455 kc. i.f. trans. (input)
T_2—455 kc. i.f. trans. (output)
T_3—Power trans. 300-0-300 v. @ 40 ma.; 5 v. @ 0.6 amp; 6.3 v. @ 1.2 amps.
S_1—S.p.s.t. sw.
S_2—S.p.d.t. sw.
RFC_1—2.5 mhy. r.f. choke
CH_1—20 hy., 50 ma. filter choke
V_1—6SA7 tube
V_2, V_4—6SK7 tube
V_3—6X5 tube *V_5—6H6 tube*

SATURABLE REACTORS

By
ERWIN LEVEY

Details on a saturable reactor that can be quickly assembled using two standard power transformers.

THE operating principles of saturable reactors have been known for quite a long time, but it is only within the past few years that these units have come into general use. Considering the reactor's versatility, the number of ways in which it can be used is almost unlimited. Basically it is a magnetic device which functions as a variable inductance. It has a d.c. winding which is used for control and an a.c. winding which is connected in series with the load to be controlled. There is no direct connection between the two circuits, the only linkage is through the magnetic properties of the core on which they are both wound.

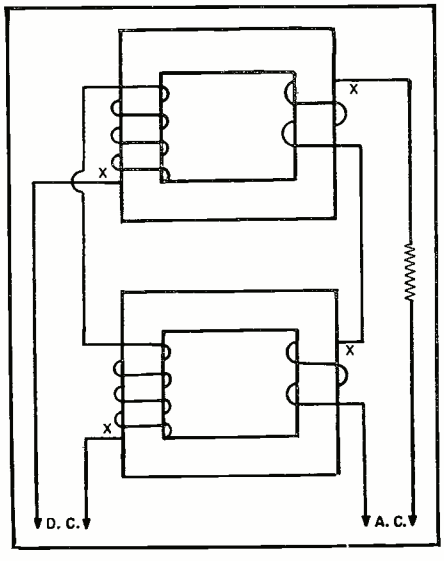
Operation is based on the phenomenon that the permeability of a magnetic material is not constant. It varies with the strength of the magnetizing force applied. Since the inductance of a coil is directly proportional to the permeability of its core material, it also will vary. When the d.c. control current is zero the permeability of the core is extremely high, therefore the inductance of the a.c. coils is large. Since they are connected in series with the load the load current is extremely low. As the d.c. control current is increased the magnetizing force through the core is increased. This causes the permeability and therefore the inductance of the a.c. coils to decrease. This, in turn, means that the load current will also increase.

As the d.c. current increases further the inductance is proportionately decreased with a corresponding increase in load current. When the core is fully saturated with full d.c. current the inductance of the a.c. coils is minimum. Therefore it can be seen that the control effect is secured by means of d.c. core saturation. Since the d.c. power required for control is less than the a.c. power used in the load circuit the unit has a certain amount of gain or amplification.

Physically a saturable reactor has the same general type of construction as a transformer although several different types of core arrangements are possible. The one described here is extremely simple and is assembled by using only two standard transformers.

Fig. 5 is a photograph of a unit which was assembled breadboard style for ease of construction. The two small transformers on the left are used as the saturable reactor, the small motor being the controlled unit. The chassis on the right is the variable d.c. power supply used for control purposes. Fig. 4 gives a close-up of the reactor unit alone, from which it can be seen that the transformer windings are connected to a screw-type terminal strip. This procedure facilitates connections and requires only a screwdriver for assembly.

Fig. 1. Terminal connections of saturable reactor using two separate transformer cores.



Before proceeding further, several terms which identify multiple coil connections will be explained in order to clarify the main explanation to follow. In a "series-aiding" connection two coils are connected together so that their relative winding directions are the same. The net result is that the voltage induced in each is in the same direction, while the total terminal voltage equals the sum of the two individual voltages. In a "series-opposing" connection the two coils are connected so that the relative winding directions are opposite, producing voltages in opposite directions. Here the total terminal voltage is equal to the difference of the two individual voltages. It is important to note that these relative winding directions are given from an electrical viewpoint, and not in terms of the actual physical windings as they are placed on the core.

Terminals of similar polarity or winding direction are indicated by means of an *X*. This end is called the "start," the other end is the "finish." The conventions that will be used throughout this article are illustrated in Fig. 3, which also shows the proper type of parallel connection. To avoid confusion they are defined specifically at this point.

As pointed out earlier in the article several different types of core arrangements are possible. The one which will be explained here as the basis for the unit to be constructed is the simplest type from an experimental viewpoint. A schematic of the unit is shown in Fig. 1.

Two separate, identical cores are used, each having a d.c. and an a.c. winding. Both a.c. windings are identical, so are both d.c. windings. However, the d.c. windings differ in physical characteristics from the a.c. windings. Since each d.c. coil is on a core with an a.c. winding there will be an a.c. voltage induced in the d.c. windings due to transformer action. Now, if the two d.c. coils are connected in series-opposing, the a.c. voltage induced in each will cancel, as a result of their being equal in magnitude but opposite in polarity. This is the only permissible connection for the d.c. coils. But the series-aiding connection for the a.c. coils, as shown in the diagram, is only one of the possible connections for them. The unit to be described here is based on this type of arrangement, as explained before.

For this purpose, two identical 40 ma. power transformers were used, each having the following windings: primary (117 v.), high voltage (480 v.), 5 v. filament, and 6.3 v. filament. All the secondaries had center taps but they were taped up since they were not used. Actually, for the construc-

tion of a simple unit only the primary and high voltage windings are needed but the low voltage windings can be used to show some further interesting control possibilities. The primary is used as the a.c. coil and the high voltage winding as the d.c. coil.

Once the transformers and terminal strips have been mounted the windings are connected in the following order: primary, high voltage, 6.3 v. filament, and 5 v. filament. The order is the same for each transformer. At this point actual physical order of the two leads of a particular winding do not matter.

The next and most important step is to properly phase all the windings, that is, to determine their winding directions with respect to the primary as the standard. The procedure will be explained first for transformer #1 separately. Since the primary is used as the starting point the connection to the first terminal is called the start, the second connection, the finish.

Connect the finish of the primary to the high voltage lead immediately adjacent to it. Then connect the primary leads to 117 volts and read the voltage appearing across the two coils which are now in series. If the reading is the sum of the two individual voltages the coils are connected in series-aiding, this being the condition desired and indicating that the high voltage leads are in the proper physical order. On the other hand, if the difference of the two voltages is indicated, the connection is series-opposing. If this is the case, reverse the positions of the high voltage leads and repeat the test. The reading will then indicate a series-aiding connection. For each set of winding leads, the first one in physical order should be the start; the second, the finish. If low voltage windings are present repeat the procedure exactly as described using the primary and each winding individually. The complete procedure should be repeated step-by-step for the windings of transformer #2.

The purpose of this test can be seen by referring to the schematic diagram in. Fig. 2. The windings are laid out in standard order to facilitate the actual interconnection of the units as a saturable reactor. This is the most crucial step in the whole procedure and a double check should be made to make sure that no errors exist. Otherwise the unit will either operate improperly or not at all.

As explained previously, the d.c. coils (high voltage windings) must be connected in series-opposing. Following the original definition this is done by connecting the finish of high voltage #1 to the finish of high voltage #2. The d.c. voltage source is then connected to the two remaining leads, which are the start of high voltage #1 and high voltage #2. In this simple arrangement the unit is not polarity sensitive, that is, the positive lead could be connected to either end. However, to keep a standard procedure (necessary for later arrangements), start high voltage #1 will be designated the plus terminal and start high voltage #2 the negative terminal. Next, the two a.c. coils (primaries) are to be connected in series-aiding. Therefore connect finish of primary #1 to start of primary #2. These coils are then connected in series with the load to be controlled. The actual schematic of this set-up is shown in Fig. 6A.

At this point it is necessary to determine the range of the unit. The size of the wire in the primary windings (a.c. coils) is determined by the power (actually current) used under actual load conditions for which the transformer was originally designed. This is done in the following manner: Total secondary power equals power of each individual winding.

HV—480 v. x .04 amps.....	19.20	watts
6.3 v.—6.3 v. x 2 amps.....	12.6	watts
5 v.—5 v. x 2 amps.....	10	watts
Total	41.8	watts

The assumption will be made that this is the same as the input power. This is not exactly true in the case of an actual transformer but it is found that the assumption is close enough to give an idea of the range, which is all that is necessary. Thus it is shown that 40 watts is the limit due to the physical properties of the unit. The actual amount of power that can be controlled is somewhat less, approximately 30 watts. From experimental results it was found that the d.c. current necessary for complete control when the high voltage windings are used as the d.c. coils was equal to the current rating of the high voltage windings plus 10% of that amount, in this particular case, 44 ma. The unit used for control was a regular variable power supply rated at 300 volts with no load. It is best to use a

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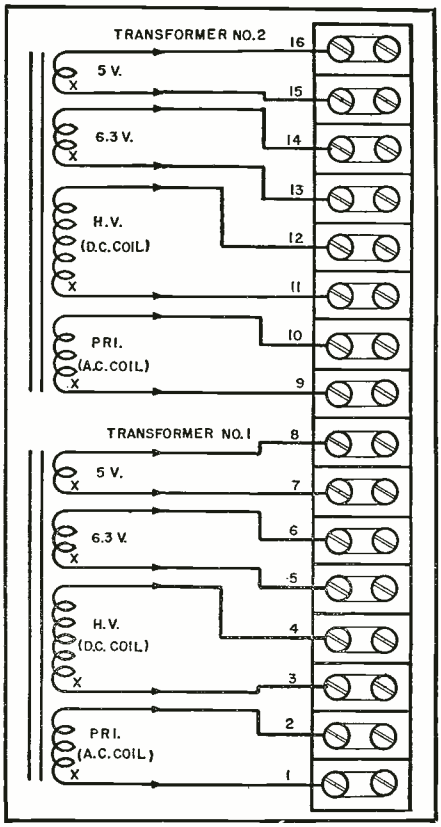


Fig. 2. Transformer winding connections.

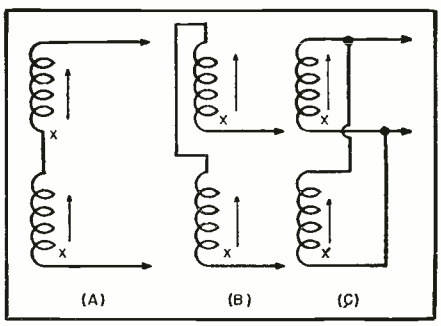


Fig. 3. Coil connections. (A) series-aiding, (B) series-opposing, and (C) parallel.

Fig. 4. Close-up of reactor. Two small transformers are used.

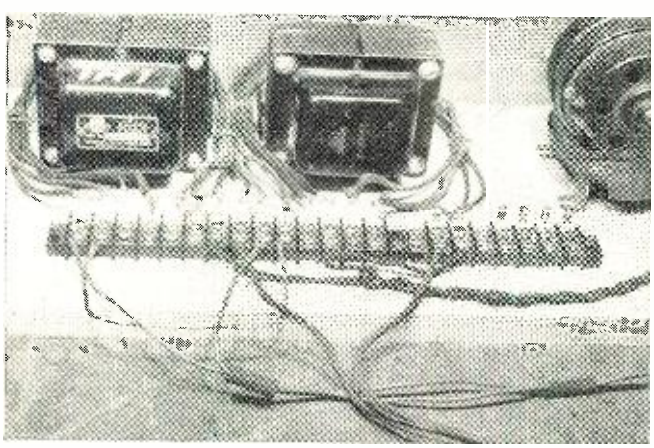
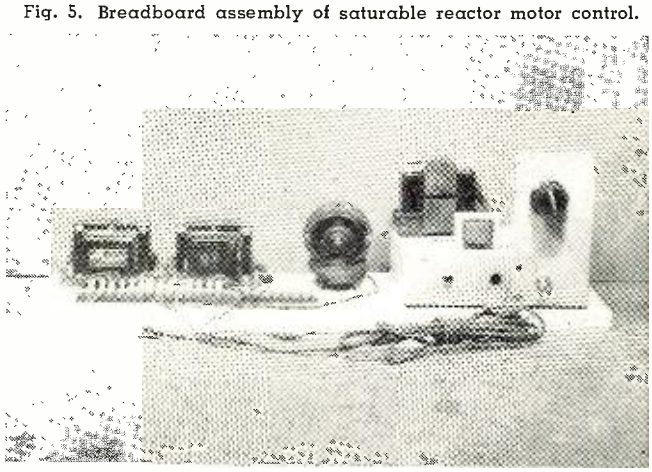


Fig. 5. Breadboard assembly of saturable reactor motor control.



Mac's RADIO SERVICE SHOP

By JOHN T. FRYE

"ALL WORK AND NO PLAY . . ."

BARNEY stood looking out of the window of Mac's Radio Service Shop at the big fat snowflakes just starting to drift down from the dark sky overhead.

"Is this winter going to last forever?" he asked morosely as he walked back into the service department. "I don't think I ever had such a bad attack of winter willies before."

Mac glanced up questioningly from the TV chassis on which he was working and then said quickly, "Know exactly how you feel, Red, for I feel the same way myself. Guess we need a little vacation of some kind."

"I've got proof I need a vacation," Barney said with a ghost of his old grin. "The other morning I was using a test pattern to adjust the focus on a TV set when suddenly the pattern was cut off and a program started in which Dagmar was a visiting celebrity. For a few minutes I was actually *mad* because the test pattern had disappeared! Now any old time a red-blooded American boy like me would rather look at the curves of a test pattern than those of Dagmar—well, there can be no doubt but that he needs a vacation from service work!"

"You are so right!" Mac agreed with a chuckle. "We really have been hitting the ball pretty hard here in the shop this past six months; but I do not think the amount of work we have been doing is altogether to blame for this sudden I'm-fed-up-to-here feeling that we both have. Part of the trouble comes from the *way* we have been working. When you first started here, we did a lot of talking as we worked because I was trying to teach you as much as I could as we went along. Then you reached the point where I wanted you to gain self-confidence by licking the problems all by yourself, and we quit talking. Whole hours go by now without our saying a word to each other."

"I know it," Barney quickly replied, "and it is not near as much fun as it used to be. I'm gaining self-confidence, all right, but I certainly miss talking over the sets with you and having you give me heck for overlooking something that is obvious or giving me a pat on the back when I pull a bright one."

"I miss our chatter, too," Mac confessed; "and I can tell you now that you would be astonished if you knew how often your prying questions prodded me into seeing what was wrong with the set when my mind was a complete blank just before your question nudged me in the right direction."

"Well okay then!" Barney exclaimed. "Let's stop 'holding Quaker meeting' and go back to the good old days. You can start right now by telling me what makes this set whistle so loudly on 910 kilocycles. It works all OK on the rest of the band, but it makes so much fuss on the University station on that one frequency that you can't listen to it."

Mac flipped over the complaint card attached to the set and glanced at it. "Hm-m-m," he hm-m-med, "says here the customer never noticed the trouble until after he had the phono jack installed on the back. Does that tell you anything, Sherlock?"

Barney looked as blank as Laurie Anders of "The Wide Open Spaces" fame.

"What's half of 910?" Mac asked.

"455, but what's that—say, that's about the i.f. frequency."

"And the phono jack is probably connected across the volume control, which, in turn, is connected to the diode plate circuit of the second detector. At the same time the jack is very near the loop antenna that is resonated to whatever station is being received. When we tune to 910 kc., the strong field about the loop is connected through the lead from the jack directly to the diode plate circuit. Here it mixes with the second harmonic of the i.f. frequency and produces the strong heterodyne whistle as the two slightly-different frequencies are combined by the rectifying action of the diode. The process is exactly the same as is used when you employ a beat frequency oscillator for receiving c.w. stations, except in that case the b.f.o. is fixed-tuned to about the i.f. fundamental frequency and is loosely coupled to the diode circuit so that it produces a whistle on every station received."

"That's the cause; what's the cure?" Barney wanted to know.

"There are several different ways you can go at correcting the trouble. The main thing is to reduce the coupling between the loop antenna and the second detector diode plate circuit. An r.f. choke in the lead from the phono jack to the volume control would do this, or you might try shielding this lead and moving the jack down into the corner of the back cover so it will be as far as possible from the field of the loop. In general, if you want to avoid birdies in the set, it is a good idea to avoid increasing the possibility of direct pickup by any circuit carrying the i.f. frequency. That's what the person who installed the phono jack forgot when he tied that long lead to the bottom of the secondary of the i.f. output transformer. He would have gotten away with it, though, if we had not had a strong station on approximately twice the i.f. frequency."

Barney soon had the jack moved and the lead from it to the hot side of the volume control shielded. This cured the trouble completely.

"And now you may return my help—if you can," Mac told him. "See if you have any bright suggestions about this little a.c.-d.c. puzzler. When I first turn it on, it plays with good volume and has good sensitivity; but after it runs a few minutes, the volume slowly dies away, and the only station I can pick up is the local one. I checked the tubes the first thing, and they are all right. Plate and screen voltages stay right up close to the recommended values. The change in volume is far too gradual for it to be condenser trouble."

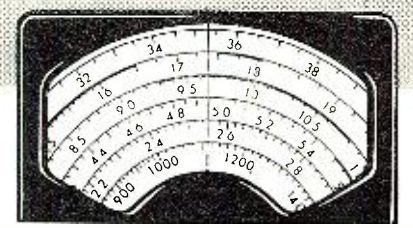
"Did you check the filament voltages?" Barney asked with a smug look.

"No, but the filament current seems to be about normal as near as I can see by looking at the brightness of the 50B5."

Barney switched off the bench lights and looked closely at the set. Then he switched the lights back on.

(*Continued on page* 132)

International SHORT-WAVE



Compiled by **KENNETH R. BOORD**

FLAVIO Serrano, Brazil, airmails this data about prospective *new* high-powered transmitters for certain countries:

"Radio Tupi, Rio de Janeiro, Brazil, has purchased a 100 kw. short-wave transmitter from *Brown-Boveri,* a Swiss manufacturer. This transmitter will be ready in late 1952 and will be the world's most powerful *'commercial'* short-wave station; it is Model SK-51-A3. Both r.f. and modulator stages will use a push-pull *Brown-Boveri* type ATW-50-1 and have a spare tube which is placed in the circuit automatically when a failure occurs. The transmitter can operate from 6 to 22 mc. and also can be operated with 10 kw. output during an emergency. Tentative channel for *Radio Tupi* is 6.200.

"Representatives of the Swiss firm in Rio de Janeiro inform me that a similar transmitter is already installed in Yugoslavia and will begin operations shortly. Belgium has two such transmitters under installation for the Institute Nationale de Radiodiffusion which probably will be ready in mid-1952."

The two *new* 100 kw. short-wave transmitters of *Radio Sweden* at Horby should be in regular operation by this time carrying programs from Stockholm.

According to a *World Radio Handbook* Bulletin, Italy should now be using a short-wave transmitter located at Palermo on a channel of 6.260; a channel of 3.930 for a Rome transmitter, and 5.980 for a Milan station. From April 1, the National Program of *Radio Italiana* is to be radiated from a short-wave transmitter at Caltanissetta on 6.240.

YOUR ISW DEPARTMENT editor will welcome further news about forthcoming transmitters.—KRB.

* * *

Radio Club Notes

England—The International Short Wave Club, London, has just concluded its annual DX Contest for listeners to (1) the short-wave broadcast bands and (2) the amateur bands. Results of the competition will be announced in the May issue of the club's bulletin. Last year's awards went to all parts of the world, according to Arthur E. Bear, secretary of ISWC.

The International Short Wave League, London, is now an independent organization and no longer has any connection with *Short Wave News,* London. Headquarters of ISWL now is 123, Starla Road, Chatham, Kent, England; QSL Bureau is at 86, Barrenger Road, London, N. 10, England. Is publishing its own monthly bulletin called *"Monitor."* (*Short Wave News,* London)

USA—The Universal Radio DX Club recently observed its 18th anniversary. This is one of the few short-wave clubs that issues a short-wave log regularly. The winter edition (which goes to *members only*) was compiled by Weldon Wilson. Short-wave editor of URDXC is Donald C. Gross; ham band editor is Ralph W. Kastner; the certificate and award section of URDXC's bulletin *"Universalite"* is compiled by Don Martinez; president of the club is Charles Norton; QRA of URDXC is 21446 Birch Street, Hayward, Calif.

Harold Buchart, Box 76, Piketon, Ohio, president of the new club USWLW says that organization now has 40 members; wants more. Don Alexander, 1136 North 10th Street, Abilene, Texas, has been named short-wave editor and the club has started a monthly bulletin. A Canadian Chapter is being organized with John Impey as director. The club is making plans to award three trophies for outstanding efforts in the world of short-wave listening. Has its first DX Contest slated for the latter part of March.

* * *

This Month's Schedules

Andorra — Radio Andorra, 5.990. noted 1750 with identification by woman as "Aqui Radio Andorra," followed by semi-classical music. (Machwart, Mich.) Noted in England 1030 with announcements in French, Spanish. (Pearce)

Anglo-Egyptian Sudan—Radio Omdurman is using 9.737 in its "early morning" transmission in Arabic 2315-2345; stringed instrument is used as interval signal; still uses 17.94 in Arabic weekdays; Fridays has *English* on 17.94 at 1230-1300. (Ridgeway, South Africa) The *English* session is likely also carried over 9.737—KRB.

Angola—Radio Clube do Cuanza-Sul, CR6RP, Redondo, is on the air daily 0600-0745, 1230-1445 on 7.806, according to verification; power is 0.25 kw. (Radio Sweden) *Radio Clube do Benguela,* CR6RB, is again using its 9.163 channel with good signal in South Africa 1230-1630 closedown (Sundays to *only* 1430). (Ridgeway)

Radio Clube do Angola, 11.865A. Luanda, noted 1445; announces *two* channels. (Pearce, England) This one is still good signal in Conn. to 1530

(*Continued on page* 107)

(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.)

The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

This attractive Listening Post belongs to John C. Catch, South Shields, Durham, England. Equipment includes a "Commander" receiver, a tape recorder, and a frequency measuring device. John is a regular contributor to the ISW Department.

AUDIO Simplified

By
DAVID FIDELMAN

An installation where the record changer and preamp control circuit are mounted in a table and connected to other units in the system by a cable.

Part 7. A discussion of audio frequency networks and corrective circuits as used in high quality sound reproducing systems.

THE most widely accepted criterion of performance in the design and setup of sound reproducing systems is that the reproduction sound exactly the same as the original program material. However, this does not mean that the signal at all points in the system must correspond exactly with the original sound—it means only that the sound reaching the listener's ear from the loudspeaker should reproduce accurately the sound reaching the microphone from the original source. The proper application of this principle has caused considerable confusion in the field of sound reproduction, and its meaning should be clearly understood by anyone who is designing or setting up any sound reproducing system.

There is no necessity for making the signal at all points in the system reproduce exactly with the original sound, provided that any alterations which are made in the signal are corrected before they reach the ear from the loudspeaker. In fact, the limitations of practical recording, transmission, and reproduction systems make it almost imperative that certain changes be made in the signal in order to obtain the best quality of reproduction. These limitations are related primarily to questions of noise level and dynamic range. The actual dynamic range of orchestral music is approximately 75 db, which cannot be reproduced by modern equipment — especially when phonograph records are included in the system. The major factor which prevents the reproducing system from attaining the required dynamic range is the inherent noise level of the system, which is considered to be good if it is more than —60 db below full output, while —50 db is considered acceptable. Therefore, as might be expected, most of the changes which are made in the signal are intended to reduce the noise level.

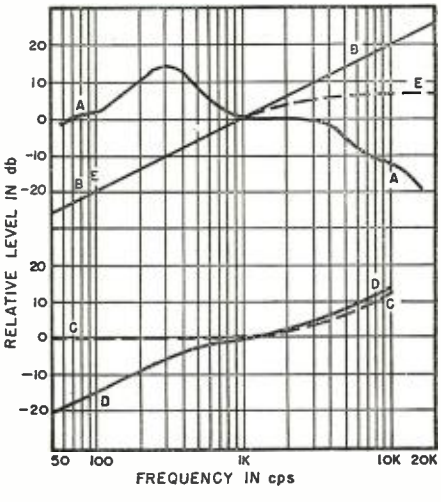
This article will discuss the various methods which can be used to reduce the noise level and increase the dynamic range of the reproduced sound. These methods include the use of tone controls and equalizers, volume compressors and expanders, and various types of noise suppressors. The fundamental principles of operation will be described, with a discussion of the important factors which must be kept in mind for their proper use and to prevent their misuse, and a number of basic practical circuits which can be included in the reproducing system.

The use of tone controls for reduction of noise depends upon the fact that the noise is not dependent upon frequency in quite the same way that the ear perceives speech and music as a function of frequency. Sound is heard by the ear in a logarithmic manner—with respect to frequency as well as volume. The logarithmic frequency response of the ear may be illustrated by the use of the term *octave* to denote a frequency range of 2:1 regardless of the absolute frequency, and musical scales are always written in terms of octaves from a particular reference frequency. The noise, on the other hand, is generally a direct function of frequency. Therefore, since an octave at higher frequencies covers a greater absolute frequency range than an octave at lower frequencies, the effects of noise are relatively more important at high frequencies than at low frequencies.

This property of noise is realized instinctively by those people who listen to their phonograph records with the tone controls set to decrease the high-frequency response and thereby reduce the record scratch. This method of reducing the record noise is not a desirable one, since the higher frequencies are lost from the reproduced sound, but to these listeners the effects of the noise are more objectionable than the loss of high frequencies.

However, even without reducing the high-frequency range of the system it is possible, because of the different frequency characteristics of the noise and of the reproduced sound, to reduce the reproduced noise level by the use of *pre-emphasis*. The relative frequency distribution of sound energy in orchestral music is shown in curve *A* of Fig. 1. This curve shows that there is considerably less sound energy

Fig. 1. Use of pre-emphasis to reduce reproduction noise. Curve A is most probable distribution of frequency components in music at high levels. B is frequency spectrum of random noise. C is FM pre-emphasis characteristic. D is NAB recording characteristic and E is reproduced noise when the proper de-emphasis characteristic is used in the playback channel.



at the higher frequencies than at the lower. Curve *B* shows the sound spectrum of a random noise plotted to the same frequency scale (and at an arbitrary 0 db level), and shows its relatively greater effect at the higher frequencies. It must be noted that such noise is generally introduced into the signal *after* the sound has been transmitted or recorded. Therefore, the most basic and simplest method of reducing the reproduced noise level is to increase the amplitude of the high frequencies in the channel before recording (that is, before the introduction of the noise), and then to decrease the high-frequency level by the corresponding amount in playback (which is after the introduction of the noise). The net effect is to decrease the noise level by the amount the high frequencies have been pre-emphasized.

This system of pre-emphasis is in use in FM broadcasting, and accounts for a considerable amount of the noise superiority of FM over AM. If pre-emphasis were used in AM broadcasting, the received signal would contain a much lower noise component than it does with the present method. The technique of pre-emphasis is also used in disc and tape recording to reduce the effects of playback noise. The frequency response curve which is used to achieve this effect in FM broadcasting is shown in curve *C* of Fig. 1, and the standard NAB recording curve is shown as *D*. (In the curve used for recording, the drop at the low-frequency end is necessary because of the practical limitations on the amplitude of motion of the recording stylus.) The effective decrease in noise level by the use of this technique in recording is shown by curve *E* in Fig. 1.

The basic methods of obtaining the frequency-response curves required for pre-emphasis and de-emphasis make use of *RC*, *RL*, and *RLC* circuits. The circuits which are of most interest to the audio experimenter are those for de-emphasis in playback, and these usually make use of simple *RC* networks to obtain the required curves. The basic *RC* tone control and equalizer circuits are shown in Fig. 2. They depend for their operation upon the fact that a resistance is constant independent of frequency, while the reactance of a condenser decreases as the frequency increases. Thus, in the simple series attenuator shown in Fig. 2, when the two impedances are pure resistances the output level does not change with frequency, remaining a constant percentage of the input voltage. However, when either of the two impedances is a capacity the output level will change with frequency—increasing at the higher frequencies to give treble boost when the series impedance is a capacity, and increasing at the lower frequencies to give bass boost when the shunt impedance is a capacity.

The general frequency correction circuit, which can be used as a basis for the practical design of all types of equalizers with a constant voltage input, is shown in Fig. 3. Some of the most useful tone control circuits based upon this general circuit are also shown in Fig. 3, together with typical frequency response curves which are obtained. It can readily be seen how the variation of capacitive reactance with frequency (that is, becoming very large at low frequencies, and very small at high frequencies), results in the indicated response. Circuits very similar to those shown are used in the majority of sound systems.

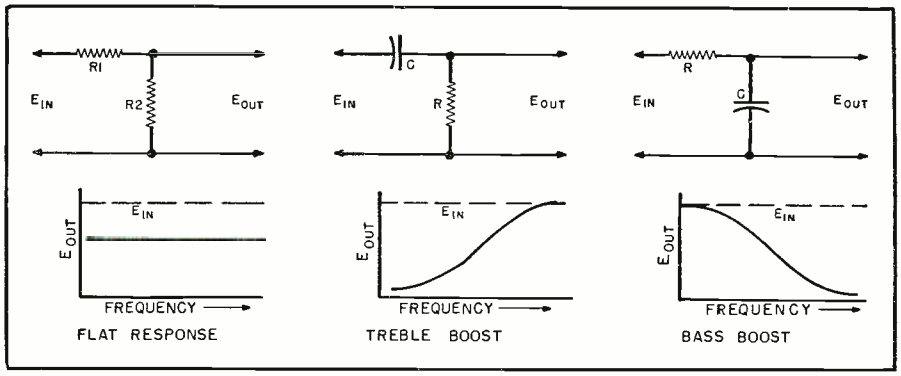
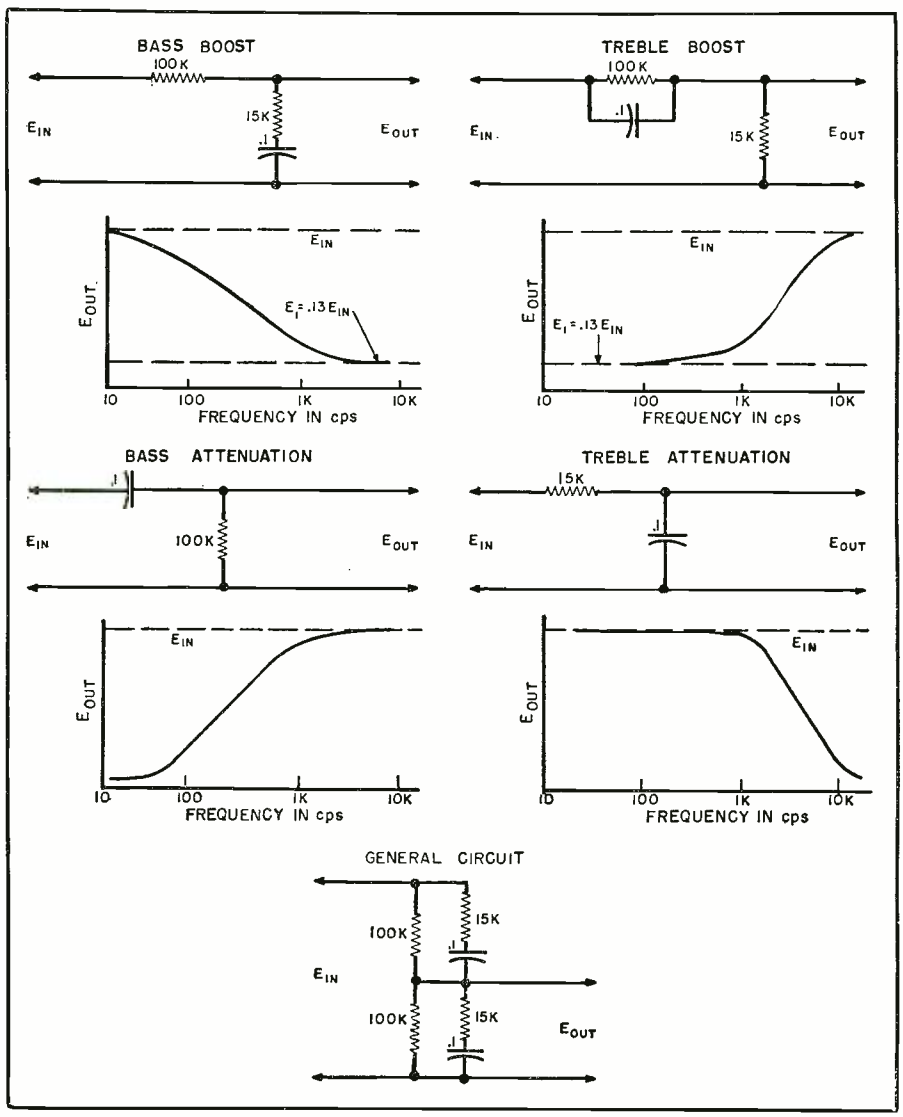


Fig. 2. Basic RC tone control and equalizer circuits for three different conditions.

In many cases the pre-emphasis curves in recording and the de-emphasis curves in playback may not always be properly matched to one another, and in the resulting reproduced sound either the high frequencies or the low frequencies may be overemphazised or underemphasized. An adjustable equalizer or *tone-control* network should be included in the reproduction channel to provide for frequency-response correction when the reproduced sound does not have the

Fig. 3. RC tone control and equalizer circuits including suitable parts values.



proper balance between high frequencies and low frequencies. A flexible tone-control circuit should have a high-frequency control which could be set for either boost or attenuation of the highs, and a low-frequency control which is capable of either boost or attenuation of the lows.

The circuit of a simple network which serves as a variable tone control is shown in Fig. 4. This network has independent bass and treble controls which are capable of giving the range of frequency response curves shown in C of Fig. 4. The treble control can be adjusted over the complete range of settings from 15 db boost to 15 db attenuation at 20,000 cps, while the bass control may be set to give from 13 db accentuation to 13 db attenuation at 50 cps. Since the controls are continuously adjustable, any intermediate setting between these two extremes may be obtained—including a flat-frequency-response position. The principle of operation of this circuit may be more clearly understood from the simplified circuits shown in Fig. 4B, which show the equivalent circuits in the *maximum bass and treble* positions, and by comparing them with the basic tone control circuit of Fig. 3.

The circuits which have been described are high-impedance networks and should have a constant-voltage input, therefore the method of their connection into the playback circuit is somewhat critical. For best results, the tone control circuit should be isolated by a triode amplifier stage (such as the 6J5, ½-6SN7, ½-6SL7, ½-12AT7, etc.), and should feed directly into the high-impedance grid of the following stage. The method of isolating the tone control network by a triode amplifier stage is shown in the circuit of Fig. 4A.

It should be kept in mind that all equalizer networks operate on the principle of attenuating certain frequencies to give their frequency response—since they obviously cannot deliver a greater voltage than is applied to their input. Therefore an equalizer which gives a 15 db bass boost actually attenuates all frequencies but the bass by 15 db, and leaves the bass level unchanged. The usual tone control network will thus have an insertion loss of about 15 to 20 db at the middle frequencies, and must therefore be inserted in the playback amplifier circuit at a point where this insertion loss can be handled properly—where the level is sufficiently high that noise will not be a problem after the 20 db attenuation, and where the level is still not so high the tube overloads.

Compression and Expansion

Even with the use of pre-emphasis techniques, an over-all noise level of better than —60 db below full output is fairly difficult to attain. When reproduction from records or AM broadcasting is included in the channel the noise level will generally be considerably higher—as high as —40 db below peak signal or even more for bad records. Since the actual dynamic range to be reproduced may be as high as 75 db, the noise level (even assuming the —60 db figure) prevents the reproduction of this entire dynamic range of signals. Thus, if the output is set for maximum at the highest signal level, the low-level signals will be lost in the noise. Furthermore, the maximum output of the system may be too loud for comfortable listening.

To improve this condition, the sound signal is usually monitored during recording or transmission, and the gain in the channel is adjusted to reduce the dynamic range. This function may be performed either manually by an operator who watches a signal-level meter and adjusts a gain control to keep the signal peaks within specified limits, or automatically by electronic gain-adjusting circuits. The automatic electronic units need just be set up properly for the particular signal being transmitted or recorded, and then observed periodically to insure proper operation.

The functioning of the electronic units for automatic gain adjustment is based upon two different principles:

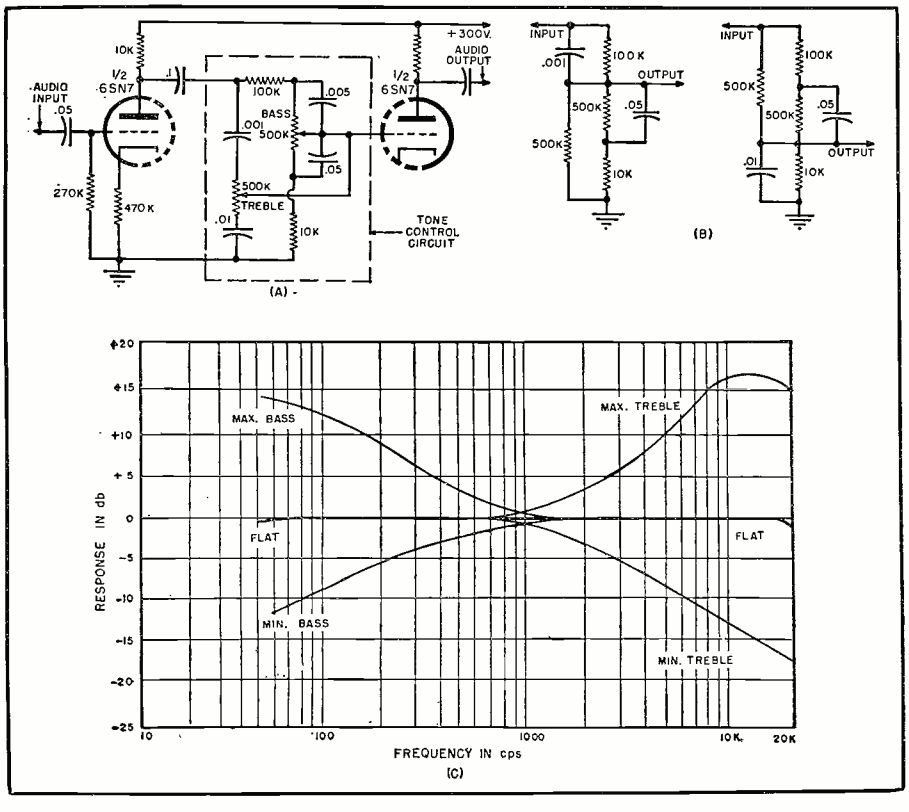
(*a*) *Volume compression* in which the channel gain is reduced in proportion as the signal level increases so that the resulting dynamic range of the signal is the same as that of the reproducing system. The operation of this system is based upon approximately the same principle as that of manual gain adjustment, in which the operator decreases the gain for loud signals to keep them below some specified maximum, and increases the gain for low levels to keep them above some specified minimum.

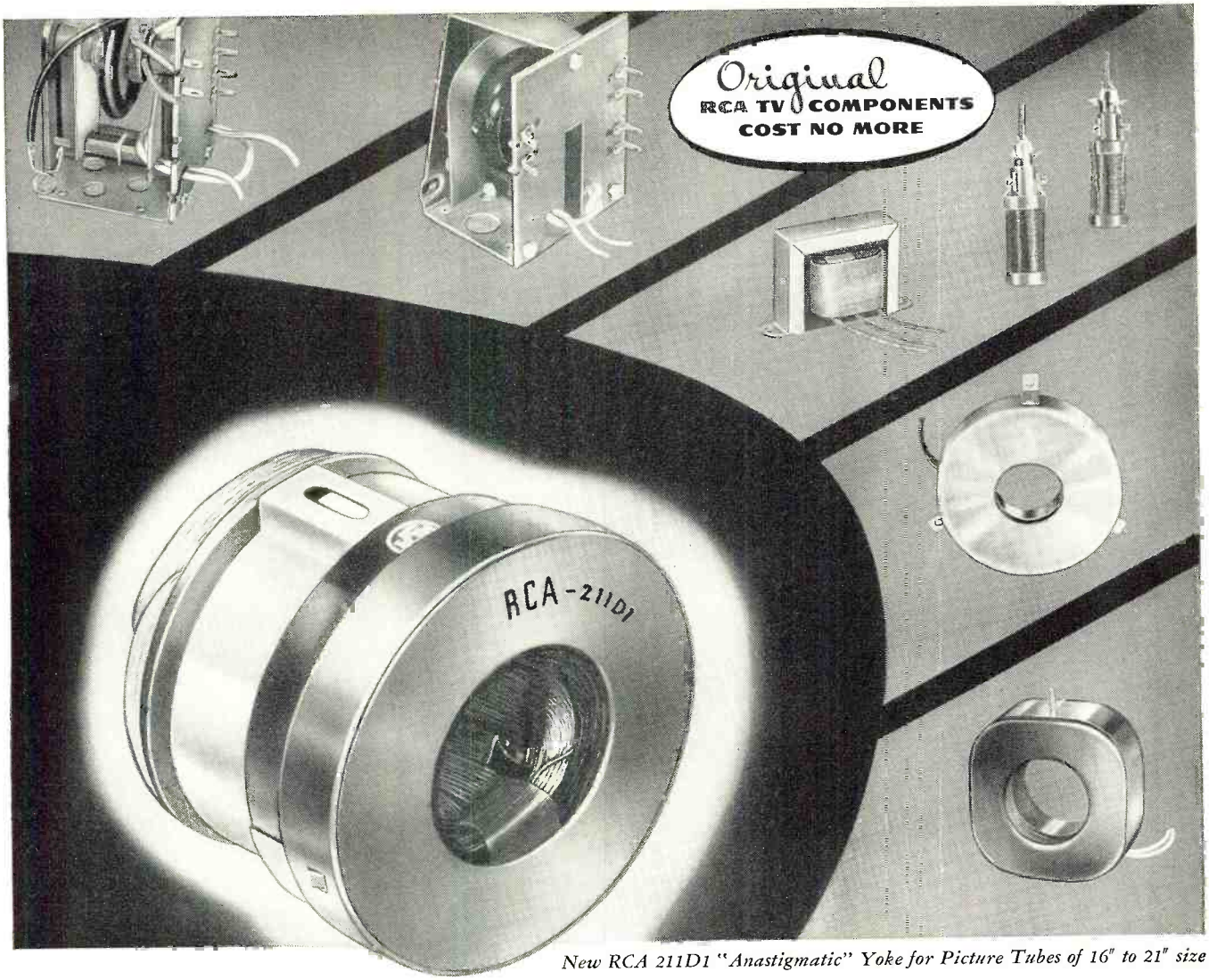
(*b*) *Peak limiting* in which the channel gain is adjusted to keep all low-level signals above the noise level, and gain control is applied only to the loud peaks. The high levels are then transmitted at their normal level as long as they are not greater than some fixed maximum which can be handled by the system without excessive distortion. Whenever the signal has a greater amplitude, the gain is reduced enough to bring this amplitude down to this same maximum amplitude.

Thus, the volume compression method decreases the dynamic range gradually for signals of all levels, whereas the peak limiting method does not affect signals below the channel maximum and limits high-level peaks to this maximum. In playback, a *volume expander* circuit which performs the inverse function may be used to restore the dynamic range of the original signal. The curves in Fig. 5 illustrate the basic functions of these units by showing typical curves of output signal levels for various input levels. If a volume expander circuit is used with a signal which has been compressed, the original dynamic range is restored accurately; if a peak limiter has been used in transmitting the signal, the reproduced dynamic range is increased but the relative signal levels are altered.

(*Continued on page* 116)

Fig. 4. (A) Variable tone control circuit, showing method of matching into amplifier circuit. (B) Simplified schematics showing operation of circuit at extreme control settings—maximum bass and maximum treble (left) and minimum bass and maximum treble (right). (C) Frequency response curves obtained with circuit shown in (A).





New RCA 211D1 "Anastigmatic" Yoke for Picture Tubes of 16" to 21" size

For best results use the yoke that's *tailored to the tube*

Check these features . . .

- ✓ **Distributed windings of modified "cosine" design for sharp corner focus**
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Why take chances with "compromise" yokes when RCA "originals" cost no more?

Remember—RCA deflecting yokes set the engineering standards of the field. That's because RCA deflecting yokes and RCA picture tubes are designed to work as a team. Mechanically and electrically, RCA yokes "fit like a glove". . . work best with the picture tubes they're specifically designed for.

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See your local RCA Parts Distributor for "Original" RCA TV Components.

RADIO CORPORATION of AMERICA

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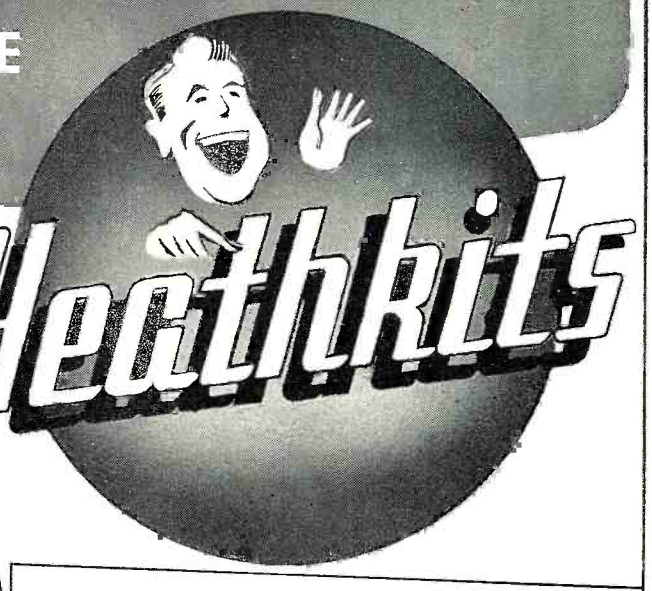
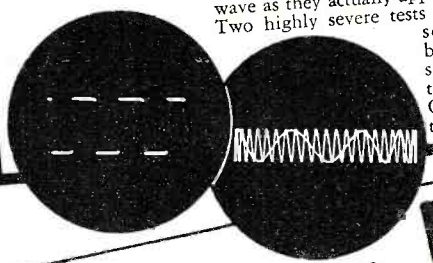
Features OF THE NEW 1952 Heathkits



PROOF OF THE NEW O-7 OSCILLOSCOPE'S OUTSTANDING PERFORMANCE

Below are actual, unretouched photographs showing the outstanding frequency response characteristics of the NEW 1952 HEATHKIT OSCILLOSCOPE, MODEL O-7. To the left is a 10 KC square wave — to the right a 4 MC sine wave as they actually appear on the screen. Two highly severe tests to make on any scope (only the best of scopes will show traces like these) — and the O-7 really comes through.

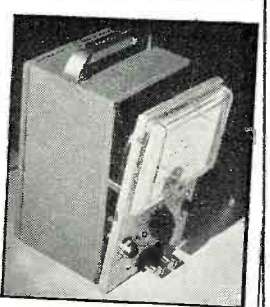


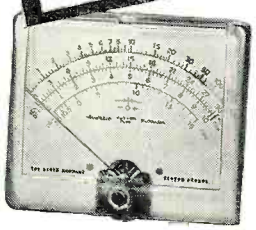
COMPANION VACUUM TUBE VOLTMETERS

Here are the two NEW 1952 VACUUM TUBE VOLTMETER COMPANION PIECES. Matched instruments of new design to open up the whole field of DC, AC, and resistance measurements for you. The new greatly reduced size combines style, beauty, and compactness — The V-5 and AV-1 have the new panel and cabinet construction as shown on the right. A tremendous pair of voltmeters. Small in size but virtual giants in the range of measurements they make.

NEW STYLE AND BEAUTY

Style that's modern, yet functional — that's the trend of today — and Heathkits are right up to the minute. Note the cut showing the new V-5 and AV-1 cabinet and panel construction. The front panel and rear cover slide right over the recessed flange of the case thereby eliminating sharp edges and pointed corners. The voltmeter kits aren't "shelf" or "mounted" instruments — they're moved about on the bench a lot and thus the new compact size and specially designed cabinets — Another 1952 Heathkit feature.





A STATEMENT FROM SIMPSON ELECTRIC CO.

In choosing Simpson Meters for their Heathkit VTVM, the Heath Co. has set a new high standard of kit meter quality. The same high quality of material, workmanship and design that has given Simpson the reputation for building "Instruments That Stay Accurate" is found in the Heathkit Meter Movement.

SIGNED
SIMPSON ELECTRIC CO.

A STATEMENT FROM CHICAGO TRANSFORMER

It is indeed gratifying to note the outstanding sales records you are building with you Heathkits.

This sales success is readily understandable, since we are cognizant of the high quality standards you have established for your component suppliers.

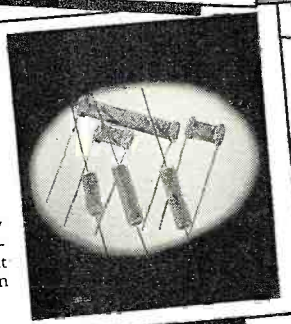
We at Chicago Transformer are proud that our product has contributed to the recognized quality and increasing popularity of Heathkits.

CHICAGO TRANSFORMER DIVISION
Essex Wire Corporation

L. S. RACINE
Vice-President and Sales Manager

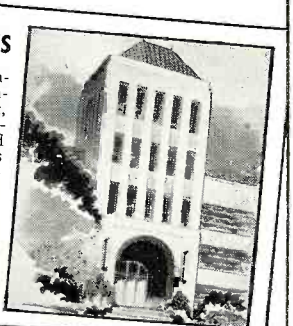
HEATHKIT PRECISION RESISTORS

Where exact resistance values are required for instrument accuracy, the Heath Co. has spared no effort in supplying the finest resistors available. Precision resistors as manufactured by Continental Carbon Inc., and Wilcor Corp., meet the rigorous JAN (Joint Army-Navy) specifications and are small in size, extremely non-inductive, highly stable, have a low temperature coefficient, and can be held to great accuracy. You'll find quality components in Heathkits.



COLLEGES USE HEATHKITS

Colleges and Universities throughout the country are using Heathkits in their electrical engineering, radio, and physics laboratories — Heathkits are the answer to good test equipment at low cost, plus being rugged, dependable, and accurate. Trade schools are having their students build Heathkits to obtain a first hand working knowledge of test equipment and to get the practical experience gained by construction. Heathkits fill school needs.



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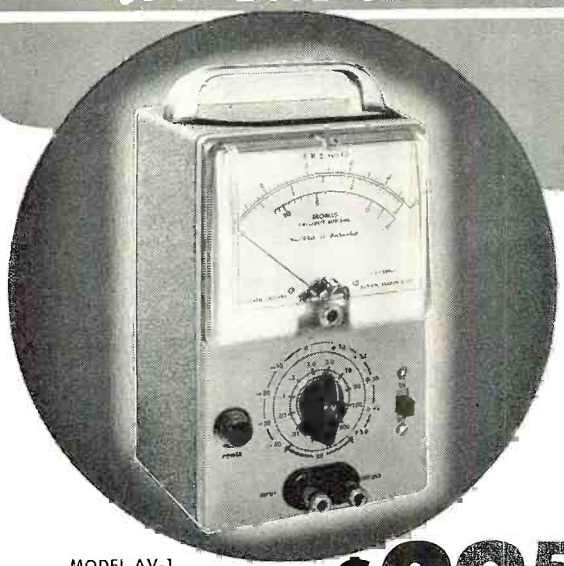
New LABORATORY LINE HEATHKITS



MODEL AV-1
Shipping weight 5 lbs.

NEW Heathkit A.C. VACUUM TUBE VOLTMETER KIT

$29.50

Now — as a Heathkit — at a price anyone can afford, an AC VTVM. A new kit to make possible those sensitive AC measurements required by audio enthusiasts, laboratories, and experimentors. Here is the kit that the audio men have been looking for. Its tremendous range of coverage makes possible measurements of audio amplifier frequency response — gain or loss of audio stages — characteristics of audio filters and attenuators — hum investigation — and literally a multitude of others. Ten ranges consisting of full scale .01, .03, .1, .3, 1, 3, 10, 30, 100, 300 volts RMS assure easy and more accurate readings. Ten ranges on DB provide for measurements from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 KC.

The ingenious circuitry incorporates precision multiplier resistors for accuracy, two amplifier stages using miniature tubes, a unique bridge rectifier meter circuit, quality Simpson meter with 200 microampere movement, and a clean layout of parts for easy wiring. A high degree of inverse feedback provides for stability and linearity.

Simple operation is accomplished by the use of only one control, a range switch which changes the voltage ranges in multiples of 1 and 3, and DB ranges in steps of 10.

The instrument is extremely compact, cabinet size — 4⅛" deep x 4-11/16" wide x 7⅜" high, and the newly designed cabinet makes this the companion piece to the VTVM. For audio work, this kit is a natural.

NEW Heathkit AUDIO FREQUENCY METER KIT

MODEL AF-1
Shipping weight 12 lbs.

$34.50

A NEW Heathkit Audio Frequency Meter — the ideal instrument for determining frequencies from 20 cycles to 100 KC. Set the selector switch to the proper range — feed the signal into the input terminals — and read the frequency from the meter — completely simple to operate, and yet dependable results.

Quality Simpson 200 microampere meter has two plainly marked scales (0-100 0-300. These scales, read in conjunction with the seven position selector switch, give full scale readings of 100, 300, 1000, 3000, 10,000, 30,000, and 100,000 cycles. Convenient ranges for fast and easy readings.

For greatest accuracy, the 1-3-10 ratio of ranges is maintained and each range has individual calibrating control.

Input impedance is high (1 megohm) for negligible circuit loading. A signal voltage anywhere between 2 and 300V can be fed directly into the instrument and a change in signal voltage between these limits will not affect the meter reading. In addition, input wave shape is not critical (the unit will read the frequency of either sine wave or square wave input).

The tube complement consists of a 6SJ7 amplifier and clipper, 6V6 amplifier and clipper, 6H6 meter pulse rectifier, 6X5 power supply rectifier, and OD3/VR150 voltage regulator.

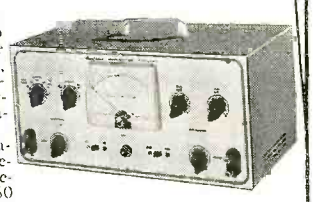
Construction is simple, and quality components are used throughout.

NEW Heathkit INTERMODULATION ANALYZER KIT

Intermodulation testing of audio equipment is rapidly being accepted by more and more engineers and audio experts as the best way to determine the characteristics of audio amplifiers, recording systems, networks, etc. — shows up those undesirable characteristics which contribute to listening fatigue when all other methods fail.

The Heathkit Intermodulation Analyzer supplies a choice of two high frequencies (3000 cycles and a higher frequency) and one low frequency (60 cycles). Both 1:1 or 4:1 ratios of low to high frequencies can be set up for IM testing, and the ratios are easily set by means of a panel control and the instrument's own VTVM. An output level control supplies the mixed signal at the desired level with an output impedance of two thousand ohms. The Analyzer section has input level control and proper filter circuits feeding the instrument's VTVM to read intermodulation directly on full scale ranges of 30%, 10% and 3%. Built-in power supply furnishes all necessary voltages for operating the instrument.

You won't want to be without this new and efficient means of testing



MODEL IM-1
Shipping wt. 18 lbs.

$39.50

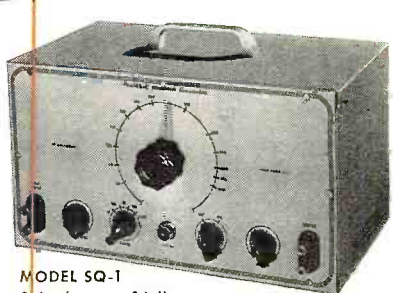
NEW Heathkit SQUARE WAVE GENERATOR KIT

The new Heathkit Square Wave Generator Kit with its 100 KC square wave opens an entirely new field of audio testing. Square wave testing over this wide range will quickly show high and low frequency response characteristics of circuits — permit easy adjustment of high frequency compensating networks used in vidio amplifiers — identify ringing in circuits — demonstrate transformer characteristics, etc.

The circuitry consists of a multivibrator stage, a clipping and squaring stage, and a cathode follower output stage. The power supply is transformer operated and utilizes a full wave rectifier tube with 2 sections of LC filtering.

As a multivibrator cannot be accurately calibrated, a provision is provided to allow the instrument to be accurately synchronized with an accurate external source when extreme accuracy is required.

The low impedance output is continuously variable between 0 and 25 volts and operation is simple. You'll really appreciate the wide range of this instrument, 10 cycles to 100 kilocycles — continuously variable. Kit is complete with all parts and instruction manual, and is easy to build.



MODEL SQ-1
Shipping wt. 14 lbs.

$29.50

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The HEATH COMPANY

. . . BENTON HARBOR 15, MICHIGAN

THE *New* 1952

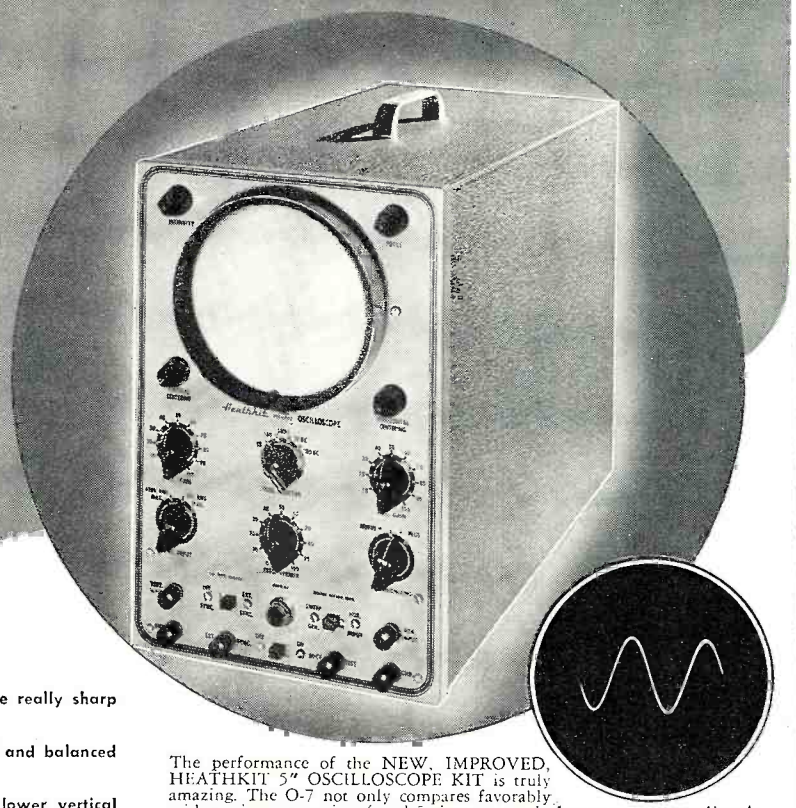
Heathkit

OSCILLOSCOPE KIT

MODEL O-7

SHIPPING WEIGHT 24 LBS.

$43.50



Features

- New "spot shape" control for spot adjustment — to give really sharp focusing.
- A total of ten tubes including CR tube and five miniatures.
- Cascaded vertical amplifiers followed by phase splitter and balanced push-pull deflection amplifiers.
- Greatly reduced retrace time.
- Step attenuated — frequency compensated — cathode follower vertical input.
- Low impedance vertical gain control for minimum distortion.
- New mounting of phase splitter and deflection amplifier tubes near CR tube base.
- Greatly simplified wiring layout.
- Increased frequency response — useful to 5 Mc.
- Tremendous sensitivity .03V RMS per inch Vertical — .6V RMS per inch Horizontal.
- Dual control in vernier sweep frequency circuit — smoother acting.
- Positive or negative peak internal synchronization.

The performance of the NEW, IMPROVED, HEATHKIT 5" OSCILLOSCOPE KIT is truly amazing. The O-7 not only compares favorably with equipment costing 4 and 5 times as much, but in many cases literally surpasses the really expensive equipment. The new, and carefully engineered circuit incorporates the best in electronic design — and a multitude of excellent features all contribute to the outstanding performance of the new scope.

The VERTICAL CHANNEL has a step attenuated, frequency compensated vertical input which feeds a cathode follower stage — this accomplishes improved frequency response, presents a high impedance input, and places the vertical gain control in a low impedance circuit for minimum distortion. Following the cathode follower stage is a twin triode — cascaded amplifiers to contribute to the scope's extremely high sensitivity. Next comes a phase splitter stage which properly drives the push-pull, hi-gain, deflection amplifiers (whose plates are directly coupled to the vertical deflection plates). This fine tube lineup and circuitry give a sensitivity of .03V per inch RMS vertical and useful frequency response to 5 Mc.

The HORIZONTAL CHANNEL consists of a triode phase splitter with a dual potentiometer (horizontal gain control) in its plate and cathode circuits for smooth, proper driving of the push-pull horizontal deflection amplifiers. As in the vertical channel, horizontal deflection amplifier plates are direct coupled to the CR tube horizontal deflection plates (for improved frequency response).

The WIDE-RANGE SWEEP GENERATOR circuit incorporates a twin triode multivibrator stage for producing a good saw-tooth sweep frequency (with faster retrace time). Has both coarse and vernier sweep frequency controls.

And the scope has internal synchronization which operates on either positive or negative peaks of the input signal — both high and low voltage rectifiers — Z axis modulation (intensity modulation) — new spot shape (astigmatism) control for spot adjustment — provisions for external synchronization — vertical centering and horizontal centering controls, wide range focus control — and an intensity control for giving plenty of trace brilliance.

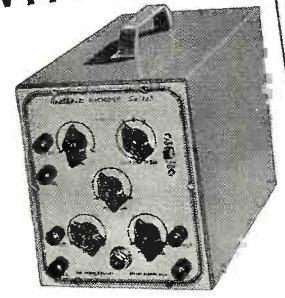
The Model O-7 EVEN HAS GREAT NEW MECHANICAL FEATURES — A special extra-wide CR tube mounting bracket is provided so that the vertical cascade amplifier, vertical phase splitter, vertical deflection amplifier, and horizontal deflection amplifier can mount near the base of the CR tube. This permits close connection between the above stages and to the deflection plates; distributed wiring capacity is greatly reduced, thereby affording increased high frequency response.

The power transformer is specially designed so as to keep its electrostatic and electromagnetic fields to a minimum — also has an internal shield with external ground lead.

You'll like the complete instructions showing all details for easily building the kit — includes pictorials, step-by-step construction procedure, numerous sketches, schematic, circuit description. All necessary components included — transformer, cabinet, all tubes (including CR tube), completely punched and formed chassis—nothing else to buy

NEW INEXPENSIVE *Heathkit*

ELECTRONIC SWITCH KIT



The companion piece to a scope — Feed two different signals into the switch, connect its output to a scope, and you can observe both signals — each as an individual trace. Gain of each input is easily set (gain A and gain B controls), the switching frequency is simple to adjust (coarse and fine frequency controls) and the traces can be superimposed for comparison or separated for individual study (position control).

Use the switch to see distortion, phase shift, clipping due to improper bias, both the input and output traces of an amplifier — as a square wave generator over limited range.

The kit is complete; all tubes, switches, cabinet, power transformer and all other parts, plus a clear detailed construction manual.

Model S-2
Shipping Wt. 11 lbs.

Only

$19.50

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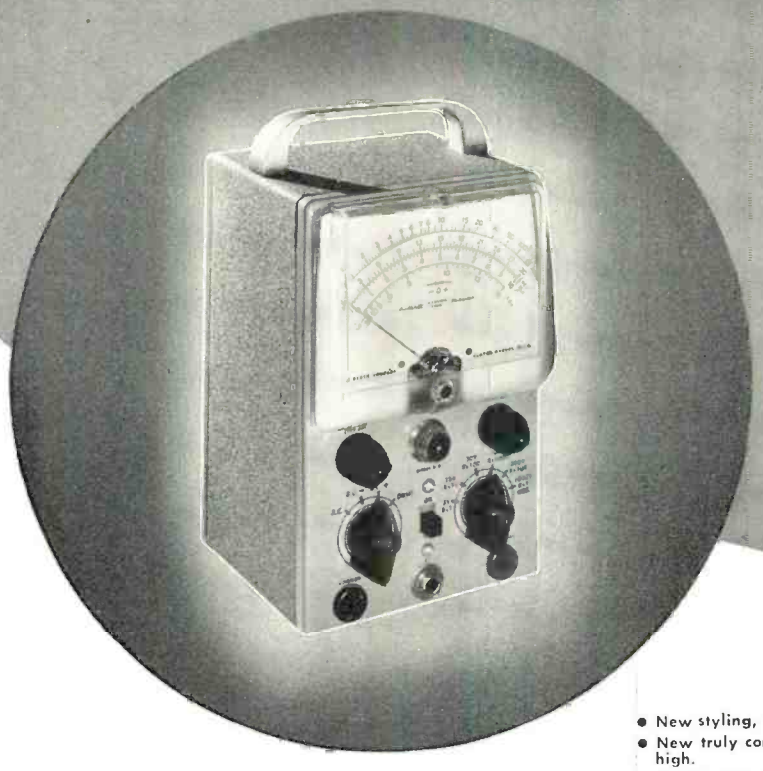
THE *New* 1952

Heathkit VTVM KIT

MODEL V-5
SHIPPING WT. 5 LBS.

$24.50



Features

- New styling, — formed case for beauty.
- New truly compact size. Cabinet 4⅛" deep by 4-11/16" wide by 7⅜" high.
- Quality 200 microamp meter.
- New ohms battery holding clamp and spring clip — assurance of good electrical contact.
- Highest quality precision resistors in multiplier circuit.
- Calibrates on both AC and DC for maximum accuracy.
- Terrific coverage — reads from ½V to 1000V AC, ½V to 1000V DC, and .1 to over 1 billion ohms resistance.
- Large, clearly marked meter scales indicate ohms, AC Volts, DC Volts, and DB — has zero set mark for FM alignment.
- New styling presents attractive and professional appearance.

A real beauty — you'll have only highest praise for this NEW MODEL VACUUM TUBE VOLTMETER. Truly a beautiful little instrument — and it's more compact than any of our previous models. Note the new rounded edges on the front panel and rear cover. The size is greatly reduced to occupy a minimum of space on your workbench — yet the meter remains the same large size with plainly marked scales.

A set of specially designed control mounting brackets permit calibration to be performed with greatest ease — also makes for ease in wiring. New battery mounting clamp holds ohms battery tightly into place, and base spring clip insures a good connection to the ohms string of resistors.

The circuitry employs two vacuum tubes — A duo diode operating when AC voltage measurements are taken, and a twin triode in the circuit at all times. The cathode balancing circuit of the twin triode assures sensitive measurements, and yet offers complete protection to the meter movement. Makes the meter burn-out proof in a properly constructed instrument.

Quality components are used throughout —1% precision resistors in the multiplier circuit—conservatively rated power transformer—Simpson meter movement — excellent positive detent, smooth acting switches — sturdy cabinet, etc.

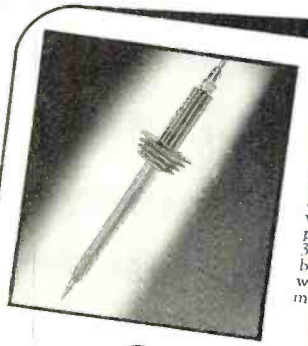
And you can make a tremendous range of measurements — ½V to 1000V AC, ½V to 1000V DC, .1 to over 1 billion ohms, and DB. Has mid-scale zero level marking for quick FM alignment. DB scale in red for easy identification — all other scales a sharp, crisp black for for easy reading.

A four position selector switch allows operator to rapidly set the instrument for type or reading desired—positions include ACV, DC+V, DC—V, and Ohms. DC— position allows negative voltage to be rapidly taken. Zero adjust and ohms adjust controls are conveniently located on front panel.

Enjoy the numerous advantages of using a VTVM. Its high input impedance doesn't "load" circuits under test — therefore, assures more accurate and dependable readings in high impedance circuits such as resistance coupled amplifiers, AVC circuits, etc. Note the 30,000 VDC probe kit and the RF probe kit — available at low extra cost and specially designed for use with this instrument. With these two probes, you can make DC voltage measurements up to 30,000V, or make RF measurements — added usefulness to an already highly useful instrument.

The instruction manual is absolutely complete — contains a host of figures, pictorials, schematic, detailed step-by-step instructions, and circuit description. These clear, detailed instructions make assembly a cinch.

And every part is included — meter, all controls, pilot light, switches, test leads, cabinet, instruction manual, etc.



Heathkit 30,000V DC PROBE KIT

A new 30,000 V DC Probe Kit to handle high voltages with safety. For TV service work and all other high voltage applications. Sleek looking — Two color molded plastic — Red body and guard — jet black handle. Comes with connector, cable, and PL55 type plug. Plugs into Heathkit VTVM so that 300V scale is conveniently multiplied by 100. Can be used with any standard 11 megohm VTVM.

$5.50

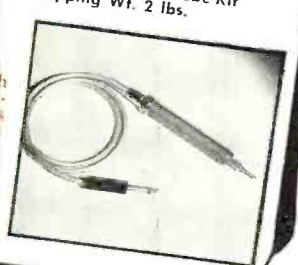
No. 336 High Voltage Probe Kit
Shipping Wt. 2 lbs.

Heathkit RF PROBE KIT

This RF Probe Kit comes complete with probe housing, crystal diode detector, connector, lead and plug and all other parts plus clear assembly instructions. Extends range of Heathkit VTVM to 250 Mc. ± 10%. Works on any 11 megohm input VTVM. Specify No. 309 RF Probe Kit.

$5.50

Ship. Wt. 1 lb.



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Heathkit

SIGNAL GENERATOR KIT

Model SG-6
Shipping Wt. 7 lbs.

$19.50

The new Heathkit Signal Generator Kit has dozens of improvements. Covers the extended range of 160 Kc to 50 megacycles on fundamentals and up to 150 megacycles on useful calibrated harmonics; makes this Heathkit ideal as a marker oscillator for TV. Output level can be conveniently set by means of both step attenuator and continuously variable output controls. Instrument has new miniature HF tubes to easily handle the high frequencies covered.

Uses 6C4 master oscillator and 6C4 sine wave audio oscillator. The kit is transformer operated and a husky selenium rectifier is used in the power supply. All coils are precision wound and checked for calibration making only one adjustment necessary for all bands.

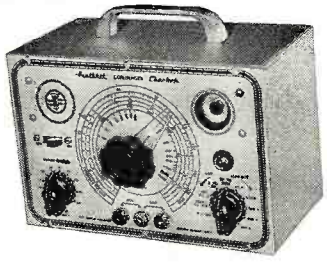
New sine wave audio oscillator provides internal modulation and is also available for external audio testing. Switch provided allows the oscillator to be modulated by an external audio oscillator for fidelity testing of receivers. Comes complete, all tubes, cabinet, test leads, every part. The instruction manual has step-by-step instructions and pictorials. It's easy and fun to build a Heathkit Model SG-6 Signal Generator.

Heathkit

CONDENSER CHECKER KIT

Only

$19.50



Model C-2
Shipping Wt. 6 lbs.

Checks all types of condensers — paper — mica — ceramic — electrolytic. All condenser scales are direct reading and require no charts or multipliers. Covers range of .00001 MFD to 1000 MFD. A Condenser Checker that anyone can read. A leakage test and polarizing voltage for 20 to 500 V provided. Measures power factor of electrolytics between 0% and 50% and reads resistance from 100 ohms to 5 megohms. The magic eye indicator makes testing easy.

The kit is 110V 60 cycle transformer operated and comes complete with rectifier tube, magic eye tube, cabinet, calibrated panel and all other parts. Has clear detailed instructions for assembly and use.

NEW *Heathkit*

SIGNAL TRACER AND UNIVERSAL TEST SPEAKER KIT

$19.50

Model T-2
Shipping Wt. 7 lbs.

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 — finds 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 an assortment of switching ranges to match either push-pull or single output impedances. Also tests microphones, pickups and PA systems. Comes complete: cabinet, 110V 60 cycle power transformer, tubes, test probe, all necessary parts, and detailed instructions for assembly and use.

Model TC-1
Shipping Wt. 12 lbs.

$29.50

Heathkit

TUBE CHECKER KIT

The Tube Checker is a MUST for radio repair men. Often customers want to SEE tubes checked, and a checker like this builds customer confidence. In your repairing, you will have a multitude of tubes to check — quickly. The Heathkit tube checker will serve all these functions — it's good looking (with a polished birch cabinet and an attractive two color panel) — checks 4, 5, 6, 7 prong Octals, Loctals, 7 prong miniatures, 9 prong miniatures, pilot lights, and the Hytron 5 prong types. AND IT'S FAST TO OPERATE — the gear driven, free-running roll chart lists hundreds of tubes, and the smooth acting, simplified switching arrangement gives really rapid set-ups.

The testing arrangement is designed so that you will be able to test new tubes of the future — without even waiting for factory data — protection against obsolescence.

You can give tubes a thorough testing — checks for opens, shorts, each element individually, emission, and for filament continuity. A large BAD-?-GOOD meter scale is in three colors for easy reading and also has a "line-set" mark.

You'll find this tube checker kit a good investment — and it's only $29.50.

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NEW 1952 *Heathkit*

BATTERY ELIMINATOR KIT

Model BE-3
Shipping Wt. 17 lbs.

- Can be used as battery charger.
- Continuously variable output 0 - 8 Volts — not switch type.
- Heavy duty Mallory 17 disk type magnesium copper sulfide rectifier.
- Automatic overload relay for maximum protection. Self-resetting type.
- Ideal for battery, aircraft and marine radios.
- Dual Volt and Ammeters read both voltage and amperage continually — no switching.

The new Heathkit Model BE-2 incorporates the best. Continuously variable output control is of the variable transformer type with smooth wiper type contacts.

There are no switches or steps and voltage between 0 and 8 Volts is available at 10 Amperes continuous and 15 Amperes intermittent. Maximum safety from overloads and shorts provided by automatic overload relay which resets itself when overload is removed.

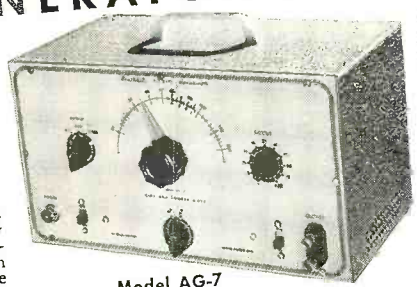
The new rectifier is a 17 plate Mallory magnesium copper sulfide type. This is the most rugged type available for long trouble-free use.

Output is continuously metered by both a 0 - 10 Volt Voltmeter and a 0 - 15 Amp Ammeter. Shorted vibrators indicated instantly by ammeter.

Equip now for all types of service — aircraft — marine — auto and battery radios — this inexpensive instrument vastly increases service possibilities — better be ready when the customer walks in.

NEW *Heathkit*

SINE AND SQUARE WAVE AUDIO GENERATOR KIT



Designed with versatility, usefulness, and dependability in mind, the AG-7 gives you the two most needed wave shapes right at your fingertips — the sine wave and the square wave.

The range switch and plainly calibrated frequency scale give rapid and easy frequency selection, and the output control permits setting the output to any desired level.

A high-low impedance switch sets the instrument for either high or low impedance output —on high to connect a high impedance load, and on low to work into a low impedance transformer with negligible DC resistance.

Coverage is from 20 to 20,000 cycles, and distortion is at a minimum — you can really trust the output wave shape.

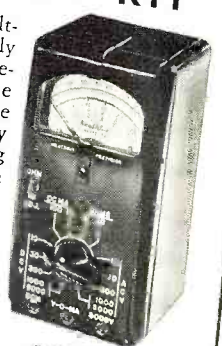
Six tubes, quality 4 gang tuning condenser, power transformer, metal cased filter condenser, 1% precision resistors in the frequency determining circuit, and all other parts come with the kit —plus, a complete construction manual — A tremendous kit, and the price is truly low.

Model AG-7
Shipping Wt. 15 lbs.

$34.50

THE NEW *Heathkit*

HANDITESTER KIT



A precision portable volt-ohm milliammeter. Uses only high quality parts — All precision 1% resistors, three deck switch for trouble-free mounting of parts, specially designed battery mounting bracket, smooth acting ohm adjust control, beautiful molded bakelite case, 400 micro-amp meter movement, etc.

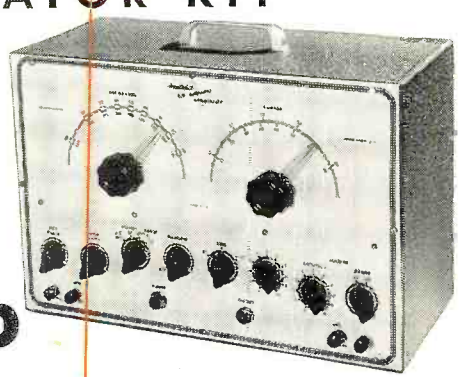
DC and AC voltage ranges 10 - 30 - 300 - 1000 - 5000V. Ohms range 0 - 3000 and 0 - 300,000. Range Milliamperes 0 - 10 Ma, 0 - 100 Ma. Easily assembled from complete instructions and pictorial diagrams.

$13.50

Model M-1
Shipping Wt. 3 lbs.

NEW *Heathkit*

T.V. ALIGNMENT GENERATOR KIT



Here is an excellent TV Alignment Generator designed to do TV service work quickly, easily, and properly. The Model TS-2 when used in conjunction with an oscilloscope provides a means of correctly aligning television receivers.

The instrument provides a frequency modulated signal covering, in two bands, the range of 10 to 90 Mc. and 150 to 230 Mc.— ALL ALLOCATED TV CHANNELS AS WELL AS IF FREQUENCIES ARE COVERED.

An absorption type frequency marker covers from 20 to 75 Mc. in two ranges—therefore, you have a simple, convenient means of frequency checking of IF's, independent of oscillator calibration.

Sweep width is controlled from the front panel and covers a sweep deviation of 0-12 Mc.—all the sweep you could possibly need or want.

And still other excellent features are: Horizontal sweep voltage available at the front panel (and controlled with a phasing control—both step and continuously variable attenuation for setting the output signal to the desired level—a convenient instrument stand-by position—vernier drive of both oscillator and marker tuning condensers—and blanking for establishing a single trace with base reference level. Make your work easier, save time, and repair with confidence—order your Heathkit TV Alignment Generator now!

Model TS-2
Shipping Wt. 20 lbs.

$39.50

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Heathkit IMPEDANCE BRIDGE KIT

Model 1B-1B
Shipping Wt. 15 lbs.

$69.50

This Impedance Bridge Kit is really a favorite with schools, industrial laboratories, and serious experimenters. An invaluable instrument for those doing electrical measurements work. Reads resistance from .01 Ohms to 10 meg., capacitance from .00001 to 100 MFD, inductance from 10 microhenries to 100 henries, dissipation factor from .002 to 1, and storage factor from 1 to 1000. And you don't have to worry about selecting the proper bridge circuit for the various measurements — the instrument automatically makes the correct circuit when you set up for taking the measurement you want. Bridge utilizes Wheatstone, Hay, Maxwell, and capacitance comparison circuits for the wide range and types of measurements possible. And it's self powered — has internal battery and 1000 cycle hummer. No external generator required — has provisions for external generator if measurements at other than 1000 cycles are desired. Kit utilizes only highest quality parts, General Radio main calibrated control. Mallory ceramic switches, excellent 200 microamp zero center galvanometer, laboratory type binding posts with standard ¾ inch centers, 1% precision ceramic-body type multiplier resistors, beautiful birch cabinet and ready calibrated panel. (Headphones not included.)

Take the guesswork out of electrical measurements — order your Heathkit Impedance Bridge kit today — you'll like it.

Heathkit LABORATORY RESISTANCE DECADE KIT

$19.50

Shipping Wt. 4 lbs.

An indispensable piece of laboratory equipment — the Heathkit Resistance Decade Kit gives you resistance settings from 1 to 99,999 ohms IN ONE OHM STEPS. For greatest accuracy, 1% precision ceramic-body type resistors and highest quality ceramic wafer switches are used.

Designed to match the Impedance Bridge above, the Resistance Decade Kit has a beautiful birch cabinet and attractive panel. It's easy to build, and comes complete with all parts and construction manual.

Heathkit LABORATORY POWER SUPPLY KITS

Limits:

No load	Variable 150-400V DC
25 MA	Variable 30-310V DC
50 MA	Variable 25-250V DC

Higher loads: Voltage drops off proportionally

$29.50

Model PS-1 ....Ship. Wt. 20 lbs.

Every experimenter needs a good power supply for electronic setups of all kinds. This unit has been expressly designed to act as a HV supply and a 6.3 V filament voltage source. Voltage control allows selection of HV output desired (continuously variable within limits outlined), and a Volts-Ma switch provides choice of output metering. A large plainly marked and direct reading meter scale indicates either DC voltage output in Volts or DC current output in Ma. (Range of meter 0-500V D.C., 0-200 Ma. D.C.). Instrument has convenient stand-by position and pilot light.

Comes with power transformer, filament transformer, meter, 5Y3 rectifier, two 1619 control tubes, completely punched and formed chassis, panel, cabinet, detailed construction manual, and all other parts to make the kit complete.

Heathkit ECONOMY . . . 6 WATT AMPLIFIER KIT

Model A-4
Ship. Wt. 8 lbs.

$12.50

No. 304 12 inch speaker . . . **$6.95**

This fine Heathkit Amplifier was designed to give quality reproduction and yet remain low in price. Has two preamp stages, phase inverter stage, and push-pull beam power output. Comes complete with six tubes, quality output transformer (to 3-4 ohm voice coil), husky cased power transformer and all other parts. Has tone and volume controls. Instruction manual has pictorial for easy assembly. Six watts output with response flat ± 1½ db from 50 to 15,000 cycles. A quality amplifier kit at a low price. Better build one.

Heathkit HIGH FIDELITY . . . 20 WATT AMPLIFIER KIT

$33.50

Shipping Wt. 18 lbs.

Our latest and finest amplifier — the model A-6 (or A-6A) is capable of a full 20 Watts of high fidelity output — good faithful reproduction made possible through careful circuit design and the use of only highest quality components. Frequency response within ± 1 db from 20-20,000 cycles. Distortion at 3 db below maximum power output (at 1000 cycles) is only .8%. The power transformer is rugged and conservatively rated and will deliver full plate and filament supply with ease. The output transformer was selected because of its exceptionally good frequency response and wide range of output impedances (4-8-16-150-600 ohms). Both are Chicago Transformers in drawn steel case for shielding and maximum protection to windings. The unit has dual tone controls to set the output for the tonal quality desired — treble control attentuates up to 15 db at 10,000 cycles — bass control gives bass boost up to 10 db at 50 cycles.

Tube complement consists of 5U4G rectifier, 6SJ7 voltage amplifier, 6SN7 amplifier and phase splitter, and two 6L6's in push-pull output. Comes complete with all parts and detailed construction manual. (Speaker not included.)

MODEL A-6: For tuner and crystal phono inputs. Has two position selector switch for convenient switching to type of input desired.

MODEL A-6A: Features an added 6SJ7 stage (preamplifier) for operating from variable reluctance cartridge phono pickup, mike input, and either tuner or standard crystal phono pickup. A three position selector switch provides flexible switching. **$35.50**
Shipping Wt. 18 lbs.

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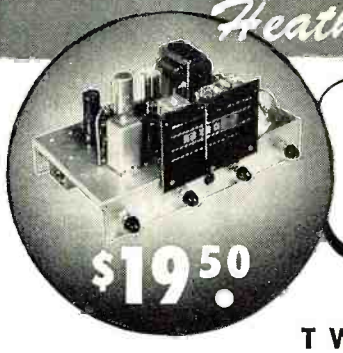
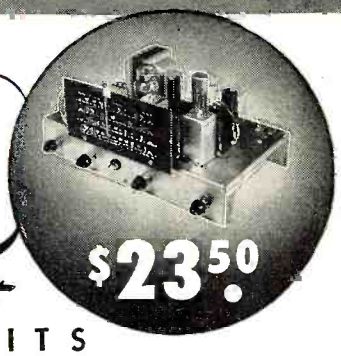
Heathkit RECEIVER & TUNER KITS for AM and FM



$19.50

Model BR-1 Broadcast Model Kit covers 550 to 1600 Kc. Shipping Wt. 10 lbs.

Model AR-1 3 Band Receiver Kit covers 550 Kc. to over 20 Mc. continuous. Extremely high sensitivity. Shipping Wt. 10 lbs.

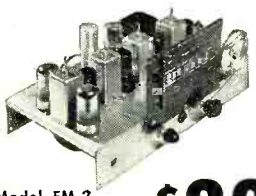


$23.50

TWO HIGH QUALITY Heathkit SUPERHETERODYNE RECEIVER KITS

Two excellent Heathkits. Ideal for schools, replacement of worn out receivers, amateur and custom installations.

Both are transformer operated quality units. The best of materials used throughout — six inch calibrated slide rule dial — quality power output transformers — dual iron core shielded. I.F. coils — metal cased filter condenser. The chassis has phono input jacks, 110 Volt output for phono motor and there is a phono-radio switch on panel. A large metal panel simplifying installation in used console cabinets is included. Comes complete with tubes and instruction manual incorporating pictorials and step-by-step instructions (less speaker and cabinet). The three band model has simple coil turret which is assembled separately for ease of construction.



Model FM-2
Ship. Wt. 9 lbs.

$22.50

TRUE FM FROM Heathkit FM TUNER KIT

The Heathkit FM Tuner Model FM-2 was designed for best tonal reproduction. The circuit incorporates the most desirable FM features — true FM.

Utilizes 8 tubes: 7E5 Oscillator, 6SH7 mixer, two 6SH7 IF amplifiers, 6SH7 limiter, two 7C4 diodes as discriminator, and 6X5 rectifier.

The instrument is transformer operated making it safe for connection to any type receiver or amplifier. Has ready wound and adjusted RF coils, and 2 stages of 10.7 Mc IF (including limiter). A calibrated six inch slide rule dial has vernier drive for easy tuning. All parts and complete construction manual furnished.

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	Heathkit VTVM Kit — Model V-5			Heathkit R.F. Signal Gen. Kit — Model SG-6	
	Heathkit FM Tuner Kit — FM-2			Heathkit Condenser Checker Kit — Model C-2	
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	Heathkit Amplifier Kit — Model A-6 (or A-6A)			Heathkit Impedance Bridge Kit — Model IB-1B	
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CHECK THAT PICTURE TUBE

By
F. C. KROEGER

Details on a simple adapter that can be used in conjunction with your regular tube tester.

ONE of the most useful and handy devices for the TV technician is a means for checking the picture tube. TV has been in our community two and a half years and we are beginning to have an increasing number of kinescope replacements due to length of service as well as the seemingly early failure of the rectangular types. These faults may often appear as trouble in some other section of the receiver and after wasting time in a vain attempt to repair the set CRT substitution is resorted to in a last effort. Remember, as a service technician your time is your most precious commodity. It must be utilized intelligently if you are to realize your maximum profit.

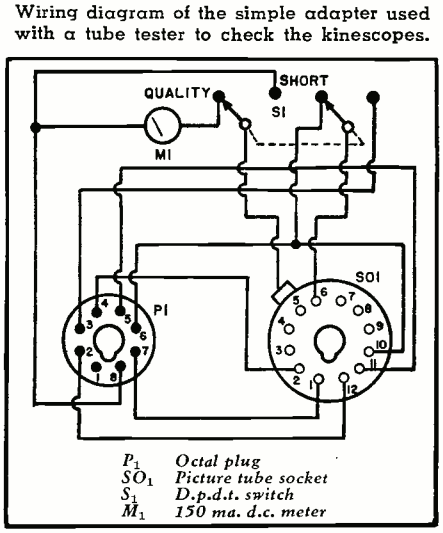
Kinescope troubles may be divided into the following categories: burned out filaments and defective picture screen are both visible to the eye when the set is in operation; shorts and leakage, defects in the electron gun may often be found with an ohmmeter, but most likely are only present when the cathode is heated. The most difficult trouble to spot without a kinescope checker is, of course, low emission. If this is suspected and you have no checker your only recourse is tube substitution. There are now several excellent makes of checkers on the market, but by using a special adapter, I have found that my conventional tube checker will give equal results. Not only has this spared me the expense of a separate CRT checker, but also eliminates one more item to be carried in the car or truck. This adapter will work, not only with our conventional magnetic type tubes, but also with the new electrostatic focus tubes such as the 17FP4. However, no attempt has been made to check electrostatic deflection tubes, as we have found that customers are no longer interested in repairing this type set when it involves a major expenditure.

Because anode current is so very low and the meter in the conventional tube checker (we use a *Hickok*) is one ma. or more it is necessary to use an external meter with a sensitive 150 to 200 microampere movement. The schematic of this adapter is self-explanatory. I use an octal plug hooked to a regular kinescope socket with a 150 microampere meter in series with the accelerating anode lead. The switch is used for checking the new type electrostatic focus tubes for shorts and to protect the meter during short tests. When the switch is in "quality" position, pin 6 of the picture tube socket is connected to pin 10. I selected the 6SK7 setting of my tube checker to provide the necessary voltages to the picture tube socket. The operation of the adapter is quite simple.

First, set your tube checker for a 6SK7 with the "bias" setting (*Hickok* only) on 35, "English" on zero, and the "micromhos" switch control to "English". The bias for a 50 degree deflection type tube must be set at 25 instead of 35. Then, without removing tube from chassis, connect the tube to the checker through the adapter. The adapter switch should be on "short test". Allow a reasonable warm up period, then check for shorts. If there are none, throw the adapter switch and check for anode current. I usually remove the ion trap because we have found that if it is improperly set, readings are often false. The anode current of a new tube should be 100 microamperes plus or minus ten per-cent. A tube is still usable from 40 to 60 microamperes. You may set up your own standard of good, bad, and doubtful by taking readings on sets going through your own shop. Be sure your filament switch is at 6.3 volts and not left on 35 or 50 volts from checking an a.c.-d.c. blooper.

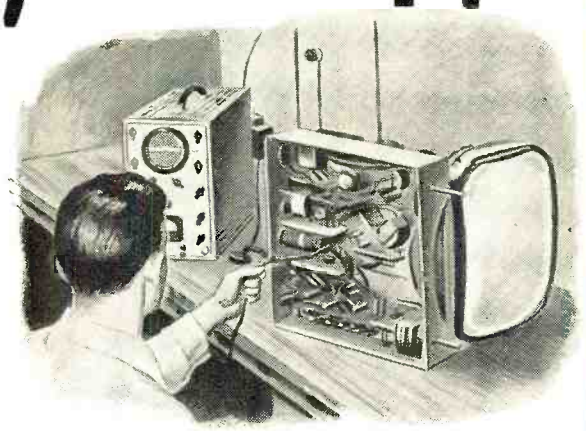
This adapter is quite simple to make and will repay you many times for the slight effort necessary. While this one was used for my own particular make of tube checker it may be used with any other that checks the individual tube elements. Good luck and faster servicing! —30—

Wiring diagram of the simple adapter used with a tube tester to check the kinescopes.



P_1 *Octal plug*
SO_1 *Picture tube socket*
S_1 *D.p.d.t. switch*
M_1 *150 ma. d.c. meter*

Here's your Opportunity



to prepare for a good job or a business of your own in TV SERVICING

There are today more good jobs open in TV Servicing than there are trained and experienced men to fill them. Yes, thousands of opportunities exist now for good-pay jobs offering employment security for years and years to come. Thousands of TV Servicing jobs are going begging. Do you want one of them?

Experts agree, that because of the critical shortage of trained and experienced TV Servicemen, and the tremendous future growth of the industry, no vocational field today offers more opportunities than TV Servicing.

The Big New Industry with a Great Future

Television is just in the beginning stages of its big industrial boom. Look at these amazing facts:

- Lifting the freeze on new TV stations will open many new TV areas and will improve the coverage of existing areas. The result will be an enormous demand for TV receivers.
- Within a few years over 1000 TV stations will be telecasting compared with 108 TV stations now on the air.
- Nearly one-half of all families living within the present TV areas do not yet own TV receivers.
- The new trans-continental video network plus better and more interesting programs plus larger viewing screens and color TV will increase the installation of new receivers, will induce present owners of 12-inch and smaller size viewing screens to buy newer model receivers.
- The power increases of many existing stations and improved reception range of current receivers will result in receivers being installed and serviced in the fringe areas of present stations.
- Under the FCC proposal, over 70 per cent of all communities will be served by UHF channels exclusively. This means TV servicemen must know UHF receivers before the new UHF stations in their area are opened.
- No one yet knows how great the industrial TV market will be.

RCA Institutes Home Study Course prepares you for a Career in TV Servicing

The addition of the RCA Institutes TV Service Training to your present radio-electronics experience will qualify you to step out and grasp the golden opportunities that now exist in television—America's fastest growing industry.

Learn at home—in your spare time—while you study the practical *how-to-do-it* techniques with *how-it-works* information. Easy-to-read and easy-to-understand lessons under the supervision of RCA engineers and experienced instructors quickly train you to qualify for the many good jobs now waiting for trained TV servicemen. Don't pass up this lifetime opportunity for financial security and a bright future in TV. Learn TV Servicing from RCA—pioneers and leaders in radio, television and electronic developments.

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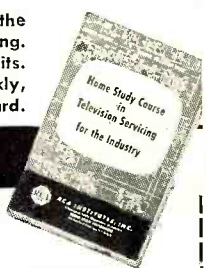

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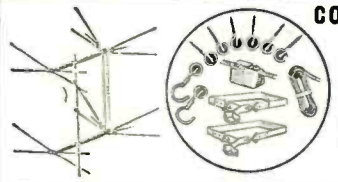
—Nothing More to Buy



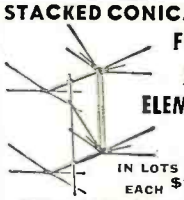
STOCK NO. AU-67

$16.99

Latest model. Genuine Aircraft Aluminum Tubing. Everything you need to erect a high-gain 20 element two-bay "X" type antenna. HERE'S WHAT YOU GET: 1 stacked deluxe 20 element conical antenna with high frequency stubs; 2 5-ft. steel mast sections; 1 UL approved twinline lightning arrester; 1 steel chimney mounting assembly with necessary strapping; 75-ft. 300 ohm twinline; 6 insulated screw-eye standoffs; and 2 insulated mast standoff insulators.

The antenna has a conical pattern providing high gain on ALL channels. All the necessary installation parts are packed with the antenna. Here's the economical way to buy. Have everything at hand for that installation. Order these kits NOW. This is real Olson Value. Shpg. wt. 25 lbs.

STACKED CONICALS FULL 20 ELEMENT



IN LOTS OF 3, EACH $7.99

With matching Q bars and High Frequency Stubs Genuine Aircraft Aluminum elements. High gain stacked conical. Will pull in those stations in "Fringe Areas." Works on all channels. Easily assembled.

THIS IS A TERRIFIC VALUE!

Each Antenna consists of two conical bays plus a pair of matching Q bars. Less mast. Packed—3 Antennas to a carton. This gives you six bays and 3 pairs of Q bars.

Sold Only in Boxes of 3 Antennas AU-66. Carton of 3 ..... **$23.97** Weight 25 lbs.

TWIN LINE

300 Ohm Poly Twinline

High quality, low loss. For all TV and FM installations. Shpg. wt. 2 lbs.

Stock No. W-73. 100 ft. coil. Lots of 10, ea. Single, ea. $2.99 **$1.99**

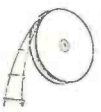
OPEN WIRE TV LINE

★ Use in Place of 300 Ohm Line

Ideal for fringe area installations. Not affected by moisture or sun. Made of #18 copperweld wire with genuine polystyrene insulators spaced 6" apart. Tensile strength 400 lbs.

Stock No. W-78. 100ft. coil. Shpg. wt. 4 lbs. $5.95

Stock No. W-79. 250ft. coil. Shpg. wt. 9 lbs. $14.50



OLSON SMASHES KINESCOPE PRICES!

Every Tube Brand New and Guaranteed

16GP4A	Round, Dark Face, Metal Envelope. Retail Price $51.00...	$24.95
17B4PA	Rectangular, Dark Face, Glass Envelope. Retail Price $37.50.	19.95
19AP4B	Round, Etched Dark Face, Metal Env. Retail Price $65.00.	29.95
20CP4	Rectangular Dark Face, Glass Envelope. Retail Price $59.00.	29.95

Here are real bargains in Picture Tubes. Prices which would be impossible except for the fact that Olson made a cash deal on THREE SOLID RAILROAD CARS full of BRAND NEW TUBES. This is one of the biggest deals that has been swung around here for a long time. We had to make one promise when we bought this deal. We promised not to advertise the manufacturer's name. However every tube is in the original carton and bears the manufacturer's name.

Build a Receiver Set of Basic Components

Kit of 5 parts AS-38 **$1.89**

You get this kit of 5 basic parts to build an AC-DC set or portable:

Parts	Reg. List Price
Loop	$0.95
R. F. Coil	1.10
I.F. Transformer (456 KC) Input	1.60
Output	1.60
Oscillator Coil	.75
List Price of Set	6.00

Use any 365 mfd variable for tuning. Covers 535-1625 KC.

PRESTO—Call Intercom

The Modern Electronic Communication System

Stock No. RA-96. Olson Special Price for Master Station, Substation and 50 ft. of cable only **$19.83**

Now talk with anyone, anywhere at the mere flick of a button! All electric master station and sub-station give clear, powerful voice reproduction to rooms or other buildings up to 1000 ft. away. Thousands have been sold for use in restaurants, on farms, in offices, stockrooms, factories and in homes. Just plug master station into any 115 V AC electrical outlet—connect 3 wires and you're operating. Modern design. Each unit measures 4½x4½x5½. Equipped with rubber feet and easy slide switches. Handsome appearance—gray crackle finish. High amplification—use 3 tubes. Power output 2½ watts. Regular list price is $37.50. You get the master station, substation and 50 ft. of 3 conductor cable. Complete with tubes. Shpg. wt. 8 lbs.

IT'S OLSON FOR SPEAKERS

Don't hesitate—here's that opportunity to buy quality speakers at less than jobbers cost. Again Olson was Johnny-on-the-Spot. We had the cash and made the deal. Now you can get your share of the savings. All are PM, with 3.2 ohm voice coils.

Stock No.	Size	Shpg. Wt.	Olson's Price
S-4	4"	2 lb	$1.69
S-5	5"	2 lb	1.79
S-7	6"	3 lb	2.29
S-96	7"	3 lb	3.39
S-123	8"	3 lb	2.99
S-97	10"	5 lb	3.95
S-167	12"	7 lb	4.95

DO YOU LIVE IN A TV FRINGE AREA?

- Amazing manufacturer's close-out
- Regular retail price $32.50

Model No. 107—Complete with tubes. Ready to work. Not a kit. **$10.95**

Continuous tuning for TV and FM through all channels. Coils wound with PURE SILVER wire. Improves TV reception and reduces noise and "snow." Housed in beautiful plastic case 5½x7½x5. Tube is 6J6 push-pull triode amplifier. Operates on 115 volts. In original factory sealed carton. Shpg. wt. 5 lbs.

★ 12" Wide Range Co-Axial Speaker — CLOSE-OUT

Special close-out price while they last

★ 40 to 17,500 CPS Response

Stock No. S-160 **$10.95**

MAKE WAY FOR NEW MODEL

Closing out reg. $32.50 retail hi-fi, 20 watts speaker. Thousands sold at $13.95. This is the same type of speaker you will find in $300.00 combination radios. Each speaker consists of a 12" woofer section driven by a heavy 2 lb. magnet and this part delivers the bass notes. The 3" tweeter speaker is built into the center of the speaker and is driven by a 2.15 oz. Alnico 5 magnet delivering the treble notes. High pass filter is built into speaker and entire combination gives tones you never dreamed possible. Only two wires to connect to any radio or amplifier and speaker is ready to play. Voice coil impedance is 8 ohms. Shpg. wt. 10 lbs.

PHONO CARTRIDGES

Take your pick of these two types of cartridges. . . . Astatic flip over crystal and General Electric dual Variable Reluctance magnet. Both are bargains. Get yours while they last.

Astatic LQD Turnover Model

Stock No. XC-46 Single, ea. **$3.98** Lots of 10 $3.50 ea.

Popular "turnover" Type crystal cartridge for 33⅓, 45 and 78 RPM discs. Excellent frequency response, 50-7000 cycles. Equipped with 2 precious tip needles which are removable. Stamped aluminum housing with needle guards, mounting bracket and turnover knob. Reg. list price is $10.00.

G-E Magnetic Cartridges Triple Play—RPX-050

Stock No. XC-48 **$5.99** each

Variable reluctance cartridge that plays all records. Equipped with baton style dual sapphire-tipped needle .001" tip for 33⅓ and 45 RPM. Also .003" tip for 78 RPM. Requires preamplifier. Not affected by humidity and high temperatures. Supplied with knob to fit most tone arms. Complete with dual needle. Reg. list price $13.95.

BUILD YOUR OWN VIBRATOR POWER SUPPLY

Build your own Vibrator power supply and get 150 volts DC from any 6 volt storage battery. Use it to furnish "B" power for portable radios, aircraft and marine receivers. Ideal for experiments. No tube needed. In this kit you get:

1 Mallory Type 45 Sync. Vibrator
1 Power Transformer

These are the main components. A simple diagram is included so you can build the supply easily in less than half an hour. The Mallory vibrator fits a standard 5 prong socket and the can measures 1½x3¼". This is the same as Mallory number 245. The transformer is fully shielded and measures 1¾x1¾ x2". The genuine Mallory vibrator lists at $7.70 and the transformer at $3.00. Shpg. wt. 3 lbs. **$1.49**

Stock No. X-272—You get both for only.....

BIG VALUES AT OLSON'S

Stock No.	Description	Olson's Price
T-80	TV Focus Coil. Replaces RCA 202D1. For magnetically deflected 55° Kinescopes..	$1.79
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T-91	Ion Trap with 2 powerful Alnico 5 magnets. Bronze clamp keeps it firm.....	.98
X-263	Ion Trap single magnet type. Most popular in use. Order plenty.....	.49
T-94	GE Type Universal Flyback Trans. similar RTO-085. 77J1 for all 65°-70° Kinescopes. Ferrite core. supplies 14,000 volts. Single ea. $3.99. Lots of 3, each.	$3.49
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T-84	55° TV Yoke. Similar to RCA 205D1. For 10", 12" and 16" Kinescopes. Single. ea. $2.79. Lots of 3, each.....	$1.99
C-256	500 MMFD 10KV Ceramic TV Condenser. With threaded terminals. Single. ea. 79c. Lots of 10, each.....	.49
C-399	500 MMFD, 20KV Ceramic TV Condenser with threaded terminals. single, ea. 99c. Lots of 10, each.....	.85
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W-75	TV Anode Connector. Phosphor Bronze plug, rubber shield and polyethylene cord	.49
X-197	JFD Lightning Arrestor. UL approved. For all 300 ohm TV lines.....	$1.32
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Olson bought over $64,000 worth of these fine wire wound resistors (a famous manufacturer's entire stock). You can have them at 80% discount off list price. Stock up. Order whether you need them now or not. Regular list prices run from 75c to $1.10 each. These resistors are unaffected by heat, cold, or fumes. Winding is rigidly held in place on asbestos core by special formula. Stands terrific overloads. Accuracy 10%. FULLY GUARANTEED. Equipped with tinned leads.

TAKE YOUR CHOICE WHILE THEY LAST

20¢ EA.

Olson's Special

Available in the Following Resistances.

OHMS	OHMS	OHMS	OHMS	OHMS	OHMS
5	50	250	1250	3,500	11,000
20	100	750	1500	4,000	12,000
25	125	800	1750	7,000	12,500
33	150	1000	2000	7,500	13,500
35	200	1100	2250	8,000	14,300
40	225	1200	2500	8,500	15,000
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30 WATT AMPLIFIER

- Factory Built
- Latest Design

Olson's Price less tubes. RA-23 ..... **$34.95**

A real commercial amplifier which looks good and performs well. Not a kit. Gain, mike, 130DB, phono 80DB. Has dual tone controls, one for bass and the other for treble tone. Output impedances 4, 8, 15 and 500 ohms. Input for two mikes and one crystal pickup. Shpg. wt. 20 lbs. Tubes required, 3—6SQ7, 1—6SC7, 2—6L6g, 1—5V4g.

AS 46

KIT OF 20 **$2.49**

10 WATT RESISTOR KIT

We mean to move 80,000 fine 10 watt wire wound resistors during this sale. REGULAR LIST PRICE OF THIS KIT IS $15.00. Each kit contains 20 popular insulated resistors, with tinned copper leads. Shpg. wt. 2 lbs.

FAIRCHILD GRINDER

TL-3 **$9.98**

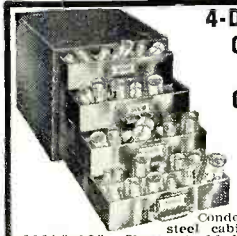
Every service shop needs one of these handy tools made by Fairchild, famous manufacturer of precision electric grinders. Regular nationally advertised price is $19.75. The set consists of 1—115 volt high speed, air cooled grinder, 6 assorted grinding wheels, 1 circular saw blade, 1 hardened steel reamer, 1 buffing brush, 1 abrasion stone and a natural finish wood case size 10"x8"x3" to house the grinder. Shipped in original factory sealed cartons.

3 SPEED PICK-UP ARM

M-64 **$4.95**

Cartridge flips by means of a lever. Dual cartridge, one side plays 33⅓ and 45 and other 78 RPM. Double needle.

4-DRAWER STEEL CABINET GIVEN WITH OLSON'S GIGANTIC, NEW AKRAD KIT



Olson's Price AS-20 **$16.95**

You get $51.60 list worth of "Akrad" Condensers plus the 4 drawer steel cabinet FREE, size 10"x 11½"x10". Shpg. wt. 11 lbs.

12 "AKRAD" By-Pass Condensers

Qty.	Cap.	Volts	List ea.	Total
2	.001	600	$.25	$.50
2	.002	600	.25	.50
2	.005	600	.25	.50
5	.01	600	.30	1.50
5	.02	600	.30	1.50
10	.05	600	.40	4.00
10	.1	600	.45	4.50
2	.005	1600	.55	1.10
2	.008	1600	.55	1.10
2	.01	1600	.60	1.20

Also 27 "AKRAD" Electrolytic Condensers

Qty.	Cap.	Volts	List ea.	Total
2	10	25	$1.00	$2.00
2	25	25	1.00	2.00
5	20	150	1.20	6.00
5	40	150	1.35	6.75
4	20-20	150	1.65	6.60
5	8	450	1.25	6.25
4	16	450	1.40	5.60
69	Value			$51.60

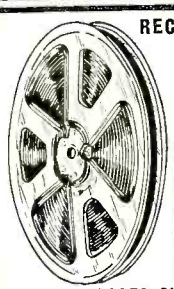
MIKE

High output crystal mike for PA systems and recorders. Equipped with handle base and 7' shielded cable. Shpg. wt. 5 lbs.

M-67, each..... **$5.95**

M-66, same but with on-off switch built into handle.... **$6.95**

RECORDING TAPE—Famous Mfr's Close-Out!



Get the buy of your life. Save up to 64% on high quality RECORDING TAPE. A large manufacturer had to sell his inventory and he unloaded the whole deal. Olson now offers you this high grade recording tape at prices which defy competition. Standard ¼" wide, 1200 ft. long. Frequency response 50 to 8,000 cy. Plastic Reel included with each.

PAPER BASE— 1200 ft. Stock No. X-248 Single, each $1.69 Lots of 10, each **$1.49**

PLASTIC BASE 1200 ft. Stock No. X-249 Single, each $2.19 Lots of 10, each **$1.99**

PRICES SLASHED ON EMPTY PLASTIC REELS

Finest Clear Plastic—Will Not Warp

5" Diameter—600' Size No. X-250 Single, ea. 39c. LOTS OF TEN, EA..... **29¢**

7" Diameter—1200' Size No. X-251 Single, ea. 49c. LOTS OF TEN, EA..... **39¢**

NOTICE—RADIO MANUFACTURERS

- Olson Radio has established a tremendous market among radio servicemen, amateurs, universities and industrials all over America as well as principal foreign countries. Our famous rapid mailing service is the talk of the trade.

If you have any good, clean surplus radio material which you wish to dispose of, contact Olson at once. We can use: radios, amplifiers, condensers, chassis, phono motors, pickup arms, volume controls, test equipment, speakers, in fact any radio or electronic part or piece of equipment.

Here is your opportunity to turn idle inventory into cash. Write, wire or call Olson, the popular name in radio.

SEND FOR OLSON'S BRAND NEW BARGAIN CATALOG. GET NATIONALLY FAMOUS RADIO PARTS AND SUPPLIES AT BIG DISCOUNTS

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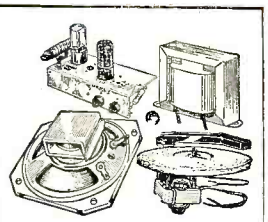
CHICAGO, ILLINOIS
623 W. Randolph Street
If you live in or near Chicago visit our store, get these and many more bargains.

MAIL ORDERS SHOULD BE SENT TO AKRON, OHIO

BUILD YOUR OWN RECORD PLAYER

★ Kits available now from Olson. Choose from 2 Models.



Each Kit contains a rim drive motor with velvet finish turntable, crystal pickup, all purpose needle, 4" PM speaker, matching output transformer, 2 tube AC-DC amplifier complete with tubes (35W4 and 50B5).

Single Speed Model 78 RPM
Complete Kit as described above. Shpg. wt. 8 lb. Stock No. AS-52 **$8.95**

3 Speed Model 33⅓-45-78 RPM
Complete Kit as described above. Shpg. wt. 8 lb. Stock No. AS-53 **$11.95**

FAMOUS BRAND 3-SPEED AUTOMATIC RECORD CHANGER

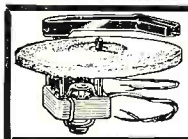
$19.99 RA-69

- Sorry, we promised not to mention the manufacturer's name.
- Automatically Plays 7", 10" and 12" Records.
- Plays All Type Discs—All Speeds 33⅓, 45 and 78 RPM.

Completely automatic and what's more it's one of the most famous brands in changers. Precision built by experienced craftsmen. Every changer brand new in original factory packing. 100% guaranteed to please or your money back. Here is one of Olson's most sensational bargains. Believe us—you can't go wrong. Order one or more but we can't promise to repeat this offer. We have a limited quantity and when they are gone—no more.

The changer has a reject lever and a control for selecting 33⅓, 45 or 78 RPM speeds. Plays all 7", 10" and 12" records. Equipped with an Astatic Ceramic cartridge and a sapphire long life needle. Records drop gently and smoothly—just like velvet. Operates on 115 volts, 60 cycles AC. Base 12x12½". 5⅛" above plate and 3½" below. Shpg. wt. 15 lbs.

BIGGEST BARGAIN



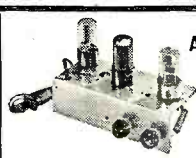
COMBINATION OFFER—You get an Alliance Rim Drive 78 RPM Phono Motor with turntable PLUS a Pickup Arm with high Output Cartridge.

Special while they last for the combination **$3.99** RA-91

3 SPEED MOTOR

Self starting, complete with turntable. Operates on 115 volt AC 60 cy. Shpg. wt. 5 lbs Stock #M-63. **$5.99**

PHONO AMPLIFIER



RA-19. **$3.98** LESS TUBES

A real high efficiency 3-tube amplifier of modern design. Connect to any crystal phono arm and speaker. Has volume and tone controls 7"x 3¼"x2". Shpg. wt. 2 lbs.

SET OF TUBES FOR AMPLIFIER 12SQ7 50L6 35Z5 No. AS-22..... **$2.64**

3 SPEED AUTOMATIC CHANGER

COMPLETE with VM Model 950 Changer, Amplifier, Speaker and Case. A real Olson value if we ever saw one! Here is the latest VM Model 950 Automatic Changer built into a beautiful carrying case with speaker and fine Amplifier. Plays twelve 7" records (33⅓ or 45 RPM); twelve 10" or ten 12" (33⅓ or 78 RPM); 100% automatic in operation. Nothing more to buy when you order this fine player from OLSON. The cartridge is equipped with a long life needle. Motor shuts off after last record. Equipped with volume control and tone control. Speaker is Alnico V PM. Carrying case is beautifully covered. Size 15" x 17" x 8". For 115 volts 60 cy. AC. Regular list price $77.95.

RA-70 **$42.95** WHILE THEY LAST

THIS COSTS YOU NOTHING—NOT A RED CENT

Just to get the ball rolling and to get your order coming our way—Olson is going to send you one of his valuable TUBE SOCKET KITS. The kit contains 20 popular assorted 6-7-8-9 pin sockets which can be used in AM-FM and TV work. To get this kit all you need do is make up an order for $10.00 or more from this ad—use the order blank below. We will ship your order at once and include the 20-piece socket kit—FREE.

IT'S EASY TO ORDER FROM OLSON'S

How to order: Order directly from this ad. For convenience use this order blank. Fill in columns below with quantity desired, stock number, description and price. You may send remittance with order (include enough for postage or parcel post shipment), or if you prefer SEND NO MONEY. Olson will ship C.O.D. and you may pay mail or expressman for merchandise and postage.

MONEY BACK GUARANTEE: *Everything you order from Olson is guaranteed as advertised. If you are not more than satisfied, you may return merchandise for cash refund.*

Please Minimum Order $3.00

QUANTITY	STOCK NUMBER	DESCRIPTION	PRICE EACH	TOTAL

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ADDRESS _____

CITY _____ ZONE ___ STATE _____

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TOTAL	
ADD POSTAGE	
TOTAL AMOUNT	

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Within the Industry

(*Continued from page* 26)

Starrett Television Corporation of New York. He was formerly special consultant to the company's board of directors in the fields of procurement and finance . . . **WILLIAM W. TAYLOR** is the new sales promotion manager of the Capacitor Division of *Sangamo Electric Company*. He will make his headquarters at the Marion, Illinois, plant of the firm . . . **MANFRED E. PHILIP** has been appointed controller and director of purchases for *Telrex, Inc.* . . . **MARTIN F. SHEA,** veteran *Philco* employee, has been named vice-president of the Auto-Radio Division in charge of car radio manufacturing sales and head of the company's Detroit operation . . . **DAVID S. RAU** has been elected vice-president and chief engineer of *RCA Communications, Inc.,* while **C. W. LATIMER,** formerly vice-president in charge of engineering, has been named vice-president and chief technical consultant of the firm . . . **S. I. NEIMAN** has been named executive secretary of Radar-Radio Industries of Chicago, Inc., while **KENNETH C. PRINCE** has been retained as general counsel of the trade group . . . **EDWARD A. ROPPEL,** quality control engineer at *Packard-Bell Company,* has assumed his new post of supervisor of government production . . . **MARVIN L. BRUCKNER** has been named assistant sales manager of the jobber division for *Quam Nichols Co.,* Chicago speaker and electronics manufacturer.

* * *

ALBERT COUMONT has been appointed service manager of the Radio-Television Manufacturers Association, succeeding E. W. Merriam who held the post previously on a temporary basis.

Mr. Coumont was formerly sales manager, Electronics Section, *International General Electric Co., Inc.* and prior to that gained wide experience in his own service business and in the service divisions of various manufacturers.

He will make his headquarters at the new RTMA offices, 777 14th St., Washington 5, D. C.

* * *

DOUGLAS Y. SMITH, veteran of nearly a quarter-century of service in the engineering, merchandising, and sales activities of *RCA,* has been promoted to the post of manager of sales operations for the Tube Department of *Radio Corporation of America.*

Earl M. Wood, for the past 10 years manager of manufacturing at the Tube Department's Lancaster, Pa., plant, will succeed Mr. Smith as plant manager in Lancaster.

In his new post Mr. Smith will be responsible for the coordination of the department's renewal and equipment sales activities and of the tube parts and machinery sales.

He joined the company as a tube design engineer in 1930, shortly after his graduation from Cooper Union College.

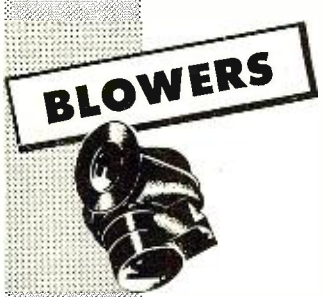
—30—

NEATER DRILLING

By MORRIS DORSEY

NEATER, quicker drilling of aluminum, metal, and plastic can be accomplished by placing a small piece of cellophane tape over the spot to be drilled.

The tape seems to provide a "bite" for the drill point and at the same time prevents the usual burrs which have to be reamed or filed out. In addition, the tape keeps the drill from slipping and marring an otherwise good-looking panel. —30—



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MOTORS AND SELSYNS

MANUFACTURER	TYPE OR NO.	VOLTAGE	RPM	DIMENSIONS	SPECIAL INFORMATION
Stewart Warner	.....	6VDC	....	2¼"x2¾"	¼"x½" Lg. shaft
John Oster	B-9-2	12VDC 1.4A	5600	2¼"x3¾"	¼"x7/16" Lg. shaft. Shunt Wd.
General Ind.	62800	13VDC 9A	6800	2⅛"x4"	¼"x¾" Lg. shaft. 1/12 HP
Emerson	D-26-BT	24VDC 24A	100	2¼"x5½"	160 Ft.-Oz. torque
Redmond	7-N	24VDC .96A	6000	2¾"x3¼"	Complete blower assembly
F. A. Smith	40H	115VAC 60 Cy	....	6"x5¼"x5"	100 CFM blower ($12.95)
Western Elect.	FL	115VAC 400 Cy	6700	3¼"x4"x4½"	25 CFM blower
Signal Elect.	D-4272	24VDC .66A	2100	2¼"x2⅞"	¼"x1" shaft. 1/190 HP
Stromberg	D-4496	24VDC .45A	....	2½"x3⅛"	¼"x¾" shaft. .003 HP
Amglo	.....	24VDC	....	1½"x2⅛"	Telephone ringing circuit motor
John Oster	A-16B-26R	26VDC	....	1½"x2⅛"	3/16"x5/16" shaft. Series Rev.
John Oster	DEST-8-1R	27VDC 1.4A	3800	2¼"x4⅝"	⅜"x¾" shaft. 1/40 HP
Delco	5069267	27.5VDC .25A	6000	1⅝"x2½"	¼"x1⅛" shaft. 1½ Oz-In Tq.
Western Elect.	KS5996-L04	28VDC	....	2"x2¼"	3/16"x7/16" shaft. Series Rev.
Bendix	MO5B	28VDC 1.75A	3200	1½"x2½"	¼"x1⅛" shaft. Series Rev.
Bendix	E-11500-1	28VDC 1A	9000	1½"x2½"	¼"x1⅛" shaft. Series Rev.
Fractional Mtrs.	SH-280	28VDC 3.1A	3900	3¼"x5½"	¼"x⅝" shaft. Used in ART 13
Electrolux	20100	28VDC .1A	....	2"x2 15/16"	5/32"x⅝" shaft. 20 Deg. rotation
John Oster	A-21-E-12R	28VDC .4A	....	1½"x2⅜"	3/16"x⅜" shaft. Series Rev.
Emerson	D-26-BV	28VDC 3.1A	3900	2½"x3½"	¼"x⅝" shaft. 1/20 HP
Electrolux	16876	28.5VDC 1.8A	2200	3¾"x5"	¼"x1¾" shaft. 1/35 HP
General Elect.	2J1G1	57.5VAC 400 Cy	....	2¼"x3½"	Selsyn transmitter
General Elect.	5BN38HA10	80VDC .25A	3000	2⅞"x3⅛"	¼"x¾" lg. shaft
General Elect.	2J1F1	115VAC 400 Cy	....	2¼"x3"	Selsyn generator
Diehl	11-1	110VAC 60 Cy	....	4"x5¼"	Synchro repeater selsyn
Bendix	.....	110VAC 60 Cy	....	3¼"x6½"	Synchro differential selsyn
Bendix	.....	110VAC 60 Cy	....	3¼"x6½"	Synchro transmitter selsyn

DYNAMOTORS AND POWER UNITS

MANUFACTURER	TYPE OR NO.	INPUT	OUTPUT	DIA.	LGTH.	SPECIAL INFORMATION
Eicor	ML3415-254	27.5VDC 1.5A	250VDC .060A	4"	8⅜"	With bracket mounting
Eicor	ML3412-42	13.8VDC 2.45A	220VDC .070A	3⅜"	5¼"	No mounting
Western Elect.	DM53AZ	14VDC 2.8A	220VDC .080A	2¾"	4½"	With base plate
Westinghouse	1171187A	27VDC 1.4A	285VDC .060A	2⅛"	4½"	No mounting
General Elect.	5DY82AB52	27VDC 1.5A	285VDC .060A	2¾"	4½"	No mounting
Western Elect.	1171091B	27VDC 1.6A	285VDC .075A	2¾"	4½"	No mounting
Redmond	5047	27VDC 1.75A	285VDC .075A	2¾"	4½"	No mounting
Eicor	ML3415-254	27.5VDC 1.5A	100VDC .150A	3½"	5½"	With base plate
Eicor	ML3420-194	27.5VDC 4.0A	325VDC .200A	3⅝"	6½"	With base plate
C.Q.R.	355D2BA	27.9VDC 1.25A	220VDC .070A	3⅜"	5⅜"	No mounting
Continental	DM310A	28VDC .5A	100VDC .01A	2¾"	4½"	No mounting
C.A.Y.	DM32A	28VDC 1.1A	250VDC .060A	2¾"	4½"	With base plate
Pioneer	PE86M	28VDC 1.25A	250VDC .060A	2¾"	4½"	With base and filter
Bendix	DA-1A	28VDC 1.6A	230VDC .100A	3½"	5½"	No mounting
Redmond	DM5 3A	28VDC 1.4A	220VDC .080A	2¾"	4½"	With base plate
Redmond	5056	28VDC 1.4A	250VDC .060A	2¾"	4½"	With base plate
Eicor	ML-3420-90	28VDC 3.3A	400VDC .125 A	3½"	6½"	With base plate
Continental	DM33A	28VDC 5A	575VDC .160A	3½"	7½"	Cont. duty. No mounting
Winco	41S6	13VDC 13A 13VDC	250VDC .060A 300VDC .225A	4"	8⅜"	With base plate Intermittent
Continental	DMX310A	12VDC 2.8A	150VDC .100A	2¾"	4½"	Cont. Duty. No mounting
				DIMENSIONS		
Pioneer	PE 55	12VDC .16A	500VDC 0.2A Cont.	7¼"x12⅛"x13½"		Pwr. Unit W/DM 19G DYN, Filter and Mounting
Westinghouse	PE 94C	28VDC 10.5A	300VDC .260A 150VDC .010A 14.5VDC 10A	8⅛"x6½"x12½"		Pwr. Unit W/DA3A DYN, Filter and Mounting

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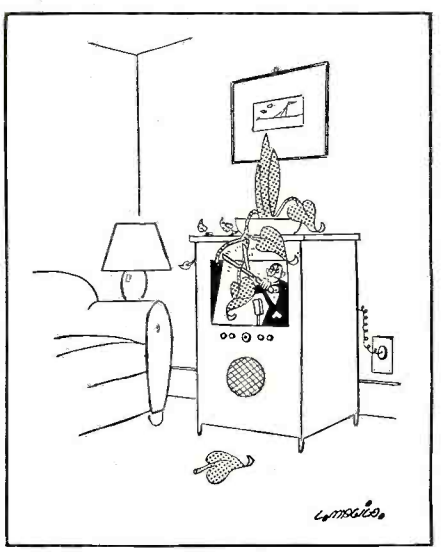
Dual-Channel Receiver

(*Continued from page 67*)

nected firmly to the chassis which is tied to the separate electrical ground at some point. Instability or regeneration often shows up in the form of distorted audio and critical tuning. The previously mentioned procedure of shunting the tuned circuits with resistances of from 50,000 ohms to .5 megohm often tends to reduce these effects, but likewise lowers the gain of the system and makes tuning broader.

It is usually considered that high selectivity means lower noise in reception. There seems to be at least one possible exception to this, however, as far as AM reception is concerned. Noise, consisting of single pulses, will tend to shock excite tuned circuits, producing a damped wave train of a duration depending upon the *"Q"* of the circuit. A rough relationship appears to be that a coil with a *"Q"* of ten will ring for ten cycles before the amplitude level drops to one-tenth of its initial value. As a result, the "hangover" produced by highly selective tuned circuits may cause noise impulses, when detected, to fall well within the audio range, while in the case of low *"Q,"* broadly tuned circuits the resultant noise may fall largely in the ultrasonic range and is therefore not as objectionable even though of considerably greater amplitude than would be the case with a highly selective system. Consequently, the author prefers relatively low *"Q"* input circuits as a means of reducing audible noise in the reception. In the tuner design shown this appeared to work very well, with background noise and hiss being reduced to a low level with the audio gain control fully open.

In conclusion, it seems that a dual channel tuner represents a good solution to the problem of enjoyable reception of amplitude modulated signals. It is simple both in design and construction and requires no elaborate equipment for alignment and adjustment. —30—



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Think of the 1,500 TV stations within the next 5 years and the 2,500 stations within 10 years, as predicted by the Chairman of the FCC. Think of the 13,000,000 TV sets now in use. *Remember that we weren't supposed to reach that figure until 1954.* Think of the 100,000,000 radios in current operation. (95% of the nation's homes have one or more sets.) Think of the tremendous defense orders now being placed for electronic equipment and installations.

Think of the thousands of radio-equipped fire and police departments throughout the U.S. Of the many radio-equipped railroads, of the hundreds of cities with 2-way radio service for cars and cabs. Think of the wide-ranging field of aviation communications—radio-controlled aircraft, navigation-and-traffic control, airport stations.

Think of the maritime world with its navigational aids, fathometers, ship-to-shore and ship-to-ship communications and radar. Think of electronic heating, fax and ultra-fax, of electronic medicine, and all the other applications of electronic know-how.

Countless positions must be filled—in development, research, design, production, testing and inspection, manufacture, broadcasting, telecasting and servicing. Who will get those positions? You—if you prepare today—if you are alert and have the ambition to advance your knowledge. You—if you take 2 minutes to send for a free copy of "Your Future in the New World of Electronics."

This helpful book shows you how CREI Home Study leads the way to greater earnings through the inviting opportunities described above.

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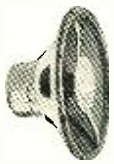
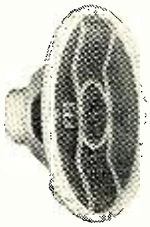


NEW 1952 MODEL 12" COAXIAL P.M.

$12.95

WHY PAY MORE?

McGee offers its new 1952 model 12" coaxial PM speaker. The finest that we have ever offered. Quality you would put in your finest sets if you were a manufacturer. Genuine Alnico V magnet 6.8 oz. in the 12" woofer. The tweeter is coaxially suspended inside the 12" and has a metal diffusor attached. The high pass filter is concealed under the pot cover, leaving only two wires to connect to your radio or audio amplifier. Why, buy an ordinary speaker, when you can have a 12" coaxial PM for only $12.95? Input 8 ohms with 18 watt peak and 10 watts average. Shipping weight 8 lbs. Response from 30 to 17,500 cps. McGee's finest speaker value. Stock No. CU-14Y. Sale price, **$12.95** each.



15" COAXIAL P.M. SPEAKER

$19.95

Only $19.95 buys a full 15" 20 watt coaxial PM speaker, with built-in high pass filter. Hook to any 8 ohm output on radio or amplifier. Response below 20 to above 17,500 CPS. Good bass response. A lucky purchase makes this price possible. Full 32 oz. magnet in the woofer. 5" tweeter. Model P15-9. Ship. wt. 11 lbs. Sale price, **$19.95.**

HALLICRAFTERS S-78
11-TUBE FM-AM CHASSIS

ONLY **$89.50** LESS SPEAKER — WITH 12" COAXIAL SPEAKER **$99.50**

★ **PUSH-PULL WIDE RANGE AUDIO**

Hallicrafters S-78, 11-tube AM-FM radio receiver chassis, with push-pull 6K6 high fidelity audio system. A new model chassis for custom installation. Full range tone control, with bass boost. Input for automatic record changer. Output transformer has 8 ohm and 500 ohm connections. Chassis size, 12¾" x 10" x 7¾" high. Knobs and escutcheon plate are furnished. Receives standard broadcast and FM. 88 to 108 mc. Shipping weight, 25 lbs. Model S-78, priced less speaker at **$89.50** net.

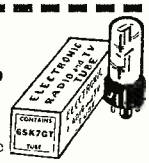
S-78, 11-tube AM-FM chassis with our 12" coaxial PM speaker, both for **$99.50.** S-78 with 15" coaxial PM speaker, both for **$107.95.**

If you want a record changer, see our special listing below. If changer with variable reluctance cartridge is desired, add **$8.95** for a pre-amplifier, as the S-78 is designed for use with a crystal pick-up.

DELUXE CAPEHART CABINET $99.95

Beautiful, top quality, walnut combination radio-phono cabinet. 42" high, 42" wide and 22" deep. Made for Capehart's finest combination. Highly polished matched walnut panels. Cabinet top is 1¼" thick. This cabinet weighs approximately 180 lbs. Both the radio and changer compartments and speaker grill have hinged doors. Radio compartment on the right-hand side is 14" high and 11½" wide. Made to mount chassis vertically. The changer compartment is 14" high and 26½" wide. Large enough to hold any record changer or recorder mechanism. Front 10" of top over the changer compartment is hinged to fold back for easy access to the changer. Both radio and changer compartments come with uncut panels. Speaker baffle is cut for a 12" speaker and the compartment is completely enclosed. Shipping weight, 275 lbs. Stock No. K-275, Capehart combination cabinet. Net price. **$99.95.**

ELECTRONIC RADIO and TV TUBES



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- IN RED AND BLUE DE LUXE VARNISHED CARTONS
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ORDER 50 ASSORTED—TAKE 10% OFF. Prices as Low as 39c

0Z4	$0.59	6AV6	$0.49	65A7GT	$0.59	12BA7	$0.69
1H5GT	.59	6BA6	.59	6SK7	.59	12AX4	.69
1L4	.59	6BA7	.69	6SL7GT	.69	12BE6	.59
1R5	.59	6BC5	.59	6SN7GT	.69	12SA7GT	.59
1U4	.59	6BG6G	1.29	6U8	.79	125K7	.59
1U5	.59	6BH6	.59	6V6GT	.59	125Q7GT	.59
3A4	.69	6BJ6	.59	6W4GT	.59	25BQ6GT	.99
3Q4	.69	6BQ6GT	.99	6X4	.49	25L6GT	.59
5U4G	.49	6C4	.49	6X5GT	.49	35C5	.59
5Y3GT	.39	6CB6	.59	12AT6	.49	35W4	.49
6AB4	.69	6CD6G	1.50	12AT7	.69	35Z5GT	.49
6AK5	.99	6H6GT	.59	12AU7	.69	50B5	.59
6AL5	.49	6K6GT	.49	12AV7	.89	50C5	.59
6AQ5	.59	6L6G	.99	12AX7	.69	50L6GT	.59
6AT6	.49	654	.59	12BA6	.59	117Z3	.49
6AU6	.59						

3-SPEED CHANGERS ON SALE AT McGEE

WEBSTER CHICAGO 3-SPEED Regular $47.50 List Only $24.95

Webster Chicago Model 100-16 3 speed automatic record changer with crystal cartridge and all speed Sapphire needle. (1 needle plays all records). Base size 12x12¾". Shipping weight 14 lbs. This offer good only as long as our stock lasts. A special purchase makes this offer possible. Webster Chicago 3 speed changer, Model 100-16, Sale price **$24.95.**

WEBSTER CHICAGO MODEL 100-2 ONLY $26.95

For the first time we offer the world famous Webster-Chicago, model 100-2. Features a newly designed spindle, that drops the records flat; air-cushioned to the turntable. Pickup arm sets down automatically after the last record plays. Plays all records automatically, 33⅓, 78 and 45 rpm. New balanced tone arm with Electro-Voice Tilt-A-Matic cartridge with dual needles. Ordinarily cost over **$37.00.** McGee offers them for only **$26.95** each. Base size 12"x12¾". Shipping weight 14 lbs.

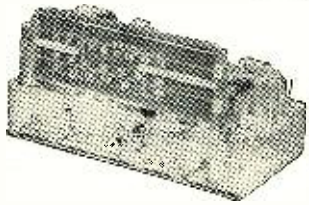
V.M. 3-SPEED MODEL 406 $22.95

VM model 406, deluxe 3 speed automatic record changer. Plays them all. Intermixes records of the same speed. Equipped with a flip over crystal pickup with twin needles. Base size, 12¼x13". Shipping weight 12 lbs. VM-406. Net price **$22.95.**

GENERAL INSTRUMENT 3-SPEED $19.95

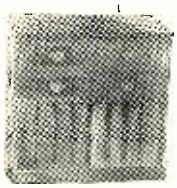
Another tremendous McGee record changer scoop. Only 500 to sell. General Instrument, 3 speed automatic record changer with standard crystal cartridge and all purpose permanent needle. Brand spanking new. Our first offering of a 3 speed changer at less than $20.00. We purchased a large quantity and pass our saving on to you. Stock No. GI-3384. Sale price **$19.95** each. Price to the small manufacturer in lots of 48 or more, **$19.50** each.

New Versatile Espey
12-TUBE FM-AM CHASSIS
$64.50



- ★ BUILT IN PRE-AMPLIFIER FOR G.E. VARIABLE RELUCTANCE PICKUP
- ★ WIDE RANGE AUDIO
- ★ MAY BE USED WITH A CRYSTAL MIKE AS A HOME P.A. SYSTEM

McGee's new 1951 model 12 tube FM/AM chassis. Latest design with phono inputs for all types of record players, crystal or G.E. variable reluctance. Receives standard broadcast 550 to 1700 KC and FM 88 to 108 MC. Wide range audio response (push-pull 7C5) and bass boost tone control. Loop antenna for broadcast and 300 ohm line type antenna, may be stapled in cabinet. Attractive lighted slide rule dial. Chassis size, 13½x8½" high and 9" deep. Shipping weight 20 lbs. **Stock No. 7-CX.** Made to sell at a much higher price. McGee's sale price is **$64.50,** less speaker (output matches 8 ohms). **7-CX** chassis with our 12" coaxial PM, CU-14Y, both **$74.50.** Espey 7-C chassis, 12" coaxial PM speaker and 3 speed VM changer with G.E. variable reluctance cartridge. **$104.95.**



TERRIFIC RADIO-PHONO SALE

12-TUBE ESPEY CHASSIS
2—12" P.M. SPEAKERS
$200.00 VALUE WALNUT CABINET
GE 2-SPEED CHANGER

$179.95

Buy this combination offer and have a fine radio-phono combination for less than the value of the cabinet alone. This beautiful walnut cabinet was intended for a Capehart $800.00 combination and is the finest possible, furniture quality cabinet workmanship. 37" high, 40" wide and 21" front to back. Hinged top lifts in two sections. 25½" lid covers the changer compartment and 14½" covers the radio compartment. Changer mounting panel is furnished blank. Radio panel is shipped ready cut to fit the Espey 7-C chassis. Twin heavy duty 12" PM speakers are furnished. Espey 7-C chassis and a General Electric 33⅓ and 78 rpm, 2 speed automatic changer with two plug-in G.E. variable reluctance cartridges. Stock No. MED-375 cabinet. Espey 7-C chassis, 2 speed G.E. changer and 2 12" speakers. Sale price, **$179.95.**
3 speed VM automatic changer with G.E. variable reluctance turnabout cartridge furnished for $15.00 extra. Shipping weight 200 lbs. Shipped via truck, rail or express only.
Capehart cabinet described above, furnished cut to fit the Espey 7-C chassis, cabinet only **$79.95.**

100 Molded Plastic Bypasses $9.95

100 molded plastic tubular by-pass condensers. All 600 volt. And all by the same nationally known mfgr. Regular dealers' net is over two and one-half times our 20th Anniversary sale price. You'll chuckle when you look these over. Here's what you get: 10—.001, 10—.002, 20—.005, 20—.01, 20—.02, 10—.05 and 10—.1. Our big deal No. RN-202. 100 plastic tubulars. Shipping weight 2 lbs. Net price, **$9.95.**

100 600 VOLT TUBULARS $6.95

100 top quality 600 volt tubular by-pass condensers. Made this year by a famous condenser factory. Don't confuse these with grab-bag surplus. McGee's deals are guaranteed to please you. Here's what you get: 10—.001, 10—.002, 20—.005. 20—.01, 10—.02, 20—.05 and 10—.1 600 volt condensers. Our big deal No. RN-203. Shipping weight 2 lbs. Net price, **$6.95.**

50-W. OUTPUT TRANS. ONLY $7.50 WHY PAY MORE

50-watt super quality high fidelity output transformer. Matches push-pull parallel or push-pull 6L6 tubes to 4/8/16-ohm voice coil, also 60 and 250 ohm line. Very efficient winding construction only 140 ohms, total resistance in primary, and 8-ohm voice coil tap only .2 of an ohm. This output transformer wastes a minimum amount of audio power due to heat loss within the transformer. Very ideal for public address amps. Stock No. 50-JB, net weight 5½ lbs. Bargain price **$7.50** ea., 2 for **$13.95.**

McGee's Super High Fidelity *Best Value in U. S. A.*

OUTPUT TRANS. 20-20,000 CPS. $7.95

Model A-403 High fidelity output transformer. Why pay $20 or $30 for an output, when our A-403 is available at $7.95? Impedance, 6600 ohms plate to plate (for PP 6L6 or 6V6), 10% feedback winding, 4-8-15-250 and 500 ohm secondary. Housed in a potted case. Net weight 6 lbs. Recommended for all amplifiers up to 34 watts.

SPEAKER AND BAFFLE SALE
8" SPEAKER AND BAFFLE $4.95

Stock No. 818, Tan leatherette covered, plywood slant type wall baffle; plus an 8" Oxford, 2.15 oz. Alnico V magnet PM speaker. A red hot McGee special for only **$4.95** each, or **$4.70** each in lots of 3 or more.

10" SPEAKER AND BAFFLE $6.95

Stock No. CA-10, Tan leatherette covered plywood slant type wall baffle; plus 10" Permaflux, 3.16 oz. Alnico V PM speaker. Only a few hundred to sell at **$6.50** each, or **$6.25** each in lots of 3 or more.

12" SPEAKER AND BAFFLE $6.95

Stock No. CA-12, Tan leatherette covered plywood slant type wall baffle; plus a 12" Quam, 4.64 oz. Alnico V magnet PM speaker. (Popular Adjustacone model). A terrific McGee value for only **$6.95** each, or **$6.60** each in lots of 3 or more.

50-WATT BOOSTER AMPLIFIER—$39.95

25-Watt Horn $28.95

50-Watt Booster $39.95

2-Mike Pre-Amp. $10.00 Extra.

50-WATT BOOSTER A sensational value. 50 watt booster amplifier with push-pull parallel 6L6 output tubes. Connect to your present amplifier as a booster or use with the PR-2X Pre-amp to add the use of 2 mikes and one low level input. The booster amplifier has one input jack and with 1 volt input gives 50 watts of audio. Booster has a 6 lb. potted case high fidelity output transformer, matches speaker with 4-8-16 ohm voice coil, also 60 ohm and 250 ohm line. Booster has a 225 mill power supply with 5U4 rectifier. Price includes tubes: 4 6L6, 7N7 and 5U4. The two variable controls are for master volume control and base boost tone control. Size 8 x 6½ x 14½. Stock No. PA-55X. Shipping weight 26 lbs. Sale price **$39.95** ea.

2-MIKE PRE-AMP. Pre-amplifier plugs in directly to the PA-55X Booster amplifier. It enables use of 2, Crystal or Dynamic Mikes plus one low level input. Furnished with 4 foot cables and plugs for remote control of the 55 watt Booster Amplifier. Small chassis size 5 x 3¼ x 4". Stock No. PR-2X, with tubes 7F7 and 7N7. Net price **$10.00** ea.

25-WATT HORN 25-Watt Driver and 3½-foot air column re-entrant Trumpet. The standard type trumpet and driver you see the most. Drivers are 100% weatherproof, horn is spun aluminum, offered to you at a considerable savings. Stock No. MA-33. Shipping weight 20 lbs. Net price **$28.95.**

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

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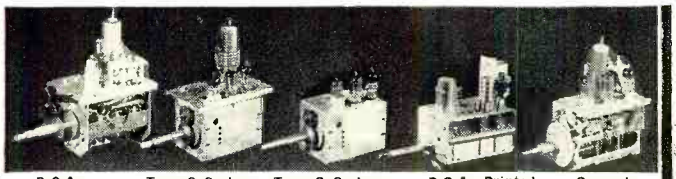
ALWAYS LOOK TO McGEE FOR UNCOMPARABLE V LUES!



R.C.A. $9.95 | Type 3 Sarkes-Tarzian $9.95 | Type 2 Sarkes-Tarzian $7.95 | R.C.A. Printed Circuit $19.95 | General Inst. $2.95

RCA TV FRONT END WITH TUBES $9.95

Terrific buy on this RCA TV tuner. We have a limited quantity of the famous original 201E1, 13 channel completely wired and tested TV front end tuners. Ready to connect to your TV video I.F. strip. Offered at a sacrifice. Price was originally $44.00. Now only $9.95 each, with tubes. You'll save plenty on this item. No. RCA-13P TV front end tuner. Shaft length 3⅜" from base of tuner. Converter coil type for separate sound, as used in the famous 630 chassis. Net price $9.95 each, two for $19.00, complete with 3-6J6 tubes.

SARKES-TARZIAN TYPE 3-TUNER WITH TUBES $9.95

This popular Sarkes-Tarzian TV front end is widely used today. 13 channel rotary type switch with individually tuned coils. Price includes a schematic diagram and 3 tubes; 6C4 osc., 6BJ6 RF and 6AG5 mixer. Regular factory cost is twice our price. Each tuner and its own tube sockets are wired, ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Built in fine frequency control. Shipping weight 3 lbs. Type 3 Sarkes-Tarzian TV tuner with tubes. Net price $9.95. Type 3 tuner and 205-XX video coil kit, both for $16.95.

SARKES-TARZIAN TYPE 2-TUNER WITH TUBES $7.95

Type 2 Sarkes-Tarzian TV tuner, same as Type 3 listed above, except does not have input IF coil built on. Complete with 3 tubes. Net price $7.95. Type 2 tuner and 205-XX video coil kit, both for $14.95.

RCA 12-CHANNEL PRINTED CIRCUIT TV TUNER $19.95

Latest design RCA 12 channel printed circuit TV tuner. Rotary switch with snap-in printed circuit strip principle. This popular tuner used by Hallicrafters in inter-carrier circuit sets. Shaft length 3⅜". Built in fine frequency control. Price includes tubes, 6J6 and 6CB6. A terrific value at $19.95 each.

GENERAL INSTRUMENT TV TUNER, LESS TUBES $2.95

Completely wired, 13 channel selector incorporating fixed inductance and variable capacitance. Converter output transformer is attached. To be coupled direct to separate sound and video IF's, 3 6J6 ttubes are required. Shaft length 2¼". Built in fine frequency control. Original cost over $20.00. Weight 4 lbs. Have been in sets, but guaranteed to be a good value. Stock No. GI-13PX, General Instrument TV tuner, less tubes. Net price $2.95 each.

2-TUBE SARKES-TARZIAN TUNER LESS TUBES $7.95

Sarkes-Tarzian new two tube model, type TT-3A, 12 channel television tuner. This is the new 2 tube model requiring a 6J6 plus 6AK5, or 6AG5, or 6CB6 or 6AU6 RF tube. Pre-aligned by trained factory personnel. Input feeds 21 mc broad band. Fine tuning control is over the channel selector shaft. Power requirements 120 to 140 volts DC at 17 mills, plus 6.3 volts filament. This tuner is offered at a terrific saving to you. Stock No. TT-3A. Net price $7.95, two for $15.00, less tubes. Available with 2⅝", 5½" or 7½" shaft. Specify shaft length desired. 6J6 and 6AU6 tubes for above tuner, both for $2.39 extra.

T.V. FRINGE AREA DEALERS—ATTENTION

FM AND TELEVISION BOOSTER SALE

ANOTHER McGEE SCOOP $10.95

WHY PAY MORE?

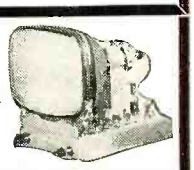
NOT A KIT BUT A FACTORY-BUILT BOOSTER

Sensational value. Continuously variable inductance type tuner, from channel 2, including the FM band, through channel 13. This booster is self powered for 110 volts AC operation. Incorporates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to the TV set. Single knob tuning. Attractive plastic case. McMurdo-Silver Super Sonic TV-FM booster, Stock No. GB-6B. Shipping weight 5 lbs. McGee's terrific sale price, $10.95 each, two for $20.00.

COMPLETE 17" TO 20" T.V. KIT

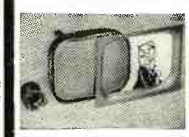
★ AC-TRANS-TYPE ★ CONVENTIONAL CIRCUIT ★ READY WIRED 12 CHANNEL T.V. FRONT END ★ 70° DEFLECTION ★ CERAMIC FLYBACK ★ KIT OF TUBES EXCEPT KINE $16.95 ★ 17BP4A $21.95 EXTRA

$59.95 LESS TUBES



A complete kit of parts to build an AC transformer operated television chassis for use with a 16, 17 or 20 inch rectangular picture tube. The 12 channel Sarkes Tarzian tuner is ready wired. The 4 tube video IF strip is also wired. Circuit is of the conventional accepted design, with latest ceramic type flyback high voltage supply. Chassis is ready punched. Warning: Do not buy this kit unless you understand Television and electronics. It is difficult to wire. We furnish schematic and photos. Kit model WH 20 ship weight 40 lbs., less all tubes $59.95. Kit of 19 tubes but less picture tube $16.95 extra. 17 inch 17BP4A $21.95 extra. 20CP4 inch rect. tube $39.95 extra.

CONVERT YOUR T.V. TO A LARGER PICTURE TUBE

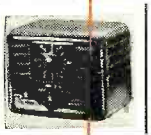


LOOK—16" RECTANGULAR CONVERSION KIT $28.95

With each conversion kit you get a plastic mask, 70 degree deflection yoke, 90 day guaranteed black face picture tube, plus our new 7J1-X 14,000 Volt Universal fly-back and horizontal output transformer that works on any output tube and any single rectifier (1B3 or 1X2). A suggested diagram is furnished for use of the transformer with several different output tubes and rectifiers. We think this is the finest and best priced conversion kit in the country. Shipped Truck or Express, only:

Kit No. TCK-14,	with 14BP4A	14" rectangular tube, Net price	$27.95
Kit No. TCK-16,	with 16RP4A	16" rectangular tube, Net price	28.95
Kit No. TCK-17,	with 17BP4A	17" rectangular tube, Net price	29.95
Kit No. TCK-20,	with 20CP4A	20" rectangular tube, Net price	49.95

REGENCY T.V. BOOSTER $19.10



McGee has the famous Regency DB-410 TV booster. Order yours from McGee. Shipping weight 6 lbs. Sale price, $19.10 each.

Video Coil Kit $7.95

20 matched TV video and sound I.F. coils. Intended for use with the RCA circuit. You get 6 peaking coils, 4—25.75 mc picture I.F.'s, 2—21.25 mc sound I.F.'s, discriminator and converter coil and 5 filament chokes. Stock No. 205-XX, weight 3 lbs. Net price, $7.95. $6.95 if purchased with ANY TV tuner: all coils identified.

SENSATIONAL NEW 2-BAND RADIO KIT ONLY $14.95

10-WATT HIGH FIDELITY AMPLIFIER KIT $14.95

★ MIKE INPUT ★ PHONO INPUT ★ BASE AND TREBLE BOOSTER

A complete kit of parts, including tubes, diagram and instructions, to build a 10 watt high fidelity twin tone control audio amplifier, with bass and treble boost. Inputs for radio tuner, crystal mike and crystal phono pickup. Output transformer matches 4-8-250 ohms. Use with our 12" coaxial PM speaker, or any good PM and have a beautiful sounding, yet low cost amplifier. Response form 50 to 15,000 cps. Chassis is ready punched and a ventilated cover is furnished. A straight forward circuit with twin triode gain stages and 2-50L6 tubes in push-pull. New twin 150 ma. selenium rectifier voltage doubler; television type power supply. Price includes tubes; 12AX7, 12AU7 and 2-50L6, plus rectifiers. A good quality kit with matched parts. Size, 5¼"x10"x5⅝" high, including cover. Stock No. AP-10R, shipping weight 8 lbs. Sale price $14.95 each. 12" coaxial PM speaker, $12.95. extra.

MODEL ME6-2 $14.95

NEW MODEL 6-TUBE, 2-BAND RADIO KIT

A FULL 2-GANG SUPERHET KIT

RECEIVES 550-1600 KC PLUS 6-18 M.C.

McGee's new 1951, 6 tube; AC-DC 2 band radio kit. Receives broadcast, 550 to 1600 kc and short wave, 6 to 18 mc. A straight forward superhet circuit with 2 gang tuning condenser, 456 kc I.F. transformers, etc. 5" speaker illuminated slide rule dial. Everything furnished, including tubes, 12SK7, R.F., 12K8 mixer, 12SK7 I.F., 12SQ7 detector, 1st audio. 35L6 output, 35Z5 rectifier, diagram and a photo showing view of underside of completely wired chassis. The chassis pan and dial parts are factory production. With this kit, you can build a commercial looking and factory quality 2 band radio, housed in a streamlined plastic cabinet. Size: 13 x 6¾ x 6¼". Stock No. ME6-2, shipping weight 10 lbs. Net $14.95.

SELF POWERED AC Broadcast Tuner Kit. 3-Gang Tuning. Complete Kit, $12.95

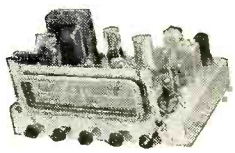
A self-powered, 3-gang superhet tuner kit with R.F. stage. When wired according to our diagram will make a top quality broadcast tuner (550 to 1650 kc), for use with any amplifier. Don't class this with ordinary tuners; this has its own power transformer. This complete kit is furnished with a diagram, photos and tubes. 6AU6 R.F., 6BE6 oscillator R.F., 6AU6 I.F. detector, 6AL5 diode, AVC, plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020, TM-16 or 7X5 amplifier kits. Chassis size, 9½x4x4¼" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price. $12.95.

8-TUBE 22 WATT Wide Range Amp. Model 7x5 Kit Only $37.95

A complete kit, including tubes (3-7E5, 2-7F7, 2-6A3, plus rectifier), diagram and photos. All triode circuit makes for minimum harmonic distortion. Inputs for radio tuner any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output transformer matches 8 ohm voice coil. Twin electronic tone controls, bass and treble with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. The best quality amplifier kit we know how to make. Has a very wide range output and heavy power transformer. Response 18 to 20,000 CPS. 8 tube all triode amplifier kit, complete with tubes. Weight 25 lbs. Net $37.95.

10-TUBE RADIO KIT $29.95

3-GANG TUNING
MIKE INPUT
12 WATT
HI-FI AUDIO
BASS-TREBLE
BOOST



A NEW 1951 ALL-PURPOSE RADIO KIT

10-Tube Broadcast (550 to 1700 kc) Radio Kit for custom builders. Features 3-gang superhet circuit with A.V.C., high gain IF circuit, 8" slide rule dial. Chassis size 12½" long. 10" front to back, 6½" high. Audio inputs for a crystal or dynamic mike, and record changer or player. Tone compensation for standard crystal pick-up or General Electric variable reluctance. Push-pull 6V6 output tubes, shielded high fidelity output transformer matches 8 ohm PM speaker, husky power transformer, 2 tone controls for separate bass and treble boost. A complete kit, including tubes 6SK7 R.F., 6SA7 mixer, 6SK7 I.F., 6H6 detector, AVC, 6SQ7 1st audio, 12AX7 variable reluctance and mike amplifier, 12AX7 phase invertor, 2-6V6 outputs, plus rectifier, diagram and instructions. Shipping weight 18 lbs. Stock No. BK-R10. Net price $29.95. 10" PM speaker, $6.95 extra. Crystal mike and desk stand, $4.95 extra. 12" coaxial speaker $12.95 extra.

5-Tube Broadcast SUPERHET RADIO KIT $12.95

Model RS-5 tube AC-DC superheterodyne radio kit. Has loop antenna and 2 gang condenser, with lighted slide rule dial and attractive plastic cabinet. Receives broadcast. 550 to 1650 kc. Full size dynamic speaker, matched 456 I.F.'s, automatic volume control. This is a complete radio kit. Everything furnished, including diagram, photos and tubes: 12K8 mixer, 12SK7 I.F., 12SQ7 detector, 1st audio, 50L6 output, 35Z5 rectifier. Shipping weight 7 lbs. Stock No. RS-5. Net price $12.95.

Build Your Own Phono-Mike Broadcaster $7.95

Kit Model DE-6R. With this simple kit, you can build a 3-tube phono oscillator that also has a mike input. Will broadcast over any radio, within your home, (about 75 feet) from 1000 to 1500 kc. Inputs for crystal mike or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, baby listener and home entertainment. A complete kit of parts including tubes. Kit Model DE-6R. Net price, $7.95. DE-6RWT, wired and tested. Net price, $9.95. Crystal mike and desk stand, $4.95 extra. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No. T-001. Net $3.95 extra.

McGEE HAS EICO TEST EQUIPMENT KITS

Model 145-K, Multi-Signal tracer.	Net	$19.95
Model 221-K Vacuum Tube Voltmeter	Net	25.95
Model 315-K Signal Generator Kit	Net	39.95
Model 320-K Signal Generator Kit	Net	19.95
Model 425-K 5" Oscilloscope Kit	Net	44.95
Model 625-K Tube Tester Kit.	Net	34.95
Model 360-K Sweep Generator Kit	Net	34.95
Model 950-K Cond. Res. Comp. Bridge Kit	Net	19.95
Model 1040-K Battery Eliminator Kit	Net	25.95

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.

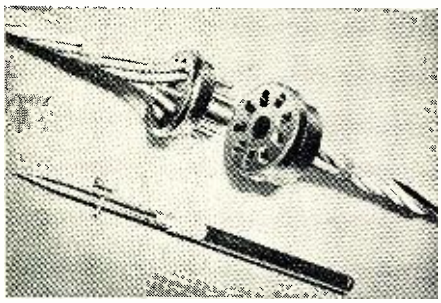
TELEPHONE VICTOR 9045. WRITE FOR FLYER
1422 GRAND AVE., KANSAS CITY, MISSOURI

WHAT'S New in Radio

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page, and the issue number, delay will be avoided.

CABLE CONNECTOR

Alden Products Company, 117 North Main Street, Brockton 64, Massachusetts, has developed a new octal type 9-pin connector for use with TV color



adapters, u.h.f. converters, and other applications requiring a rugged, small connector.

The connector (209FEC) and plug (109C) unit feature leads attached directly to the contact with no projecting solder terminals, 100 per-cent molded insulation around each contact and lead, individual strain relief for each lead, and the wire tip crimped firmly to eliminate the danger of cold solder joints.

PREAMP-EQUALIZERS

Brociner Electronics Laboratory, 1546 Second Avenue, New York 28, New York, is currently marketing two new preamplifier-equalizers, the Models A100 and the A100P.

Correct equalization is provided for all makes of microgroove records as well as for the older 78 rpm discs. Included are the original *Columbia* LP curve and the very different characteristic used by *RCA* for its LP's and 45's. The AES recommended playback curve is obtainable with one of the indicated dial settings.

Both units are supplied with brushed-brass designation plates for front panel mounting and both are

housed in chassis measuring 3" high and 8½" long at the panel and 7½" deep behind the panel.

The Model A100 has an adapter power plug to fit under the beam power output tubes while the A100P has an integral power supply.

A data sheet on these new units is available from the company on request.

COAXIAL SPEAKER

Oxford Electric Corporation, 3911 South Michigan Avenue, Chicago 15, Illinois, has added another speaker to its line—a 12" coaxial unit.

The new speaker, the Model CO12JB, has been designed for quality AM, FM, and TV receivers as well as for monitoring, recording applications, and other sound installations.

Frequency range is 65 to 15,000 cps, the network crossover is at 4000 cycles, power rating is 10 to 12 watts, input impedance -8 ohms, while the woofer magnet measures 12" and weighs 6.3 ounces and the tweeter magnet is 3" and weighs 1.47 ounces.

WIDE-RANGE SPEAKER

University Loudspeakers, Inc., has added a new 12" wide-range, wide-dispersion cone speaker to its line.

The "Diffusicone-12" features a dual

concentric apex horn which both extends the high frequency response to over 13,000 cps and disperses these normally beam-like frequencies uniformly throughout the listening area. The "diffusor" element used provides dual horn loading of the speaker apex, substantially increasing high frequency efficiency, and combines both radial projection and aperture diffusion of the high frequencies to assure reception of the speaker's complete range of reproduction.

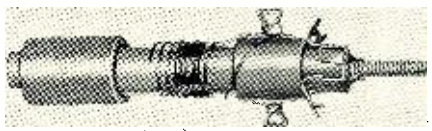
Of special interest to the service technician and custom installer is the company's exclusive "bi-sectional" construction of this unit which enables replacement of either the entire basket/diaphragm assembly or the magnet mechanism in the field without special tools.

A specially prepared catalogue sheet, together with complete cabinet prints, is available by writing direct to the company at 80 S. Kensico Avenue, White Plains, N. Y.

NEW "LOOPSTICK"

Grayburne Corporation of 103 Lafayette Street, New York 13, New York has come out with a companion unit to its "Ferri-Loopstick"—the "Vari-Loopstick."

The new unit retains all of the features of the "Ferri-Loopstick" but has,



in addition, micrometer adjustment. This new feature has been incorporated for the benefit of technicians and hobbyists who are "station jumpers" and "DX hounds" and for those who want to peak-resonate for a series of stations at will.

Both the new and the older unit can be used to replace older type loop antennas in any broadcast receiver.

FOLDED HORN BLUEPRINTS

Jensen Manufacturing Company, 6601 S. Laramie Avenue, Chicago 37, Illinois, is offering without charge blueprints and instructions for building the new backloading folded horn which was recently demonstrated in conjunction with the company's G-610 "triaxial" speaker at the Audio Fair in New York.

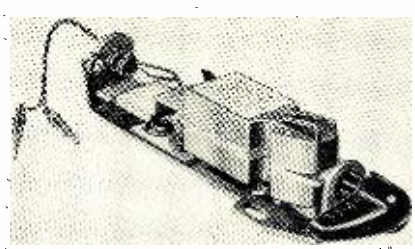
This 30 cubic foot enclosure, developed by D. J. Plach and P. B. Williams, is of particular interest to professional sound men and high fidelity enthusiasts because of its moderate cost.

Compactly arranged in a cabinet 5 x 3 x 2 feet, the new horn design reduces the loudspeaker resonant frequency by almost one octave, increases efficiency 4 to 6 db over the entire piston range, improves transient performance, and allows doubling the loudspeaker power rating for a given amount of distortion.

For details on how to secure the building plans for the cabinet write the company direct.

PICKUP CARTRIDGES

The Astatic Corporation of Conneaut, Ohio, has developed a new turnover pickup cartridge which is said to



provide performance quality equal to that obtainable from single-needle units.

The cartridge uses two complete

(*Continued on page* 120)

EDW. H. GUILFORD
Vice President

I can train you to pass your FCC License Exams in a minimum of time if you've had any practical radio experience—amateur, Army, Navy, radio servicing, or other. My time-proved plan can help put you, too, on the road to success.

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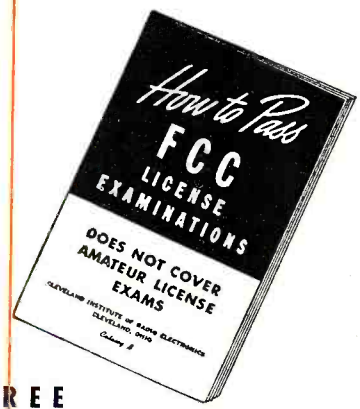
Just fill out the coupon and mail it. I will send you, free of charge, a copy of "How to Pass FCC License Exams," plus a sample FCC-type Exam, and the amazing new booklet, "Money-Making FCC License Information."

How to Pass FCC License Exams

Commercial Radio Operator

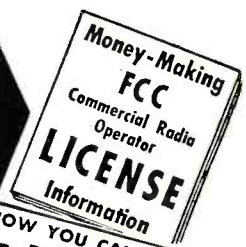


FREE

Tells where to apply and take FCC examinations, location of examining offices, scope of knowledge required, approved way to prepare for FCC examinations, positive method of checking your knowledge before taking the examination.

Get Your FCC Ticket in a Minimum of Time

Get this Amazing Booklet FREE



TELLS HOW YOU CAN GET A FREE TELEVISION ENGINEERING COURSE

TELLS HOW—

WE GUARANTEE

TO TRAIN AND COACH YOU AT HOME IN SPARE TIME UNTIL YOU GET

YOUR FCC LICENSE

If you have had any practical experience—Amateur, Army, Navy, radio repair, or experimenting

TELLS HOW—

Employers make JOB OFFERS Like These to Our Graduates Every Month

Letter, October 11, 1951, from Chief Engineer, Broadcast Station, North Carolina, "Need men with radiotelephone 1st class licenses, no experience necessary. Will learn more than at average station for we are equipped with Diesel Electric power, transmitting and studio equipment."

Telegram, October 2, 1951, from Chief Engineer, Broadcast Station, Wyoming. "Please send latest list available first class operators. Have November 10th opening for two combo men."

These are just a few examples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs . . . it might have been you!

HERE'S PROOF FCC LICENSES ARE OFTEN SECURED IN A FEW HOURS OF STUDY WITH OUR COACHING AT HOME IN SPARE TIME

Name and Address	License	Lessons
Lee Worthy 2210½ Wilshire St., Bakersfield, Cal.	2nd Phone	16
Clifford E. Vogt Box 1016, Dania, Fla.	1st Phone	20
Francis X. Foerch 38 Beucler Pl., Bergenfield, N. J.	1st Phone	38
S/Sgt. Ben H. Davis 317 North Roosevelt, Lebanon, Ill.	1st Phone	28
Albert Schoell 110 West 11th St., Escondido, Cal.	2nd Phone	23

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-39—4900 Euclid Bldg., Cleveland 3, Ohio

TELLS HOW—

Our Amazingly Effective JOB-FINDING SERVICE Helps CIRE Students Get Better Jobs

Here are a few recent examples of Job-Finding results

GETS FIVE JOB-OFFERS FROM BROADCAST STATIONS
"Your 'Chief Engineer's Bulletin' is a grand way of obtaining employment for your graduates who have obtained their 1st class license. Since my name has been on the list I have received calls or letters from five stations in the southern states, and am now employed as Transmitting Engineer at WMMT."
Elmer Powell, Box 274, Sparta, Tenn.

GETS CIVIL SERVICE JOB
"I have obtained a position at Wright-Patterson Air Force Base, Dayton, Ohio, as Junior Electronic Equipment Repairman. The Employment Application you prepared for me had a lot to do with my landing this desirable position."
Charles E. Loomis, 4516 Genessee Ave., Dayton 6, Ohio.

OURS IS THE ONLY HOME STUDY COURSE WHICH SUPPLIES FCC-TYPE EXAMINATIONS WITH ALL LESSONS AND FINAL TESTS.

GETS JOB WITH CAA
"I have had half a dozen or so offers since I mailed some fifty of the two hundred employment applications your school forwarded me. I accepted a position with the Civil Aeronautics Administration as Maintenance Technician. Thank you very much for the fine cooperation and help your organization has given me in finding a job in the radio field."
Dale E. Young, 122 Robbins St., Owosso, Mich.

Your FCC Ticket is recognized in all radio fields as proof of your technical ability.

Get All 3 FREE

MAIL COUPON NOW

CLEVELAND INSTITUTE OF RADIO ELECTRONICS
Desk RN-39, 4900 Euclid Bldg., Cleveland 3, Ohio
(Address to Desk No. to avoid delay)

I want to know how I can get my FCC ticket in a minimum of time. Send me your FREE booklet, "How to Pass FCC License Examinations" (does not cover exams for Amateur License), as well as a sample FCC-type exam and the amazing new booklet, "Money-Making FCC License Information."
☐ Tell me how I can get your Free Television Course.

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ADDRESS .....
CITY ..... ZONE ..... STATE .....

Paste on penny post card or send air mail

Spot Radio News

(*Continued from page* 18)

Electronics Production Board, and Lieutenant Colonel Carl B. Lindstrand of the Electronics Production Resources Agency, in the Department of Defense, during a visit to the facilities of twelve companies in Western Germany and Milan, Italy.

The purpose of the trip, it was revealed, was to survey possible sources for electronic parts in Europe to determine the availability of certain items, considered to be critically short here. The investigation indicated that generally .05 to 3 watt resistors were in common production, while some companies produced sizes up to 50 watt capacity. Production in this country has been limited to .5-2 watt types. It was pointed out that the small-size resistors, between .05 and .25 watt, could be considered by the military for their gear. Facilities for precision wirewound resistors were also located, although the outputs were small. Fine enameled-resistance wire, as small as .0012 inch, was also found to be available. Two plants were found to be capable of producing selenium rectifiers, using selenium imported from Sweden. One manufacturer said that he was making a rod-type rectifier with ratings from 20 volts at 5 milliamperes to 5000 volts at 3 milliamperes. Also being processed are the conventional disc-type assemblies.

Reviewing the facilities and equipment employed at these foreign sources, a detailed report indicated that one organization was producing deposited carbon resisitors using automatic spiraling machines featuring a magazine feed and having a spiraling capacity of from 600 to 3500 resistors an hour, depending on the values. In addition, lead wires could be automatically attached by a machine having a capacity of 2000 resistors an hour.

The trip to the plant of the selenium disc manufacturer revealed that the company is currently producing 100,000 square inches of processed selenium rectifier plates a day. Because of the scarcity of selenium it is expected that this rate will be reduced by fifty per-cent. However, it was said, production could be increased to 160,000 square inches within six months, if material became available. When the report was prepared, late last year, it was noted that up to 50,000 discs (125 ma. or equivalent) could be delivered in approximately six to eight weeks. The cells produced in this plant were described as being of the nickel-plate iron plate type, with a layer of selenium. For passing current, an opposite electrode, composed of a special alloy, was said to be provided. This method of making contact was cited by the manufacturer as being superior to the pressure technique, assuring reliable contacts. The rectifiers were said to be usable in all of the popular applications such as for the charging and floating of batteries, d.c. supply in a.c.-d.c. chassis, excitation of electromagnets, etc.

The rod-type rectifiers were noted as being unique in their structure, an entirely new design making it possible to reduce the length of the element in tube form to less than that of any rod unit made. It was said that a peak inverse voltage of 930/cm., or 2350 volts-per-inch, had been attained. The construction of the elements in tubes made of an insulating material was cited as insurance against discharge and flashover at very high voltages. The rectifiers were said to be usable as a d.c. supply for condenser testing; d.c. supply for TV units; and d.c. supply for all types of high-voltage testing gear.

The complete report, including all this extremely valuable data, is available for inspection in either room 2314, Temporary *T* building, 14th and Constitution, N.W., or room 4H4, GAO Building, 443 G Street, N.W., Washington, D. C.

TWO NEW SHIP-TO-SHORE channels may become the official frequencies of the maritime radiotelephone service, if the proposals offered by the Commission are accepted by rail and ship operators: 162 megacycles (coast) paired with 157.3 megacycles (ship) and 161.9 megacycles (coast) paired with 157.4 megacycles (ship.).

It is hoped that these standardized frequencies will be adopted since it is felt that they will serve to simplify not only the operational problems confronting those in the Great Lakes area, but the equipment used on the lakes and connecting waterways.

The Commission has also suggested that the 157.1 megacycle channel be assigned to the government, so that ship-to-shore operators might have two adjacent channels: 157.3 (which now is a government channel) and 157.4. In the event the maritime mobile service finds in the future that it can utilize 50 kilocycle channel separation, in lieu of the present 100 kilocycle separation, the way is left open whereby an additional *public correspondence* pair or two additional *operational* frequencies can be utilized.

THE GEOGRAPHICAL, GEOLOGICAL and geophysical radiolocation services, which during the past five years have soared in importance, particularly in the southwest, have won a new band: 1750 to 1800 kilocycles.

Analyzing the reasons for the assignment of the new frequency, the Commission said that experience has indicated that, except for petroleum exploration operations in the Continental Shelf area, line-of-sight ranging would not fall short. The maximum dependable surveying range of an ultra-high frequency system limits the direct operational range of the practical exploration system to an off-shore distance on the order of 15 to 25 miles. On the other hand, there appear to be areas in the Shelf area considered commercially exploitable for oil at dis-

BUY TEST EQUIPMENT
ON THIS RADICALLY NEW
TIME PAYMENT PLAN

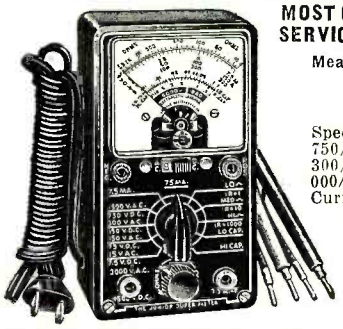
NO INTEREST!! - NO CARRYING CHARGES!!

USE CONVENIENT TIME PAYMENT ORDER BLANK BELOW

Superior's New

UNIOR SUPER-METER

MOST COMPLETE AND COMPACT MULTI-SERVICE INSTRUMENT EVER DESIGNED



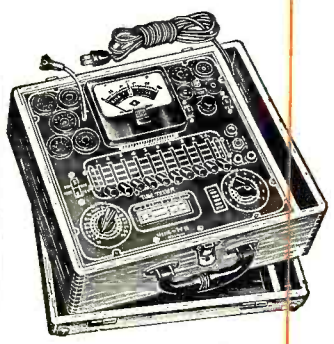
Measures: * Voltage, * Capacity, * Current, * Reactance, * Decibels, * Resistance, * Inductance

Specifications: D.C. Volts: 0-7.5/75/150/750/1500 Volts. A.C. Volts: 0.15/150/300/1500/3000 Volts. Resistance: 0-10,000/100,000 ohms. 0-10 Megohms. D.C. Current: 0-7.5/75 Ma. 0-7.5 amps. Capacity: .001 Mfd.—.2 Mfd. .1 Mfd.—20 Mfd. Electrolytic Leakage: Reads quality of electrolytics at 150 Volt test potential. Decibels: —10 Db to +18 Db. + 10 Db. to + 38 Db. + 38 Db. to + 58 Db. Reactance: 15 ohms—25 K ohms 15 K ohms—2.5 Megohms. Inductance: .5 Henry—50 Henries 30 Henries—10 K Henries. Plus Good-Bad scale for checking the quality of electrolytic condensers.

Handsome round cornered molded bakelite case 3⅛" x 5⅞" x 2¼" complete with all test leads and instructions ..... **$21.40** NET

Superior's New Model TV-11

TUBE TESTER



• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. • Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover ..... **$47.50** NET

Superior's New Model CA-12

SIGNAL TRACER

The well known Model CA-12 is the only signal tracer in the low price range including both meter and speaker!!!

SPECIFICATIONS: • Comparative Intensity of the signal is read directly on the meter—quality of the signal is heard in the speaker. • Simple to Operate—only one connecting cable—no tuning controls. • Highly Sensitive—uses an improved vacuum-tube voltmeter circuit. • Tube and Resistor Capacity Network are built into the detector probe. • Built-In High Gain Amplifier—Alnico V Speaker.

Completely Portable—weighs 8 pounds—measures 5½" x 6½" x 9".

Model CA-12 comes complete with all leads and operating instructions ..... **$33.95** NET

Superior's New

TV BAR GENERATOR

Throws an Actual Bar Pattern on Any TV Receiver Screen!!

Two Simple Steps:

1. Connect Bar Generator to Antenna Post of any TV Receiver.
2. Plug Line Cord into A.C. Outlet and Throw Switch.

RESULT: A stable never-shifting vertical or horizontal pattern projected on the screen of the TV receiver under test.

Power Supply: 105-125 Volt 60 Cycles. Power Consumption: 20 Watts. Channels: 2-5 on panel, 7-13 by harmonics. Horizontal lines: 4 to 12 (Variable). Vertical lines: 12 (Fixed). Vertical sweep output: 60 cycles. Horizontal sweep output: 15,750 Cycles.

TV Bar Generator comes complete with shielded leads and detailed operating instructions. Only .... $39.95 NET

Superior's New Model 660—AN AC OPERATED

SIGNAL GENERATOR

Provides Complete Coverage for A.M.-F.M. and TV Alignment

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 240 Megacycles on powerful harmonics. • Accuracy and stability assured by use of permeability trimmed Hi-Q coils. • R.F. available or modulated by the internal audio oscillator. • Built in 400 Cycle sine wave audio oscillator used to modulate the R.F. signal also available separately for audio testing of receivers, amplifiers, etc. • Oscillator Circuit: Uses a miniature high frequency type of acorn triode in a Hartley circuit to insure a high degree of stability. By using the same type of triode as a buffer amplifier, complete and positive isolation between the R.F. oscillator and the attenuator is attained. • Attenuator: a 3 step ladder type of attenuator is used. Each step of the attenuator is controlled by a separate attenuator control thus providing intermediate level steps. • Tubes used: 955, as R.F. Oscillator, 955 as Modulated Buffer Amplifier,

6SN7 as Audio Oscillator and Power Rectifier.

The Model 660 comes complete with coaxial cable test lead and instructions ..... **$42.95** NET

NEW TIME PAYMENT PLAN
ORDER BLANK

MOSS ELECTRONIC DISTRIBUTING CO., INC. B-19
Dept. B-19, 38 Murray Street, New York 7, N. Y.

Please send me the units checked below. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

☐ JUNIOR SUPER METER ..... Total Price $21.40
$5.40 down payment. Balance $4.00 monthly for 4 months.

☐ MODEL TV-11 ..... Total Price $47.50
$11.50 down payment. Balance $6.00 monthly for 6 months.

☐ MODEL CA-12 ..... Total Price $33.95
$9.95 down payment. Balance $4.00 monthly for 6 months.

☐ TELEVISION BAR GENERATOR ..... Total Price $39.95
$9.95 down payment. Balance $5.00 monthly for 6 months.

☐ MODEL 660 ..... Total Price $42.95
$12.95 down payment. Balance $5.00 monthly for 6 months.

☐ I enclose $..... as down payment.

☐ Ship C.O.D. for the down payment.

Signature .....

Name .....

Address .....

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

tances of 40 to 70 miles from the Gulf of Mexico coastline. The use of the customary survey procedures to carry the survey stepwise in the water to offshore distances much greater than 15 to 25 miles appears to be neither reliable nor economically practical. Accordingly, the Commission felt that there was a definite need for a radiolocation service which is not subject to the line-of-sight limitations of the frequencies on the higher bands, as an aid in the development of the oil resources lying beneath the waters of the Gulf of Mexico.

A normal maximum bandwidth was also prescribed in the new ruling: 3 kilocycles. No definite prohibition was imposed against exceeding this bandwidth because it appears as if the question of *lane identification* or means of obtaining spot positioning has not as yet been satisfactorily resolved. During the hearings there were described phase-comparison methods which permit the use of low or medium frequencies and the elimination of the line-of-sight limitation as a radiolocation technique. However, *with this method,* within the limits of the space available, it has not been possible to develop an adequate system of *lane* identification, and thus mobile craft must enter the hyperbolic grid system at a known point, and thereafter maintain continuous operation throughout the duration of the survey. This lack of an adequate method of spot positioning has been found to be one of the chief stumbling blocks to the development of an all-purpose radiolocation system. Present methods involve the use of either additional 3 kilocycle channels or the use of a wider bandwidth. Accordingly, the Commission noted that a bandwidth greater than 3 kilocycles will normally not be authorized, except where additional space is needed for *lane identification* purposes.

Since there does not appear to be any single radiolocation system which has been found to be satisfactory in all respects, all stations licensed under the new regulations will be on a developmental basis only.

DURING WORLD WAR II, radio proved itself to be a dynamic aid in psychological warfare. Since then, broadcasting has played a roaring role in this direction in a multi-million dollar campaign, here and overseas, through the facilities of the Voice of America and stations in occupied zones in Europe.

To provide flexibility to the program and permit the transmission of psychological warfare messages into enemy territory, there has been produced a complete mobile broadcast system which can be carried by truck and trailer on land, by cargo planes aloft, and by ships at sea. Housed in a pair of 26-foot trailers and three eleven-foot shelters designed by the Army Signal Corps Engineering Labs at Fort Monmouth and the Department of the Army, the station is as complete as a modern fixed station. The broadcast

studio and control room are soundproof and air conditioned. Equipment includes the latest control consoles, magnetic tape recorder-reproducer units, turntables, and remote pickup units for on-the-spot broadcasts away from the studio. The range of the station is said to be several hundred miles.

By the time this column appears in print, it is expected that the station will have been placed in operation by psychological warfare teams overseas.

WHEN THE PRESIDENT enters the remodeled White House, he will find that he will be able to tune in his favorite radio stations with a telephone-dial system. Sound will emanate from ceiling or wall units.

The President will also be able to listen to network programs not being broadcast locally, for they will be available through a telephone line system, directly tied into the facilities of the four network stations represented in Washington.

FM BROADCASTING has finally found itself approved by the BBC in Great Britain. After almost five years of exhaustive tests and surveys, it has been decided to set up a chain of FM stations operating in the 88 to 100 megacycle band. The final decision to accept this medium was due to a lack of standard broadcast bands, poor quality due to fading, increasing interference from foreign stations, and particularly the striking quality results achieved in difficult receiving areas. A report on these results, which appeared in the *"BBC Quarterly,"* indicated that the sound quality was much better and there was generally less background noise, facts with which many hi-fi conscious listeners over here are quite familiar.

The introduction of the very-high frequencies and FM in England, featuring specially prepared BBC programs, will undoubtedly create a new family of high-fidelity enthusiasts whose reactions will probably be watched closely by the rabid wide-range fans over here. . . . L.W.

LEAD-IN CLEARANCE

FROM Guy F. Butts, 320 Lakewood Drive, Asheville, North Carolina comes a worthwhile service suggestion which we would like to pass on to technicians.

Mr. Butts warns that often lead-in clearance at the mast, near metal tension screens, metal casement windows, metal foundation ventilator grilles, basement pipes, and heating air ducts is inadequate and is responsible for a lot of service headaches.

He cites two recent cases of "snow" that were traced to a foundation grille and a metal casement window. Vibration had cut through the insulation in the first case and closing pressure had destroyed the insulation in the second case. He suggests that what was true in these two cases could also apply to tension window screens or ordinary screen wire used on enclosed porches if the lead-in comes in contact with those surfaces. —30—

RADIO-TV Service Industry News

AS REPORTED BY THE

TELEVISION TECHNICIANS LECTURE BUREAU

WHEN major changes occur in a basic business activity they seldom happen with dramatic speed. This is especially true when the affected business is a supplementary part or function of a development of first magnitude such as occurred with the widespread public acceptance of the automobile, electric refrigerator, the self-service cash-and-carry grocery store, and recently, of course, television. Each of these developments gradually brought about tremendous changes in our pattern of living and in so doing they created a myriad of new types of businesses with their inherent opportunities. At the same time they smothered the businesses that had been serving the outmoded method that the new development had displaced.

The transition of a business activity to meet the peculiar needs of the market for newly created products occurs subtly and comparatively slowly. When something radically new is created it first seeks its markets through existing business channels. From this it gradually expands to create its own economic pattern and in so doing remains profitable only to those business enterprises which are able to adjust their methods of operation to meet its individual needs. In the early days of the automobile, gasoline was handled by drug stores and automobiles were repaired by blacksmiths.

The statistics that eventually give us the true picture of what has been a major business transition usually lag so far behind the development that when they are published we learn what has *happened* instead of what is *happening*.

However, spot surveys that are being made at regular intervals by competent market analysts will often disclose a definite trend which, to the alert businessman, can be of invaluable assistance in helping him to project long-range plans.

As an example of how statistics definitely indicate a trend, back in 1948 the "Service Trades" bulletin included in the U. S. Census of Business for that year, in referring to "radio repair shops," showed that in 1939 there were 10,732 shops operated by 11,000 active proprietors with 2842 employees. In 1948 there were 12,588 shops operated by 12,955 active proprietors with 10,262 employees. Gross receipts per shop increased from $21,687 in 1939 to $100,679 in 1948. Payrolls increased from $2004 per shop in 1939 to $20,791 per shop in 1948.

From these figures it is evident that while the number of shops increased only a scant 20%, the number of paid employees increased nearly five times or at about the same rate as gross income. The number of proprietors increased at a slower rate than the number of shops. These figures bring the situation up only to 1948, however, when the greatest swing in the transition of the service business had not yet come about.

Since then it has become increasingly evident that the television service business has not only shown a definite pattern of growth but that it is also following, to a recognizable degree, the pattern of other large service industries.

The new stature of television service as a business was succinctly described by Louis J. Smith, a prominent television service contractor in Philadelphia, Pa., during a recent interview on the "People's Forum" program aired by radio station KYW of Philadelphia. In reply to questions about the Television Contractors Association (TCA) and its function in the radio and television service business, Mr. Smith said:

"TCA is a group of television and radio service contractors who, in this complex electronics age, are most intelligently geared to provide the best and the maximum in service to the consumer. They have office staffs to handle customer requests and to dispatch service calls. They have complete libraries of all diagrams necessary to guide the competent technician in doing a good job. They have vehicles specially fitted to provide speedy transportation for the technician, his equipment, and spare parts so that the consumer is most efficiently served. They have completely fitted service shops that have all of the test equipment that is needed, together with a well-stocked parts department which contains the most needed parts.

"With the advent of television, an

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All Brand New

Machine aluminum housing and case. Bakelite end cap with coded screw terminals. ¼" shaft.

C-78249 Cal. 11280 Synchro Differential 100 V. 60 Cycle. Price. **$3.75**
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The below listed type is similar to above, but contained in a solid machined bronze housing. 5 leads 5 ft. long, of color coded fiber glass insulation are provided.

C-56776-1 Ca-4460A-4 Repeater type 11-5 110 V. 50 Cycle. Price..... **$7.50**

National NC SW-54

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Sleek, Low-Priced, Beauty in a Compact General Coverage Receiver.

11" x 7" x 7"

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IF YOU are involved in the present rapidly expanding range of electrical and mechanical control and communication products, we have something that may be extremely interesting to you. Wheeler Voice Powered Telephone Systems represent a considerable background of pioneer research and development. Today, this product, technically and commercially mature, has broad uses in both military and civilian fields. But over and beyond these standardized designs and applications they make many special high level handset units and signaling components for "built-in" applications. Further information on request.

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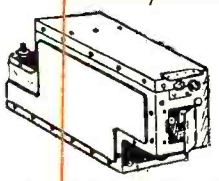
ARC-5/R-28 RECEIVER

100—156 Mcs.

New or Used



Here is the aircraft superhet you have been looking for. Absolutely one of the best available today. Tunes from 100 to 156 mcs. in four crystal channels. Accurately calibrated dial on front panel. Contains the following tubes: 717a—R.F., 717a—Mixer, 2—12SH7—1st and 2nd I.F. (16.9 mc.), 12SL7—Det., AVC, Squelch. 12SL7—1st audio, and squelch amplifier, 12A6—2nd audio, 12SH7—R.F. Osc. and 4th harmonic gen., 717a—trip. 12th Harmonic gen., 717a—Dblr. 24th Harmonic gen. (all tubes are included.)
New, in sealed cartons..... **$24.95**
Used, excellent condition..... **$20.95**

T23/ARC-5 TRANSMITTER

FAMOUS AIRCRAFT TRANSMITTER. COMPANION TO ABOVE RECEIVER.

A desirable VHF transmitter with turret switching coils for all stages. Uses the following tubes: 1625 Osc., 1625 Tripler, 832 Tripler. 832 Final amplifier. Range: 100 to 156 Mcs. Four crystal channels are provided.
Brand new with all tubes, less crystals **$39.95**

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TOPS ON ANY WORK BENCH!

Versatility plus! 15 different ranges. Resistance ranges from .2 ohms to 1000 megohms in 5 steps! Exceptionally accurate. Big 4½" fused meter. Dozens of features too numerous to mention. Sum it up in one word.

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EICO VTVM Kit No. 221K **$25.95**
EICO VTVM, wired and tested..... **49.95**

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HEART OF THE BC-221 FREQ. METER

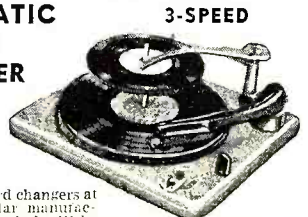
This VFO Sub-Assembly, used in BC-221 Freq. Meter, is ideally suited for home construction of: 1—Amateur V.F.O. 2—Freq. Mtr. Foundation. 3—Portable Transmitter. 4—Replacement for BC-221. Unit contains two temperature and moisture compensating coils, wafer switch, 3 variable condensers, carbon resistors and silver mica condensers. FULLY WIRED and mounted on sturdy aluminum sub-chassis, ready for installation. Brand new—in original packing.
New Low Price..... **$4.95**

WEBSTER CHICAGO AUTOMATIC RECORD CHANGER

3-SPEED

SERIES 100-75

WITH FLIP-OVER CARTRIDGE



Fine, new record changers at less than regular manufacturer's cost. Made by Webster-Chicago and only introduced on the market a few months ago as one of their latest models. Plays 12, 10 or 7 inch records at 33⅓, 45, or 78 R.P.M. New spindle carefully lowers unplayed record stack. Balanced arm assures light needle pressure and long wear. Needle-tip (included) for standard or micro-groove records. Inside-out records played without any adjustment. Pickup arm comes to rest position after last record has played. Complete factory packed and sealed record changers, normally listing at $47.50 — While they last. Shipping Wgt. 15 lbs..... **$24.85**

ONE OF AMERICA'S GREAT RADIO STORES

Niagara RADIO SUPPLY CORP. R-3-2

160 Greenwich Street, New York 6, N. Y.

Digby 9-1132-3-4

instrument that has six to ten times the parts of an average radio, combining audio and video (voice and sound), we found that many more facilities, test instruments, and non-technical people (such as clerks, dispatchers, cost accountants, supervisors, etc.,) were needed to conduct an efficient, consistently reliable service business. The radio technician who, in addition to his technical qualifications, possessed the business qualifications needed to operate such a business soon developed into what is known as a 'service contractor.' This new businessman-technician soon found that the major part of his activity was concerned with the details of business management of the operations. He hired a service manager to take care of technical problems.

"With business problems his foremost interest the service contractor, like businessmen in other fields, observed the need for a trade association which would enable him to exchange information and knowledge with his competitors on common problems for their mutual good and for better service to the consumer. The natural culmination of this thought was the organization of the Television Contractors Association."

The business aspects of television servicing are clearly reflected in the following statement about television servicing business possibilities in 1952 which was made recently by a prominent TV market research specialist:

"There will be plenty of business for the TV serviceman in 1952. The rapid growth of television markets will make his business more active but it will also create tremendous problems. He will face new financing problems, will probably have to expand the space his business occupies. He will find that expanding operations will mean he will have to hire more help, find and train salesmen. He will also be faced with problems of supervising expanded operations and will have to assume the moral obligation that goes with assisting in the training of repairmen in problems pertaining to technical knowledge, business knowledge, and business ethics."

Turning again to statistics to get a clear picture of the reasons for this vast transition in the service business, the following figures from the 1951 edition of "National Income" published by the Bureau of Foreign and Domestic Commerce, Office of Business Economics, U. S. Department of Commerce depict the tremendous increase in dollar volume of business that has occurred in the radio-television servicing industry during the past ten years:

(These represent over-all expenditures in millions of dollars.)

1941	$ 36
1942	46
1943	59
1944	70
1945	84
1946	114
1947	135
1948	172
1949	206
1950	272

These figures indicate that during

the past ten years the dollar volume of business flowing into radio-television service shops increased more than seven and one-half times. They also show that the increase has been getting greater each year and especially so since 1948. This fact alone is quite interesting in view of the station construction freeze which prevented the opening of new television receiver markets during the same period.

On the basis of these statistics it is obvious, too, that the opening of new telecasting areas after the station construction freeze has been lifted, will greatly accelerate the increase in the dollar volume of service business in the years immediately ahead.

The conclusion to be drawn from these figures is simply that present television service businesses must prepare to expand their facilities and personnel to handle a growing volume of business or new radio-television service businesses will come into being to handle the growth.

New TV Areas

The green light on the construction of u.h.f. telecasting stations will immediately create a potential of more than one thousand new cities and towns that will be primary signal areas. At the present time a large percentage of these areas are fringe, far fringe, or completely out of the signal areas of present telecasting stations. They will be, in effect, brand new television markets and provide very fertile ground for new television service businesses.

Television at the ultra highs will present many new problems to the service forces of the industry that they have not had to contend with in the present v.h.f. ranges. It is quite probable that every u.h.f.-v.h.f. television receiver sold in a primary u.h.f. signal area will include an outdoor antenna installation, a rotator, and perhaps a booster. The reason for this is that the majority of cities and towns where new u.h.f. television stations are constructed will also be in the fringe areas of other u.h.f. as well as v.h.f. stations. Customers who purchase receivers with facilities for tuning in twelve stations will want to get the maximum number of stations possible in the area in which they live. Alert set retailers and servicing contractors in those areas will quickly learn to take the same advantage of this potential market for supplementary sales as the service contractors have done in the fringe and far-fringe areas of present telecasting stations.

Radio service operators whose businesses are located in cities where the first local telecasting station will operate on a u.h.f. channel can probably anticipate installation requirements in their localities by studying the v.h.f. and u.h.f. channel allocations for nearby cities.

The Television Technicians Lecture Bureau has prepared a lecture on u.h.f. television which covers complete conversion and alignment instructions on

u.h.f. tuners and demonstrations. This lecture is now available for presentation in any community in the United States. Information on this non-commercial presentation of u.h.f. television may be obtained from local radio parts distributors or by writing the Bureau at P. O. Box 1321, Indianapolis 6, Indiana.

It has been interesting to observe that, where they have been competently managed, TV installation and service businesses in the fringe and far-fringe areas of present v.h.f. stations have generally been very successful and profitable. There is a two-fold reason for this. In selling receivers in fringe areas set dealers learned early in the game that it was business suicide to over-sell the reception that could be consistently expected in a fringe location. They also found that it was not necessary to over-sell the performance of the receiver when the buyer was properly sold on the wonders of television itself.

In far-fringe and many fringe areas the cost of a satisfactory antenna installation with a mast or tower, rotator, and one or two boosters, sometimes equals the cost of the receiver itself.

The set dealer or installation and service contractor who handles this class of business has to make a substantial investment in installation and servicing equipment. This requirement shuts out the shoestring operator and leaves this business in the hands of businessmen who know that consistent and satisfactory television service can be maintained only when such service businesses are operated at a profit.

A television service business capable of handling the installation and servicing requirements of receivers in these new u.h.f. areas will require a substantial investment in automotive equipment, tools, supplies, and replacement parts and accessories. It will also require the services of skilled installation technicians as well as shop and field servicing technicians to carry out the business at a profit.

As each new u.h.f. television area is opened there will be a minor boom in receiver sales and in installation and servicing business. After this initial boom has subsided, managers of the television service businesses that it created will be faced with the same problems of maintaining a satisfactory volume of business, as the service contractors in present v.h.f. areas.

Service Salesmanship

There are three basic ways to operate a retail business and radio-television service is a retail business with the profitable sale of labor as its major product.

The first way is to open a store or shop and depend upon street traffic, a listing in the telephone directory, and an occasional small-sized ad in the local paper to bring in the work needed to keep the business going. This is definitely a negative approach to running a business because the most im-

BC60S INTERPHONE AMPLIFIER

Easily converted to an ideal inter-communications set for office—home—or factory. Complete w/conversion diagram for 110V operation. **$4.75**

Brand New

DYNAMOTORS

Type	Input Volts	Input Amps.	Output Volts	Output Amps.	Radio Set
PE86	28	1.25	250	.060	RC36
DM416	14	6.2	330	.170	RU 19
DM33A	28	7	540	.250	BC 456
PE101C	13/26	12.6	400	.135	SCR 515
		6.3	800	.020	
BD AR 93	28	3.25	375	.150	
23350	27	1.75	285	.075	APN-1
ZA0515	12/24	4/2	500	.050	
B-19 pack	12	9.4	275	.110	MARK II
			500	.050	
D-104	12		225	.100	
			440	.200	
DA-3A	28	10	300	.060	SCR 522
			150	.010	
			14.5	.5	
5053	28	1.4	250	.060	APN-1
PE73CM	28	19	1000	.350	BC 375
CW21AAX	13	12.6	400	.135	
	26	6.3	800	.020	
			9	1.12	
PE94	28	10	300	.200	SCR 522
			150	.101	
			14.5	.5	

INVERTERS

PE-218-E: Input: 25 28 vdc. 92 amp. Output: 115v. 350-500 cy, 1500 volt-amperes. Dim. 17"x6½"x10". New. **$34.50**

PE-218-H: Same as above, except size: 16½"x6"x10". New. **$34.50**

PE-206: Input: 28 vdc. 38 amps. Output: 80 v 800 cy. 500 volt amps. Dim: 13"x5½"x10½". **$22.50**

FULL WAVE BRIDGE SELENIUM RECTIFIERS

Up to 18v. RMS a.c. Input—Up to 14v. d.c. output

Max. d.c. amps.	Price
2	$ 2.50
4	4.00
6	6.00
10	7.50
12	9.00
20	15.00
24	18.00
30	21.00
36	27.00

Up to 36v. RMS a.c. Input—Up to 28v. d.c. output

1	3.00
2	4.00
4	8.00
10	14.50
12	18.00
20	28.00
24	36.00
30	42.00
36	54.00

Up to 54v. RMS a.c. Input—Up to 42v. d.c. output

2	6.50
4	8.50

Up to 115 v. RMS a.c. Input—Up to 100v. d.c. output

2	11.00
10	48.00
12	60.00

SPECIAL RECTIFIERS ON REQUEST

Low-Voltage Transformers Primaries 115v., 60 Cycle

36V-40V at 3.5 amps $3.75
24V-1.5A 1.95
8V-1.5A ..... .98
16V-4.5A 2.69

HI CAP. FILTER CONDENSERS

Cap. Mfd.	WVDC	Price
2000	6	$1.85
500	200	2.00
250	150	1.45

A.C. ELECTROLYTICS

CAP.	VAC.	PRICE
13-15	220-	$ 1.20
20-24	110-	1.00
26-30	220-	1.35
43-65	110-	1.25
43-48	110-	1.25
50-75	110-	1.25
53-60	220-	1.50
61-69	320-	1.60
64-72	110-	1.25
72-87	110-	1.25
75-84	110-	1.25
88-106	110-	1.50
107-129	110-	1.65
130-157	110-	1.75
130-150	70-	1.50
130-180	110-	1.85
158-191	110-	1.85
161-130	110-	1.75
189-210	110-	1.95
200-220	110-	1.95
270-300	110-	2.10
324-360	110-	2.40
378-420	175-	3.00
432-480	110-	2.75
485-540	110-	2.85

OIL CONDENSERS

Mfd.	Volt	Price
5	50	$ 0.45
650	80	1.95
15	220 AC	2.20
0.5	750 AC	1.59
0.5	1000	.69
2x0.5	1000	.70
1	1000	.75
1.5	1000	.85
2	1000	.90
4	1000	1.75
3x.01	1200	1.35
1	1500	1.30
1.5	1500	1.40
2	1500	1.45
0.15	4000	1.20
2x0.1	4800	1.20
0.1	6000	2.39
1.5	6000	17.50
2x0.1	7000	2.95
.015	16000	3.95
.0016	15000	5.95
.25	20000	
1	25000	
.5	25000	
1	7500	

MANY OTHERS

VARISTORS

D-167176	$ .95
D-172155	2.25
D-168687	.95
D-171812	.95
D-171528	.95
D-162356 (308A)	1.50

THERMISTORS

D-166228	$ 1.50
D-167332 (tube)	1.50
D-170396 (bead)	1.50
D-167613 (button)	1.50
D-164699 for MTG "X" band Guide.	$2.50

LINE FILTERS

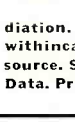
LINE FILTER. GE 100 Amp Filter w/2x5 Mfd 50v oil cond. Operates on 110VAC DC ... **$1.39**

1KW LINE FILTER, clean up BC1 & TV1. Easy to Mount. **$3.95**

Noise Filter. Jx51E. 10 Amp $1.29

Noise Filter. Jx55D. 4 Amp. 35c

932 PHOTO TUBE



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POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps input.

CT-77B	5500V/.002A, 2.5V/2A, 12KV TEST 6.3VCT/.6A—4600V TEST			$12.95
CT-75B	1200VCT/600MA, 2X5VCT/6.2A 6.3VCT/3A, 6.3V/.3A			14.95
CT-825	360VCT	.340	6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V	.160	2.5/12, 30/.100	9.95
XT-15A	350VCT	.070	6.3/.6, 6.3/1.8, 3 lbs.	2.95
CT-071	110V	.200	33/.200, 5V/10 2.5/10	4.95
CT-378	2300V	4 MA	2.5/2	6.95
CT-367	580VCT	.050	5VCT/3A	2.25
CT-721	550VCT	.100	6.3/1, 2.5VCT/2	2.95
CT-99A	2x110VCT	.010	6.3/1A, 2.5 VCT/7A	3.25
CT-403	350VCT	.026 MA	5V/3A	2.75
CT-931	585VCT	.036	5V/3A, 6.3V/6A	4.25
CT-610	1250	.002 MA	2.5V/2.1A, 2.5 V/1.75A	4.95
CT-137	350VCT	.026 MA	5V/3A	2.75
CT-866	330V	.065	6.3V/1.2, 6.3V /600 MA	1.75
CT-456	390VCT	30 MA	6.3V/1.3A, 5V/3A	3.45
CT-160	800VCT	.100 MA	6.3V/1.2A, 5V /3A	4.95
CT-931	585VCT	86 MA	5V/3A, 6.3V/6A	4.95
CT-442	525VCT	75 MA	5V/2A, 10VCT /2A, 50V/2A, 50V/200 MA	3.85

Filament Transformers—115V/50-60 cps input.

Item	Rating	Each
FTG-31	2.5V/2.5, 7V/7A (Tape @ 2.5V/2.5A), 16KV	$ 9.95
FT-674	8.1V/1.5A	1.10
FT-157	4V/16A, 2.5V/1.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	17.95
FT-104	6V, 5A	4.79
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	12.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A	8.95
FT-986	16V @ 4.5A or 12V @ 4.5A	2.69
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16KV TEST	18.95
FT-340	2x2.5V/3A, 7V/7A—23KV TEST	24.95
FT-038	6.3V/500A WELD	29.45

Plate Transformers—115V/50-60 cps input.

Item	Rating	Each
PT-919	1200-0-1200 200 MA	$ 8.95
PT-976	Auto: 120VCT/10 MA	.69
PT-31A	2x300V/5 MA	.79
PT-46A	4080VCT N.L. 3% to 18" Hx6" Wx7" L, 20 lbs.	29.95
PT-75-2	3780/3446/3112VCT/77MA	10.95
PT-28-1	4600VCT/.077	12.95
PT-403	Auto: 70V/1A	2.29
PT-160	1120VCT/770 MA, 590VCT/82 MA, 25 lbs.	24.95
PT-170	Auto: 156/146/137/128—.71A	3.29
PT-31A	2x300V/5 MA	.79
PT-976	120VCT/10 MA	.79
PT-12A	280VCT/1.2A	2.95
PT-614	4730VCT/500MA, 12KV INS	29.95

Special Filament Transformers

Item	Pri.	Output	Price
STF-05A	115/230	2x5V/7.57" Hx7"x5" D	$ 4.25
STF-96B	230	2.5V/6.5A	1.45
STF-370	220/440	3x2.5V/57, 2.5V/15A, 5½ x5x4½	5.25
STF-11A	220	2x40V/.05/2x5V/6A,12.6/1A	2.95
STF-631	230	2x5V/27A, 2x5V/9A, 100/4Hx5x7 30 lbs.	24.95
STF-370	220/440W	3x2.5V/5A,2.5V/15A	9.95
STF-085	220/440V	2.5V/60 ACT	15.95
STF-083	220/440V	5VCT/30A, 3000V TEST	17.50

115 V—400CY XFMRS

Stock	Ratings	Price
901699-501	2.77V @ 4.25A	$ 3.45
901698-501	900V/75 MA, 100V/.04A	4.29
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/80 MA, 5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300VCT, 135 MA	5.95
KS-9336	1100V/50MA TAPPED 625V, 2.5V/5A	3.95
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32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
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80G198	6VCT, .00006 KVA	1.75
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70G30G1	600 VCT/36 MA	2.65
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ART 13 Driver Trans. 6V6 to P-P 811's	1.29
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CH-776	1.28/130 MA/75 ohms	2.25
CH-344	1.5 H/145 MA/1200V Test	2.35
CH-854	1 HY/80 MA	1.29
CH-43A	10 HY/15 MA—850 ohms DCR	1.75
CH-999	15 HY/15 MA—400 ohms DCR	1.95
CH-511	6 H/80 MA—310 ohms DCR	2.45
CH-3-501	2x.5H/100 MA	2.79
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portant factor in the business—volume of service work—is left purely to chance.

The second way is to add a sales and advertising touch to the business by contacting set retailers regularly to handle their service work and that of their customers. The business promotion through advertising is accomplished by maintaining a mailing list of set owners and sending them appropriate service business solicitation cards at regular intervals.

The cards that are supplied by the various tube manufacturers for direct-mail solicitation of service work are exceptionally good for this purpose. However, to accomplish the purpose for which they were intended it is necessary to carry out a continuing program by mailing the various cards in a series at regular intervals.

These personal contacts with set retailers and the use of a regular direct mail program represent aggressive selling tactics that are necessary to create business. However, they do take time.

The third method of operating a retail service business is the retail merchandiser's way of conducting a business. It is based on a survey of the maximum service business potential in a given area and the creation of a selling program that will bring in a substantial part of that service volume. Where a market is given that kind of a study it is entirely possible to develop sales campaigns that will bring in service business during those periods when radio and television repair business normally is slack.

In present TV areas the average television-equipped home also has a radio-phonograph combination and several table model and portable radios. In addition, the family automobile is usually radio equipped and there is probably a battery-operated portable or two stored away in a closet after the "B" batteries went dead. In the average home where there are three or more table model radios, surveys consistently show that at least two of them, while still operating after a fashion, could use some repair.

In other words, the average home in a TV area today has from five to ten pieces of equipment that should have regular maintenance and service attention. The well-equipped radio-television service shop has the equipment, the personnel, and the "know-how" to keep all of those radio-electronic devices in top operating condition.

The radio-television service businessman who is willing to stake out an area of one thousand television-equipped homes and develop a program designed to make his organization the maintenance company for keeping all radio, television, and other electronic products in those homes in good operating condition would entrench his business in that community so solidly that neither competition nor seasonal slumps would have any serious effect on his business at any time.

—30—

International Short-Wave

(*Continued from page* 71)

sign-off. (Boice) Heard in New York as early as 1353 tune-in; signs off *without* playing "A Portuguesa;" seems to have news session in Portuguese 1420-1430 given by man and woman alternately; plays mostly classical music. (Bellington) A station believed CR6RN is noted on 9.635 with Portuguese music and announcements 1600; signs off 1630. CR6RD, *measured* 9.7047 at 1410, had musical program and heavy QRM. (Oskay, N. J.) This one noted recently with "mid-day" session 0630, good level in South Africa. A station noted on 7.764 probably is Silvo Porto; all-Portuguese programs noted through bad QRN 1515. (Ridgeway)

Argentina—LRX verified with a white card with LR1 on it in blue letters; listed LR1, 1070 kc., 50 kw.; LRX, 9.66, 7 kw., and LRX1, 6.120, 6 kw.; listed daily programs as "usually" 0530-2235. (Machwart, Mich.) LRT, 11.84, Tucuman, noted 1918 with North American recordings. LRS2, 9.320A, Buenos Aires, heard 2048 with music. (Winch, Calif.) LRS, 11.881, noted 1750 with good signal in England. (Catch) LRU, 15.29, noted signing off 1545, weak. (Niblack, Ind.)

Australia—*Radio Australia's* beam to Britain at 0245-0345 is carried over 9.580 and 11.760 (latter may be used for only part of this session); "Australian DX-ers Calling" on Sundays is now 0245 on both channels.

VLM4, 4.9175, Brisbane, noted 0340-0400 with music. (Eccles, Minn.)

Austria — Blue Danube Network, Salzburg, noted on approximately 6.06 at 0200; at 0300 was audible in parallel on 9.617 (old channel); noted another day 2255 with news and closing 1802 with "Star-Spangled Banner." (Pearce, England)

Azores—Ponta Delgada, 11.090, was noted recently (on a Sunday) signing off 1620; normal schedule in winter is 1500-1600. (Bishop, Ohio)

Bechuanaland—GDX-aren, Sweden, says ZNB, 8.230, Mafeking, is noted 1200-1400 and that news in *English* is relayed from Johannesburg, South Africa, during the first 10 minutes of the session, after which has music.

Belgium—Ruysselede is again using 17.946 in its "Calling Leopoldville" (Belgian Congo) session 1030-1130. (Ridgeway, South Africa)

Brazil—A *new* Brazilian station is *Radio Poti* in Natal, state of Rio Grande do Norte, using 4.935 to 1930; QRA is Avenida Deodoro 245, Natal, Rio Grande do Norte, Brazil. ZYZ20, *Radio Relogio Federal*, 4.905, Rio de Janeiro, by this time should be on the air. *Radio Tupi*, Rio de Janeiro, is currently operating on m.w. 1280 kc. with 50 kw.; on FM and on TV; the m.w. and FM programs at 0400-2130 are relayed by ZYC9, *Radio Tamoio*, 15.37, listed 25 kw. but using only approximately 13 kw. Brazil is now on Summer Time (3 hours *ahead* of *EST*) but

will return to Standard Time on March 31. (Serrano, Brazil)

PRA8, 6.015, Recife, noted 1659 with identification by man as "Radio Clube de Pernambuco"; continued with popular recordings to 1725. (Machwart, Mich.) PSL, 7.930, Rio de Janeiro, noted 1630-1700 with musical program. (Sutton, Ohio) ZYK2, 15.145, noted 1055 with usual Brazilian-type music and call of "Radio Jornal do Commercio;" QRM from YDC, Djakarta, Indonesia, 15.150. (Catch, England)

British Guiana—ZFY, 5.98A, opens weekdays 0443, Sundays 0543. (Bellington, N. Y.)

British New Guinea—VLT7, 7.280, Port Moresby, noted 0623-0700 at good level in Georgia. (Patterson)

Bulgaria—Radio Sofia, 7.672, noted in Portuguese 1330; at 1400 in another foreign language; still noted with *English* on 6.07 at 1600 with woman announcer. (Ridgeway, South Africa) The 6.07 channel is partly readable in Ohio during 1500 news session. (Sutton) The 9.705A channel noted with news 2000-2015 and 2300-2315 to North America; at other times evenings (*EST*) takes relays from *Radio Moscow.* (Saylor, Va.)

Burma—Burma Broadcasting Service, 28, Windemere Crescent, Rangoon, Burma, is reported widely with *English* 0915-1015 sign-off; woman announcer gives the next day's schedule at closedown. (ISWC, London) Has been heard in Sweden on 4.775 with news 1000; announces "This is the Burma Broadcasting Service calling from Rangoon." (*Nattugglan,* Sweden)

Canada—At sign-off recently, VED, Edmonton, Alberta, gave power as 5 kw., frequency as 7.320; said is on the air daily 17 hours (0900-0200); however, does run later than 0200 some days when has special relays or personal messages for listeners in the Northwest Territories. (Rosenauer, Calif.)

CBFY, 11.705, Montreal, noted opening 0700 with announcement for CBM, m.w., and CBFY, short-wave. (Ferguson, N. C.) Usually has religious service 0815.

Ceylon—Radio Ceylon, 15.120, noted recently 0815-0830 sign-off; bad QRM from *Radio Moscow* on same channel. (Catch, England) Noted on 11.975 mornings from 0830. (Niblack, Ind.) Heard on this frequency lately to 1145 sign-off. (Kelting, N. Y.)

Chile—CE622, 6.220, Santiago, noted 2323 with identification by man, then popular recordings. (Machwart, Mich.) CE920, 9.200A, Punta Arenas, heard 2130 and signing off 2200. (Sutton, Ohio) CE1180, 11.999A, Santiago, noted 1800. (Catch, England) CE1174, 11.740, Santiago, noted 1900-1930 with good signal; all-Spanish; announces "Santiago de Chile" and/or "Republica de Chile." (Niblack, Ind.)

China—When this was compiled, *Radio Peking* had moved from 10.360A to its old 10.260A channel.

ISWC, London, lists these "complete" schedules for *Radio Peking,* 3, Si-chang An Chieh, Peking, China—11.690, 15.060, at 1900 Amoy dialect, 1915 Chaochou, 1930 Siamese, 2000 Burmese; 6.100, 7.500, 10.260, 15.170, at 0300 Mongolian; 6.100, 10.260, at 0330-0400 Korean; 6.100, 10.260, 11.690, 15.060, 15.170, at 0400-0425 *English;* 11.690, 15.060, at 0430 Ke-chia dialect, 0500 Amoy, 0530 Indonesian, 0600 Japanese, 0630 Cantonese dialect; 6.100, 7.500, 9.040, 10.260, 11.690, 15.060, 15.170, at 0700-0730 Standard Chinese; 11.690, 15.060, at 0800 Vietnamese, 0830-0900 *English,* 0900 Siamese, 0930 Chaochou dialect, 1000 Burmese; 6.100, 10.260, 11.690, 15.060, at 1600-1630 Japanese; 6.100, 10.260, at 1630 Korean; 6.100, 10.260, 11.690, 15.060, 15.170, at 1700-1730 *English;* 11.690, 15.060, at 1730 Cantonese dialect, 1745 Ke-chia, 1800 Indonesia, 1830 Vietamese, 1900 closedown. POW messages recorded in Korea are given during the three *English* periods which begin 0400, 0830, 1700. *(I believe there are additional transmissions not listed above.*—KRB.)

A Chinese has been noted recently around 1800 on 9.026A; seems to have setting-up exercises 1815. (Stark, Texas) Also noted 1800-1845 fade-out by Foerster, Ill.

Colombia—HJCT, 6.201, noted to 2355 sign-off. (Leary, Ind.) HJCW, 4.945, Bogota, heard 2236-2313 sign-off; relays HJCO, m.w., according to announcement; identifies as "Emisoras Sur America" or "Transmitiendo para todo La America desde Bogota;" at sign-off man identifies in *English* and requests reports; anthem follows. HJKE, 4.834, Bogota, noted 2059 with identification by man as "Radio Continental," followed by native music. (Machwart, Mich.) Latter noted in Georgia 2221-2255; male announcer; all-Spanish. (Patterson, Ga.)

HJFB, 6.225, Manizales, noted with call 2000 and commercial announcement at 2014. (Catch, England) Bogota on 6.018 is noted with *English* announcement and sign-off 2330. (Niblack, Ind.) HJGF, 4.847, Bucaramanga, noted 2135-2202. (Patterson, Ga.)

Cyprus—ZJM8, 9.650, Limassol, is heard in Sweden 0655-0830. (*Nattugglan,* Sweden)

Denmark—OZF, 9.52, Copenhagen, noted 2130 and again 2250. (Lund, Iowa)

Dominican Republic — HI2A, 9.68, Santiago de los Caballeros, is heard regularly in South Africa from 1600 onwards; improves by 1615. (Ridgeway) HI8Z, 5.030, Santiago de los Caballeros, noted 1850-1920; all-Spanish. (Patterson, Ga.) HI4T, 5.970, noted opening 0600. (Glick, Ind.) HI1J, 6.025, San Pedro de Macoris, heard 2114 tune-in with native music; signed off 2116A; fair level and no QRM. (Bellington, N. Y.)

Ecuador—Quito, 4.928, noted with identification by man, followed by chimes and sign-off. HC4EB, 6.871, Manta, heard 2231 with identification of "Radio Manta," followed by native music. (Machwart, Mich.) HCJB, 17.890, noted strong but with QSB at 1215 in Spanish. (Kessel, Quebec)

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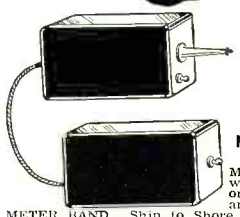

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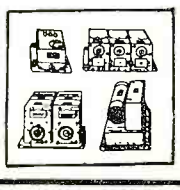

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4	MFD.	600 V.	1.95	4	MFD. 1500 V. 2.25
5	MFD.	600 V.	1.95	6	MFD. 1500 V. 2.95
6	MFD.	600 V.	1.95	1	MFD. 2000 V. 1.95
7	MFD.	600 V.	1.95	2	MFD. 2000 V. 1.95
8	MFD.	600 V.	1.95	3	MFD. 2000 V. 3.50
10	MFD.	600 V.	2.25	4	MFD. 2000 V. 3.95
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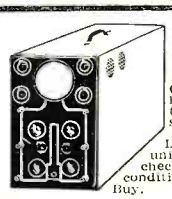

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Range or Voice for 1020 cycles Audio. Switch mounted on Filter. Excellent for C W ..... Ea. **$1.25**

WALKIE TALKIE BATTERIES

BA 37—1½ vc-A. $0.50
BA 38—103½—B 1.29
Both for 1.50

12 VOLT STORAGE BATTERY

Aircraft Type, 12 Volt, 34 Amp. HR. Made by Exide. Completely insulated with removable top. Dry Charged. All Brand New **$14.95**

PROP PITCH MOTORS

For your Beam Antenna: 20 Volt to 32 Volt. A.C. or D.C. ½ H.P. Motor: 1¼ RPM Gear Reduction, 7000 to 1. ALL BRAND NEW. Each **$13.95**

¼ H.P. PROP PITCH MOTORS (Small Size)
20 to 32 Volt A.C. or D.C. Gear Ratio: 9000 to 1. All Brand New **$16.95**

GYRO MOTOR UNITS

Dual gyro unit. Both gyro motors mounted on single base. Wired in parallel for 12 or 24 volts. Excellent condition. (Please specify if you wish the 12 or 24 volt) ..... Set **$4.95**

MISCELLANEOUS SPECIALS

9 Channel Push Button Switch, spring-back type $1.00
300 OHM Twin Lead ..... .04 per Ft.
67½ Volt Radio "B" Batt. ..... 1.00 Ea.
1 Lb. Roll Rosin Core Solder ..... .95 Roll
BC606G Interphone Switch Box ..... .59 Ea.
RG 7U COAX 95 OHM ..... .06 per Ft.
RG 59U COAX 52 OHM ..... .08 per Ft.

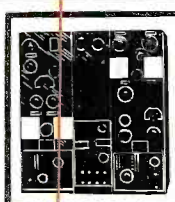
DYNAMOTORS

DM-19-C., 12 Volt DC. Input 16 Amps. Output 500 V. at 200 MA. Cont., 500 V. at 400 MA, Int. Ea. $19.95

BC 456 MODULATION UNIT

Part of SCR274N. Equipment contains Relays. Transformers and 1235, 1625 and VR. 150 (OD3 Tubes.

Less Tubes $1.50
With Tubes 2.95



MODEL GO-9 TRANSMITTER

All brand New. 100 Watts CW. or MCW. emission. Operates from 110 V., 800 Cycle, easily converted to 60 Cycle operation. Low frequency range, 300 KC. to 600 KC. High frequency 3,000 KC. to 18,000 KC. using an E.C.O. We furnish complete conversion data with each transmitter. Complete with schematics **$59.95**

BC 375 TUNING UNITS FREQUENCY RANGES AVAILABLE

200 KC-500 KC; 1500 KC-3000 KC; 3000 KC-4500 KC; 4500 KC-6200 KC; 6200 KC-7700 KC; 7700 KC-10000 KC; 10000 KC-12500 KC. With Vernier Dial and many parts which alone are worth 5 times our Low Price of ..... **$2.95** per unit

SOUND POWERED HAND SETS

TS-10 type—Various manufacturers. No batteries needed for operation. Use in pairs with wire. Audible up to 10 miles. Ideal for TV antenna installations, etc. Excellent condition ..... Pair **$17.95**

SOUND POWERED HEAD AND CHEST SET

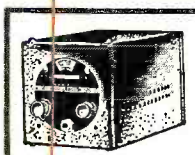
Use same way as Hand Set except you have freedom of hands. No Batteries or power source required for operation. Excellent Condition **$11.95**

2 VOLT VIBRATORS

VB8A Synchronous Type. Used in all portable radios having 2 Volt wet cell supply. All new. Ea. **$1.50**

TANK PERISCOPES

Type 249 Contains 2 glass prisms, one at each end of the periscope. Use them for looking over crowds, at parades, ball games, races, etc., or use prisms separately for optical work. Low priced. All Brand New ... **$1.95**



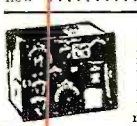
BC-1206 BEACON RECEIVERS

Manufactured by Detrola Radio. 200 to 500 KC. For Direction Finder. Contains 2—25L6, 1—6SA7, 1—6SF7, 1—6SK7, 1—6K7. Excellent condition. Complete ... **$7.95**

MIDGET SELSYNS

AY6 type operates from 6-12 Volts 60 Cycl. Use as both transmitter and receiver. These compact little units draw almost no current and work fine for all remote position indicating applications, OD 2¼x2¼x2". Has spring return shaft. All New (Appr. wt. 1 lb.) ..... Each **$2.50**

AY-1 Type or AY-5 Type, same as above but has a continuous rotating shaft. These compact units are all new **$4.95**



G.P.7 TUNING UNITS

5 Ranges: A-350-800 KC., B-800-1500 KC., D-3000-4525 KC., E-4525-6500 KC., F-6200-9050 KC. Also contains Capacitors, Resistors, Vernier Dials and many other parts. A REAL BUY while they last. Each unit range **$4.95**

DU-1 MANUAL DIRECTION FINDERS

Tunes to broadcast, lighthouse and beacon bands—easy to convert for use on marine bands. True bearing immediately. For use with any loop input receiver. Complete with 2 tube pre-amplifier. Used, good condition.

Specify 12 V. D.C. or 24 V. D.C. Excellent Condition. Each **$19.95**

TUBES

8025	$4.95	6F6	$1.00
3FP7	1.95	6N7	1.00
5FP7	1.25	8020	2.95
5BP4	12.50	6SL7	1.00
6SJ7	1.00	6V6G	1.25
12SR7	.90	6U5	.75
6AG5	1.00	6B8	.75
6AK5	1.25	83V	1.25
6AC7	1.00	6SH7	.50
4E27	12.95	7193	.50
3E29	8.95	6SN7	.90
VR-90	1.00		

304TL **$7.95**

TAPE

CANNED FRICTION TAPE, ¾", 82½ Ft., 6 Rolls to Can ..... $1.25 per Can

TAPE IN INDIVIDUAL BOXES

RUBBER TAPE, ¾", 15 Ft., 15c Roll. SCOTCH TAPE, 1", 50 Yds., 35c Can. FRICTION TAPE, ¾", 82½ Ft., 15c Roll. MICA TAPE ..... 25c Roll

All Mail Orders Promptly Filled, F.O.B. San Francisco . . . All California Orders—Add 3% Sales Tax . . . Do not send postage stamps. Write for our new 1952 free booklet listing our stock and prices on Radio, Electronics, Tools, Hardware, Motors, Wire, Meters, Batteries, Aluminum Sheets, etc. 20% Dep. on all C.O.D. orders. All items subject to prior sale, and prices subject to change without notice.

STANDARD SURPLUS

1230 Market St., San Francisco 3, Cal.
Telephone HEmlock 1-3106

HC1AC, Quito, "La Voz de la Democracia," noted on 6.210 signing on 0640; news in Spanish 0645; fair level in Calif. (Rosenauer)

Egypt—Cairo, 9.555A, noted from 1443 tune-in to 1611 sign-off with march, probably anthem; had news 1601-1605 by man; French news 1530; at 1545 played some popular American recordings. (Bellington, N. Y.) This one noted in England 1430 with *English;* signs on 1345; has news in French 1400. (Pearce)

France—Paris, 7.24, noted 0311 with "The French Have a Word For It;" fair to good level, sometimes excellent. (Winch, Calif.) Paris heard on 9.560 at 2006 with news in French to 2029 when signed with "La Marseillaise" and signature of notes played on oboe. (Niblack, Ind.) Heard on 9.68 in Czech 1445 and in Arabic on 9.755; at 1500 the 9.68 channel gave call in French followed by news in that language; also noted signing on again on this channel 1730 (in French). (Pearce, England)

Paris, 17.85, noted 1115 sign-on to *after* 1230. (Bishop, Ohio) Heard on 9.966A at 1628-1646 with severe CWQRM; used French and Portuguese; signed off 1646. (Patterson, Ga.) Noted relaying *United Nations Radio* on 9.755 at 1430. (Golden, Mass.) Heard parallel on 9.56 and 11.915 with Arabic around 1230; closed 1300. (Bellington, N. Y.)

Germany — Hamburg's "Nordwestdeutscher Rundfunk" is now operating on 7.290, 11.795, 15.275, 17.815, 17.845, Sundays 0000-1900, Sundays 2300-2200; Tuesdays 0000-1900; Tuesdays 2300-1900; Wednesday and Thursdays 2300-1900; Fridays 2300-2000 (*EST*). (ISWC, London) Heard on 7.29 with news in German 0700 in parallel with 11.795. (Pearce, England)

AFN, 5.470, Giessen, noted 1745 with poor level and much QRM. (Catch, England) Heard 1445 with songs and 1500 with news. (Pearce, England) RIAS, 6.005, Berlin, noted with religious program 0255 recently, followed by orchestral music; at 1800 with news in German. (Pearce, England)

(*Continued on page* 141)

EMPIRE STATE BUILDING MULTIPLE TV TOWER COMPLETED

The world's first multiple transmission center for commercial use, is now in operation with the completion of the Empire State Building Multiple Television Tower.

Seventeen months' time and one-hundred thousand manhours went into the construction of the new tower. Five broadcasters are now on the air with better signals as a result of this new installation.

Thirteen high power, high frequency transmitters, including three FM, five TV picture, and five TV sound, are now radiating signals simultaneously from the 222 foot steel structure atop the world's tallest building without the slightest interference.

The cost of the project has been estimated at about $875,000 of which approximately $560,000 was the cost to the Empire State Building for erecting the steel structure, and $315,000 the cost to Empire State and the five broadcasters for electronic development. In addition, each broadcaster spent about $400,000 for installing transmitters and lines.

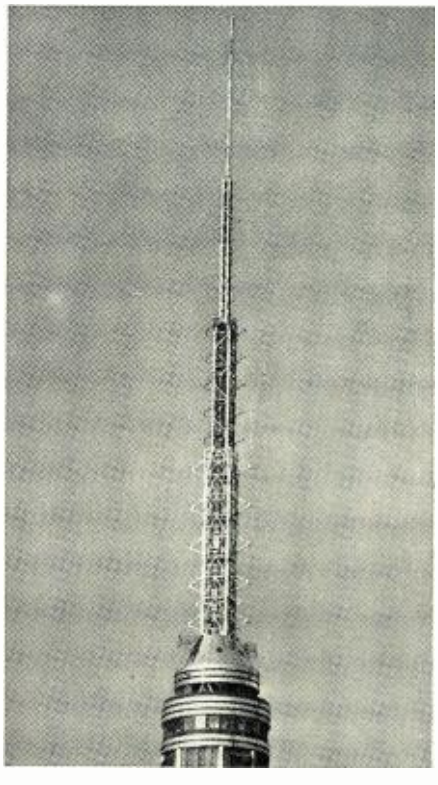
From an average service radius of 38 miles before the Empire State project, the TV broadcasters now reach a radius of about 70 miles, an area with an estimated audience of 17 million people. The extended coverage is due to a combination of the increased height afforded by transmission from Empire State and increased power permitted by the FCC.

On the tower are eight separate antenna systems, 116 radiating elements or dipoles, feed cables, transmission lines, transformers, and junction boxes. More than 60 pipes, coaxial lines, and conduits go up into the base of the tower.

The basic tower, which weighs about 60 tons, was designed to withstand wind velocity up to 150 miles per hour. Two special Pyrex bulb beacon lights were developed for the top of the tower by General Electric when ordinary lamps kept shattering. After a year of use, a lightning rod which tops the tower is already pitted in more than a hundred places where the lightning bolts have landed.

The five stations transmitting from this tower include WJZ-TV (Channel 7), WCBS-TV (Channel 2), WABD (Channel 5), WNBT (Channel 4), and WPIX (Channel 11). Station WATV (Channel 13) may also transfer to the Empire State Building during 1952. —30—

Close-up view of the multiple television transmitting tower atop the Empire State Building in New York. Five TV stations are using these facilities at the present.



Indoor Antennas
(*Continued from page 42*)

various sections of the room until a good location for it is found. Once a suitable spot is located, the housewife is restricted in the arrangement of her furniture thereafter. A person moving about in the room or a change in position of a metallic or electrical obstacle in the room can alter the relative relation between direct and reflected signals and influence effective signal strength at the receiver input. In one location it was found that the position of the telephone on a table-top adjacent to a TV receiver with a built-in antenna had a very great influence on the quality of a high-band station.

When there is a somewhat greater delay between direct and a preponderance of the reflected signals (fractional part of a microsecond), picture smear results. This is caused by close picture displacement between direct and reflected components on the tube screen. Smear also results when certain sideband frequency bands in the 4 mc. video span reach the receiver at stronger relative levels than others. Additive and subtractive relations between sideband components can be such that direct and reflected signals add for some sideband components and cancel for others. We anticipate this relation when we consider that picture and sound are not always minimum at the same angle of departure from the correct antenna orientation.

A third defect occurs when a preponderance of the reflected signals reach a comparable signal level as a direct signal and/or are delayed an appreciable time with respect to the direct signal. Usually, an unstable raster occurs because of poor sync stability. Continuous shifting of sync control between the various signal components (direct and reflected) sets up a number of pictures displaced with respect to each other. Appearance (except for instability) can be likened to reception of a number of ghosts from a range of hills.

It is apparent that reflection and orientation defects make it difficult to obtain optimum orientation for each channel when stations are in different directions. Difficulties can be encountered at many sites when stations are all in the same direction. At some indoor locations and on certain channels, peak results are often obtained when the antenna is not oriented in the direction of a station.

Signal Levels and Noise

The indoor antenna must function under very trying conditions. An indoor location means a low signal level; a *low* indoor location means a still weaker signal. The antenna, therefore, has a weaker signal to work with and is nearer to sources of noise and interference. Thus, signal-to-noise ratio is substantially poorer. Insofar as im-

pulse interference is concerned, the weaker signal means the receiver is made more subject to sync instability from car ignition and electrical appliance noises.

A trying defect of receivers with indoor antennas in certain television areas is local oscillator interference. Again the defect is pronounced because of a weaker signal and the location of the antenna nearer to offending receivers in neighborhood. This defect is prevalent in areas assigned the following channels: 2—5, 3—6, 7—11, 8—12, or 9—13.

Often the indoor signal levels are so poor that snow or salt-and-pepper effect is apparent. This condition destroys the resolution and clarity of the picture and is extremely annoying to a person accustomed to a clear, well-defined picture. This is a very obvious defect. However, the picture often is afflicted with a more obscure trouble resulting from a less serious loss in signal level and/or improper antenna orientation. Noise components in the video signal cause a constant wiggling in the background of the picture. This motion, however slight, has an apparent effect on the picture quality. It is often not so severe that a person will criticize the picture and often it goes unrecognized. Rather it is a type of subtle defect that when it is not present and picture background is rigid and steady, a person is likely to remark "That is the best picture I've ever seen," or "It's just like a movie." Proper orientation and peak signal-to-noise permit this type of picture.

Not only is attainment of a high signal-to-noise ratio hampered by orientation, weak signal level, and proximity of noise sources, but space limitations prevent use of directional parasitic elements and often dipole elements cannot be fully extended to intercept a half-wavelength on the low band. Consequently, it is difficult to obtain a steady, clear, motionless-background picture.

Inconvenience

Many indoor antennas are inconvenient—even to the extent that some families pass over certain channels because elements must be changed or the antenna moved. For example, in one home, the antenna is moved from the top of the TV set to the top of the piano when a specific channel is to be received.

The indoor antenna is not an appealing article of furniture. When extended it is annoying and can be a hazard. It limits living room styling if there are bad reception areas in the room.

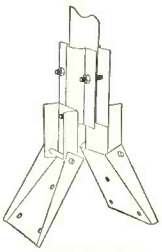
Idealized Indoor Antenna

The ideal indoor antenna would permit optimum signal-to-noise conditions from each station in accordance with its energy level. It would attain this objective with as little inconvenience as possible.

What factors, then, contribute to good indoor antenna performance?

FAIR RADIO SALES

132 SOUTH MAIN ST.
LIMA, OHIO



Television Accessories:

Universal flat and peak roof mount made of heavy gauge steel, aluminum finish. Adjustable flaps provide easy means for mounting on any peak regardless of roof pitch. Swivel mast holder takes up to 1¾" pipe and can be raised easily.

PRICES: Each: $1.69. Box of 12: $17.50

	Each	Box of 12
GUY CLAMPS up to 1¾" Pipe	25c	$2.40
GUY RINGS—1¼" Pipe	15c	1.49

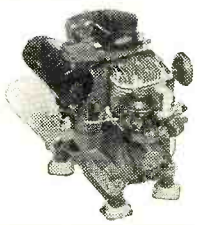
TURNBUCKLES:

	Dia.:	Total L.:	Open L.:	Closed L.:	Ea.:	Doz.:
#14	¼"	2⅜"	7⅝"	5½"	18c	$1.65
#15	5/16"	2¾"	9⅛"	6½"	20c	2.16

HOOKS: #187 ⅜" x 5" Galvanized: 6c Each; Box of 24 $1.30

AIRCRAFT CABLE: ⅛" x 7 x 7 strands. Weather-proofed. 47 Foot Lengths only at.....75c Ea.
GUY CABLE CLAMPS: ⅛" 10c Ea. Box of 25..$2.25

DELCO GASOLINE ENGINE GENERATOR



12 Volt DC 750 Watt generator driven by a one cylinder four cycle air-cooled gas engine, approx. 2 HP, with self starter, output meter, and on-off switch. Rope or electric start. Gov't surplus, reconditioned **$79.50**

HRU-28 Homelite Gasoline Engine Generator, 28 VDC, 2000 Watt output. Used, Tested **$89.50**

ANTENNA EQUIPMENT

MAST BASE—INSULATED

MP-132 BASE—as illustrated at left, 1" heavy coil spring, 2" insulator. Overall length: 11½". Weight: 2¾ lbs. Price $3.95

MAST SECTIONS FOR ABOVE BASE

—Tubular steel, copper coated, painted, in 3 foot sections, screw-in type. MS-53 can be used to make any length, with MS-52-51-50-49 for taper. Price for any section.....50c Ea.

AN-104A Antenna—100-156 MC.	$2.00
AN-117 Whip Steel—6 Ft. length	1.50
AN-109A Whip Steel, 5 Ft. w/Base	1.50
AS-27/ARN-5 Ram's Horn, 110 MC.—USED	5.95
LP-21-A Loop for ADF equip.—Used, tested	9.95
AT-37/APT Stub—113-150 MC.	6.95
AT-42/APT-3 or APT-1 Stub—113-150 MC.	6.95
AS-97/ARQ-8 Spike with coaxial load in base.	4.95
AS-61/ARN-5-Half-Wave Dipole—335 MC.	3.95

AERIAL WIRE

Aerial Wire—Phosphorous Bronze #16 Stranded. 200 lb. test. Weather-proof. 150 feet on Reel. RL-3 with Clips ...$1.50

WIRE—HEAVY DUTY RUBBER COVERED

2/#16—20 Ft. Length	$1.25
2/#12—10 Ft. Length	1.00
1/#6—Shielded, 15 Ft.	1.50
1/#6—Shielded, 7½ Ft.	.75
1/#2—Shielded, 8 Ft.	1.00
1/#8—Cotton covered—Per Foot	.06
1/#14—Shielded, Rubber Covered, 50 Ft. Length	$2.75
Or Per Foot, at	.06

INVERTERS:

NUMBER:	INPUT:	OUTPUT:	PRICE:
5-D21-NJ3A	27 VDC 35Amp	115 V—400 cycle 1 Ph. 485 VA...	USED: $14.95 NEW: 24.95
PE-118	26 VDC100Amp	115 V—400 cycle 1 Ph. 1500 VA..	USED: $19.95
PE-218	28 VDC 92Amp	115 V—400 cycle 1 Ph. 1500 VA..	USED: $19.95
PE-115	28 VDC 36Amp	80 V—800 cycle 1 Ph. 7.2 A	L.N.: $5.95
PE-206A	27.5VDC 38Amp	80 V—800 cycle 1 Ph. 500 VA	L.N.: $5.95
MG-153F	24 VDC	115 V—400 cycle 3 Ph. 750 VA 26 V—400 cycle 1 Ph. 250 VA.	USED: $69.50
MG-Type A-1	200 V—400 cy 3 Ph.	30 VDC 200 A.	L.N.: $49.50
CM-93 Alt.	6000 RPM output	120-208 3 Ph. 400 cycle 30 KW	$69.50

MISCELLANEOUS:

24 VDC Circuit Breaker—30 Amp—Heinemann.	$1.50
125 VAC Circuit Breaker—12 Amp—Heinemann	2.95
FL-8 Audio Filter—1020 cycle.....Used	1.50
Leg and Seat Assy. for Hand Generator	3.50

TRANSMITTERS:

BC-230 with Tubes	$ 4.95
TA-12B Transmitter, with Tubes.....USED:	29.95
T-20 ARC-5/BC-457—4 to 5.3 MC....NEW:	14.95
BC-459 Transmitter—7 to 9 MC.....NEW:	29.95
274N—As is—No Tubes—No Returns—BC-457 or 458	3.95
BC-375 Trans.—As is—No Tubes—No Meters—No Returns	10.00

RECEIVERS:

R-1/ARR-1 for conversion to 220 MC.	$ 4.95
RA-10 Receiver with Tubes & Dyn...USED:	24.95
BC-455 Receiver—4 to 9.1 MC	7.95
274N—As is—No Tubes—No Returns—BC-453	8.00
BC-454 or 455	3.95

CORDS—CABLES

CD-501 Cord f/GN-45 Generator	$2.00
CD-218 Cord w/PL-68 & SW-141 & JK-48F f/Throat or Lip Mic.	.89
CD-307 Cord—6.5 Ft. w/PL-55 & JK-26	.89
CD-604 Cord w/C-410 Trans. & PL-54 Plug	.89
BC-375 or 191 Cable w/PL-64, 61, or 59 each end	2.50
CD-365 Cord for LP-21 Loop	1.75
MC-215 Tuning Shaft for 274N	2.00

CONTROL BOXES:

	NEW:	USED:
C-87/ART-13—f/ART-13 Trans.	$ 6.95	$4.95
MR-9C/Control Box f/RA-10 Rec. w/Mtg.	12.95	
BC-434 for ADF	5.95	3.95
BC-732 for Localizer	3.95	1.95
BC-646 Control Box f/BC-645	2.00	
BC-461 Reel Control Box w/Counter	2.95	

HEADSETS—MICROPHONES:

Head & Chest Set for EE-8.....Used:	$2.95
Dynamic Microphone & Headset for Mark II, Used: $1.95 New:	2.95
HS-30 Headset .....New:	1.95

TUNING UNITS COILS

TU-7-8-9-10-26 for BC-191-375.....Used:	$3.95
IF Transformers f/274N—85 KC—1415 or 500 KC .....Ea.	1.50

AMPLIFIERS:

BC-605 Amplifier .....Used:	$3.95
BC-347 Amplifier with Tube	2.95
BC-709 Amplifier	4.95

PLUGS AND CONNECTORS:

PL-112 Plug for LP-21 Loop	$1.25
PL-P-103 Plug for BC-348	1.50
MC-211 Rightangle Adapter for Comm. Sets	.50
M-359 Rightangle Coaxial Connector	.25

MOUNTINGS AND CLAMPS:

FT-154 for BC-348 Receiver	$2.50
FT-470 Mounting & Clamp	1.00
MC-476 Maple Ball for above—f/Fairlead	1.00
MC-396 Wood Clamp for Fairlead	.75
M-235 Bobbin & 250 Ft. W-106 Antenna Wire.	3.50
WT-7 Weight for Trailing Antenna	1.50

AUTOSYN TRANSMITTER:

Autosyn Transmitter from LP-21A Loops, used with I-81 or I-82 Indicators. Operates from 26 Volt 400 cycle. With calibrated Dial and Correction Pointer. MC-507.....$6.95 MC-217.....$5.95

GEAR TRAIN MOTOR

Ball bearing, low inertia reversible type, 588 RPM. Extra large gear, ⅜ RPM operates 26 Volt 400 cycle or 12 Volt 60 cycle. Removed from LP-21 Loops. Type—10047-2-A $4.95

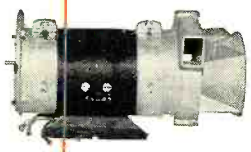
BAND SWITCH MOTOR and Switching Assy for MN-26 Compass, 28 VDC #E11500-1.....$5.95

AIRCRAFT KITCHEN GALLEY—Type C-2, 24 Volt DC operation complete w/Food Warmers, Grill & Soup Can $34.95

NOTICE

NEW POSTAL REGULATIONS, effective January, 1952, place 20 lb. weight limit on parcel post shipments. All shipments over 20 lbs. accordingly shipped via Motor Freight or Express. C.O.D. and postal M.O. Fees up to $5: 40c—$10: 55c—$25: 85c—$50: 95c. When ordering, **SEND ENOUGH MONEY AND SAVE! ANY BALANCE WILL BE REFUNDED IN CASH AT ONCE!**

DYNAMOTORS:



DYNAMOTOR And BLOWER 9 Volts DC input, output 450 Volts 60 MA., 4500 RPM. At 6 Volts DC input, output 260 Volts 65 MA., 3000 RPM. Price $4.95

INPUT:	OUTPUT:	STOCK No.:	PRICE:
14 V. DC	600 V. 300 MA.	BD-86	$9.95
12 V. DC	220 V. 70 MA.	DM-24	6.95
12 V. DC	220 V. 100 MA.	DM-18	4.95
12 or 24 V. DC	440 V. 200 MA. & 220 V. 100 MA.	D-104	9.95
14 V. DC	375 V. 150 MA.	DM-375	8.95
14 V. DC	330 V. 135 MA.	DM-330	7.95
14 V. DC	500 V. 500 MA.	PE-59	14.95
12 or 24 V. DC	275 V. 110 MA.	USA/0516	3.95

ALSO—PE-73; PE-86; DM-53; DM-33; 5055; DM-416; PE-101, etc.

BLOWERS:

115 Volt 60 cycle BLOWER (pictured), approx. 100 CFM Dis. 2¼" intake; 2" outlet. Quiet running. Motor size: 2½"x3¼". NEW—not Gov't surplus. Order No. RN-520..**$7.99**

DUAL BLOWER—Same as RN-520 above, except has blower assembly on each side of motor. Order No. RN-800.....$12.95

METERS:

0-150 Volt, 400 cycle, 2½" Rd.	$3.95
0-5 Amp. AC, 3" Rd., 0-75A Scale	3.95
0-5 Milliamp DC, 2½" Sq., 0-5 Scale	3.95
0-1 Milliamp DC, 2½" Rd., 0-150 Scale	3.95
0-500 Microamp, 2½" Rd., 0-15 & 0-600 DC Volt Scale	3.95
TUNING METER I-70B Reverse Scale, Weston #606 for Compass Control Boxes	3.95

POWER SUPPLIES:

VIBRATOR TYPE—6 Volt DC input; output 230 Volt DC 50 MA. filtered w/tube. Size: 6½"x4"x5½" Price $6.95

VIBRATOR TYPE—6 Volt DC input; output 230 Volt DC 50 MA.—not filtered—w/tube. Ideal for Command Receiver operation as receiver is filtered internally. Size: 4½"x4¼"x3½" $4.95

PE-157 POWER SUPPLY—2 Volt Vibrator Supply, operates from BB-54 2 Volt Battery mounted in Case. Output voltage 1.4 V. ½ Amp 125 V. 50 MA. Less Battery, Speaker, & External Power Cord—with Vibrator $4.95

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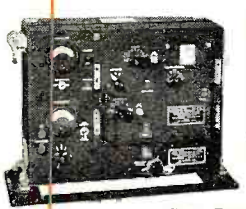

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B. High erection is important at a vast majority of sites from the standpoint of peak signal and keeping the antenna above obstacles and room activity.

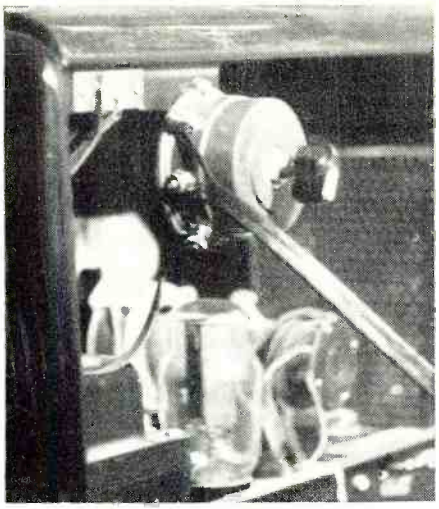
C. To intercept a peak signal, it should be possible to fully extend the elements. It should be possible perhaps to derive some gain from the antenna on the high band.

D. Antenna should be designed so it can be mounted in an out-of-way or hidden position. The antenna for a television receiver is a utilitarian device and doesn't lend itself too well to ornamentation if effective performance is to be attained.

Indoor "Directronic"

An indoor "Directronic" type of antenna displays excellent indoor characteristics. The basic type used for indoor application consists of three quarter-wave elements spaced in 120 degree relation (can be mounted at other angles to fit space available) and feeds a three-wire transmission line, Fig. 1. The three-wire line connects to a six-position switch mounted at the receiver (near antenna terminals) while an ordinary 300 ohm two-wire line connects the switch and receiver input. The switch, Fig. 1, chooses the elements in pairs, (1-2, 2-3, 1-3) or chooses two elements to work with a single (1, 2-3; 2, 1-3; 3, 1-2). A wafer-type of ganged switch is used, so arranged that the two six-pole portions operate together. In the three lower positions, the corresponding single-pole switch shown at the left in the diagram is also closed. For example, in the bottom switch position, the left-hand single-pole switch is closed; the next position up closes the center single-pole switch, and the third position up closes the right-hand switch. This arrangement allows six orientation possibilities—more than enough to fit the orientation requirements. The orientation feature is not only advantageous as a signal level adjustment, but it permits orientation away from interference and changing directions of interference arrival (such as local oscillator radiation in a crowded neighborhood). The forward tilt of elements permits some high-band gain.

The antenna elements are standard 46 inch lengths made of *aluminum tape.* The tape can be made to adhere firmly to painted surfaces, wallpaper, etc. The antenna can be mounted on the ceiling or, better still, hidden away on a closet ceiling. The antenna itself need not be oriented physically and the benefit of a full length element can be obtained. It is mounted at ceiling level and is little influenced by receiver positioning and room activity.



"Directronic" switch installed in TV set.

An indoor "Directronic" is able to take effective advantage of whatever signal levels are present. It will not be able to deliver as strong a signal as a proper outdoor antenna because, generally speaking, the signal levels are substantially weaker indoors. Nevertheless, recent increases in transmitter power and more sensitive tuners are used to advantage in a well-planned, versatile indoor antenna installation. An antenna of this type installed on an attic ceiling approaches the performance of a good outdoor antenna and is better than the poorer outdoor installations.

Typical mounting sites (see page 42) include a room ceiling, closet ceiling, or attic ceiling. A room ceiling mount can be made presentable if installed neatly—it should be very satisfactory for a den, recreation room, bedroom, hall, etc. Closet ceiling mounting is ideal from the standpoint of appearance and performance. Tape elements can be made to follow the contours of a small closet, running down corners or sides—full length elements being more important than the fact that the elements do not remain strictly in a horizontal plane.

The indoor "Directronic" is convenient for attic ceiling mounting and for mounting on ceilings of unfinished second floors.

Indoor tape antennas of the "Directronic" type have among their features: high and hidden mounting possibilities, electronic orientation, full length elements, high signal level, and interference rejection possibility by pattern orientation. —30—

HANDY TEST LEADS

By HUGH LINEBACK
Oklahoma A & M College

SERVICEABLE and convenient test leads may be made by using ordinary parallel conductor, rubber-covered lampcord.

By adding the desired terminals and splitting the ends for a short distance, there is really only one wire to worry about instead of two separate ones. Bands of tape are used to keep the cord from separating too far. —30—

Audio Simplified

(*Continued from page 74*)

The basic principle of operation of the volume compressor or expander is shown in the block diagram of Fig. 6. The audio signal is amplified to a sufficiently high level, and then rectified to give a d.c. voltage proportional to the signal level. This voltage controls the gain of a variable-gain stage in such a manner that the gain may be either reduced or increased as the signal voltage increases, depending upon whether the circuit is to be a compressor or an expander. A gain control in the amplifier-rectifier circuit can be used to control the amount of compressor or expander action, and a delay voltage can be introduced into the rectifier circuit so that the action only occurs above a certain level.

The circuit of a simple compressor or expander is shown in Fig. 7A, and the principle of its operation may be seen most clearly from the simplified diagram and equivalent circuit shown in Fig. 7B. The input signal is rectified, and the developed voltage applied to the grid of a triode whose plate resistance forms the shunt resistor in an audio-frequency voltage divider network. The equivalent circuit shows this principle of operation, and it can be seen that with proper selection of the resistor values, if the plate resistance of the tube is made to vary properly, the output signal level can be controlled over a wide range of input levels.

A simple practical circuit based on this principle is shown in Fig. 9A. The input signal is amplified by one-half of the 6SL7 dual triode, whose output is rectified by the second half of the tube connected as a diode. The voltage from the diode rectifier is then a measure of the signal level. This voltage is properly filtered and applied to the grid of one-half of a 6SN7 tube to control its plate resistance, which is used as the variable resistance in the audio voltage divider circuit. The voltages are chosen so that for high signal levels a positive voltage is applied to the grid of the variable-resistor tube, which lowers its plate resistance and therefore decreases the gain of the channel. This compression circuit is capable of giving a compression up to 10 to 15 db with 0.5 volt rms applied to the input.

The operation of a peak limiter may be compared to that of the compressor, and may be considered as having a very high degree of compression which takes place only when the input signal becomes greater than some specified level. The circuit of a peak limiter whose operation is based upon the

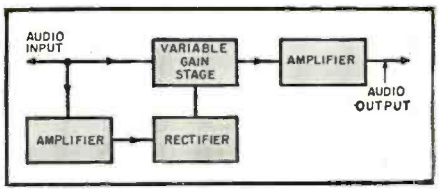


Fig. 6. Basic block diagram of volume compressor, peak limiter, and expander unit.

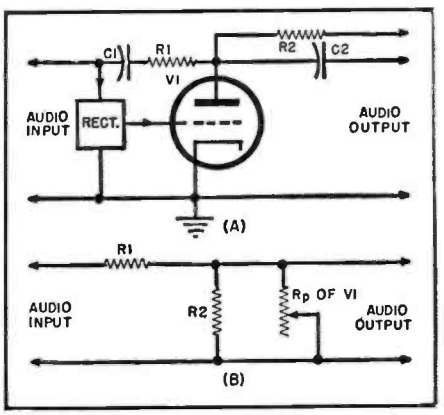


Fig. 7. Simple basic circuit for volume compression or expansion (A) and equivalent circuit of (A) for audio signal (B).

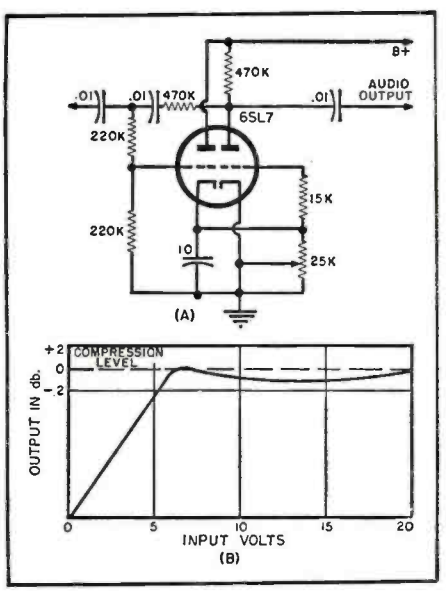
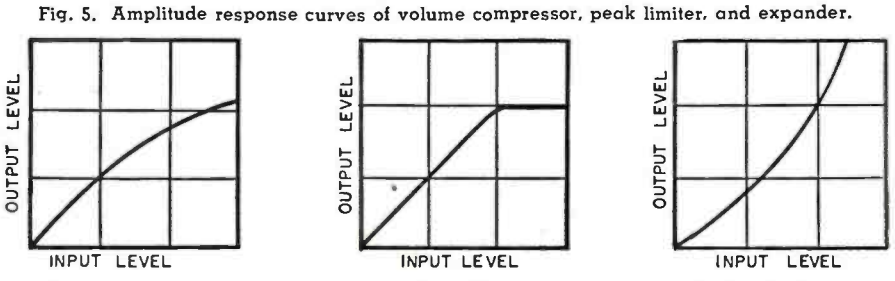


Fig. 8. (A) Peak limiter circuit, and (B) the amplitude response of peak limiter circuit.

Fig. 5. Amplitude response curves of volume compressor, peak limiter, and expander.



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1A5GT	.65	6AC7		6J7G	.79	7A8		12BH7	1.08	35L6	.59
1A7	.99	6AG5	1.19	6J8G	1.15	7B4		12C8	1.15	35W4	.45
1B3GT	.95	6AG7	1.44	6K5GT	.87	7B5	.81	12F5GT	65c	35Y4	99c
1B5	29c	6AH6	1.40	6K6GT	.59	7B6	.81	12H6		35Z3	
1C7G		6AK5		6K7GT	.79	7B7	.81	12J5GT	.54	35Z4	54c
1E7		6AK6	1.08	6K8GT	.87	7B8	.81	12K7GT	.79	35Z5	
1H6		6AL5	72c	6L5G	.95	7C4	1.44	12Q7GT	.65	35Z6G	.95
1H5GT	.65	6AQ5		6L7	.87	7C5	81c	12SA7GT	.72	35/51	.79
1H6G	1.15	6AQ6	.81	6N6G	1.40	7C6		12SC7	.79	41	72c
1J5GT	.95	6AR5	.74	6N7GT	1.08	7C7		12SF5GT	72c	42	
1L4	.29	6AT6	.54	6P5GT		7E6	.99	12SF7		43	
1LA4	1.19	6AS5	.90	6Q7GT	.65	7E7	1.19	12SH7GT	.79	45	
1LA6		6AU5GT	1.45	6R7GT	.95	7F7	.99	16SJ7GT	.81	45Z5	.59
1LC5		6AU6	59c	6S4	.65	7F8	1.76	12SK7GT	.72	46	1.04
1LC6		6AV6		6S7GT	1.15	7G7	1.19	12SL7GT	.87	47	1.21
1LD5	.95	6B4G	1.44	6S8GT	.95	7H7	.90	12SN7GT	.99	50A5	
1LE3	1.19	6B5		6SA7GT	.72	7J7		12SQ7	.54	50B5	72c
1LH4	1.19	6B6G	.79	6SC7	99c	7K7	1.19	12SQ7GT	.59	50C5	
1LN5	1.19	6B8GT	1.15	6SD7GT		7L7		12SR7GT	.79	50C6G	1.04
1N5GT	.72	6BA6	.65	6SF5	.59	7N7	99c	12Z3	.95	50L6	.59
1P5GT	95c	6BA7	.87	6SF5GT	.65	7Q7		14A7		50X6	.79
1Q5GT		6BC5	.72	6SF7	.72	7R7		14AF7		50Y6	.59
1R5	72c	6BC7	.79	6SH7GT	.79	7S7	1.19	14B6	99c	70L7	1.40
1S5		6BD5GT	1.15	6SJ7	81c	7V7		14B8		71A	.87
1T4		6BE6	.65	6SJ7GT		7W7		14C5		75	1.10
1U4		6BF5	.99	6SK7GT	.58	7X6	.99	14C7	1.19	77	
1U5	.65	6BF6	.59	6SL7GT	.87	7X7	1.19	14F7	1.08	78	
1X2A	.95	6BG6G	1.73	6SN7GT	.79	7Y4	81c	14F8	.99	80	.61
2A3	1.15	6BH6	72c	6SQ7	.54	7Z4		19BG6G	1.44	83	1.45
2A5	.79	6BJ6		6SQ7GT	.59	12A7	1.15	19T8	2.15	85	.79
3LF4	1.19	6BN6	1.44	6SR7GT	.65	12A8	.79	20	1.04	117L7	1.40
3Q4	.79	6BQ6	.85	6SS7	.72	12AH7	1.45	24A	1.40	117N7	
3Q5GT	1.08	6BQ7	1.58	6T7G	1.15	12AT6	.54	25AC5GT	.79	117P7	
3S4	72c	6C4	59c	6T8		12AT7	1.04	25BQ6GT	1.04	117Z3	.54
3V4		6C5GT		6U5	1.10	12AU6	.72	25L6GT	1.15	117Z6	1.08
5T4	1.40	6C6	.79	6U6GT	79c	12AU7	.65	25W4GT	.59	807	1.55
5U4G	.59	6C8G	1.15	6U7G		12AV6	.54	25X5	.72	813	8.95
5V4G	.87	6CB6	.72	6V6GT	.59	12AV7	1.15	25Z6GT	1.04	1294	29c
5W4	59c	6CD6G	1.69	6W4GT	.65	12AW6	.95	32L7GT	.79	1299	
5W4GT		6D6	.79	6X4	.54	12AX7	.87	35A5	1.15	1619	.45
5X4G	.65	6D8G	1.15	6X5GT	.68	12BA6	.65		.99	1629	.29
5Y3GT	.45	6E5	.79	6Y6G	.87	12BA7	.87			2050	2.00
5Y4G	.54	6F5GT	59c	7A4	.90					2051	1.15
5X4G	81c	6F6GT		7A5	.99					7193	.87
5Z3		6F8G	1.15							VT51	29c
6A3	1.15	6G6G	.95							VT52	
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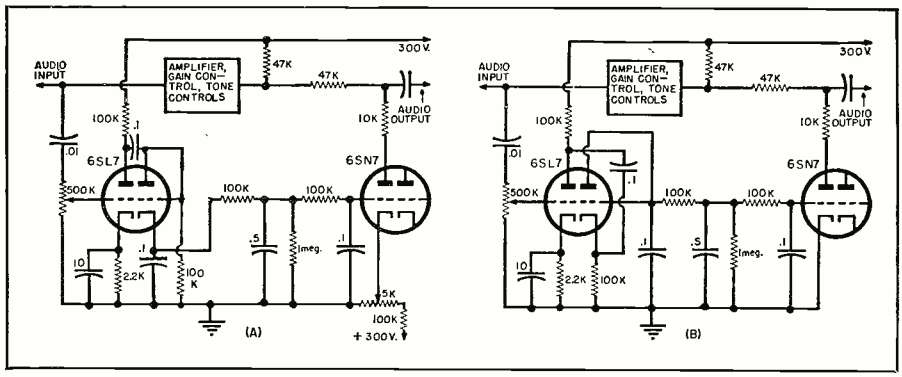


Fig. 9. (A) Conventional volume compressor circuit and (B) volume expander circuit.

same audio voltage-divider principle of Fig. 7 is shown in Fig. 8. The input signal is rectified by a high-impedance cathode detector which is the first section of the 6SL7, and the developed voltage is applied between the grid and cathode of the second section of the 6SL7 which acts as the variable shunt resistance of the voltage divider. The values of the components have been selected to give the best voltage/signal-level characteristic to result in a linear compression curve. This circuit gives a peak-limiting curve similar to that shown in Fig. 8B, and is capable of 15 to 20 db limiting with an output level change of less than 1 db. The limiting action is initially adjusted by means of the 25,000 ohm cathode resistor, and then the degree of limiting for any transmitted audio signal is adjusted by controlling the level of the signal applied to the input of the limiter circuit.

A volume expander is essentially the reverse of the compressor circuit which has already been described. The major difference between the two is that the diode rectifier must be reversed and the voltage levels reset, so that for high signal levels the channel gain is increased. Thus, the circuit of Fig. 9B is essentially the compressor circuit of Fig. 9A with the rectifier connections reversed to give a negative voltage when the audio level increases, and the cathode of the variable-resistance tube connected directly to ground

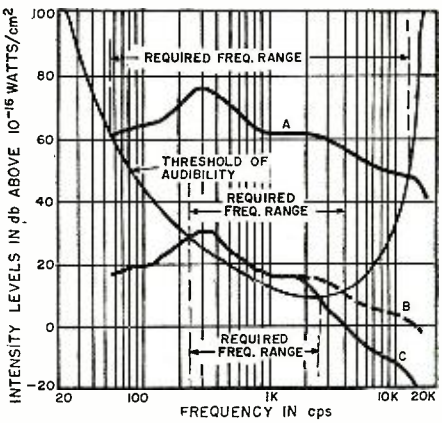
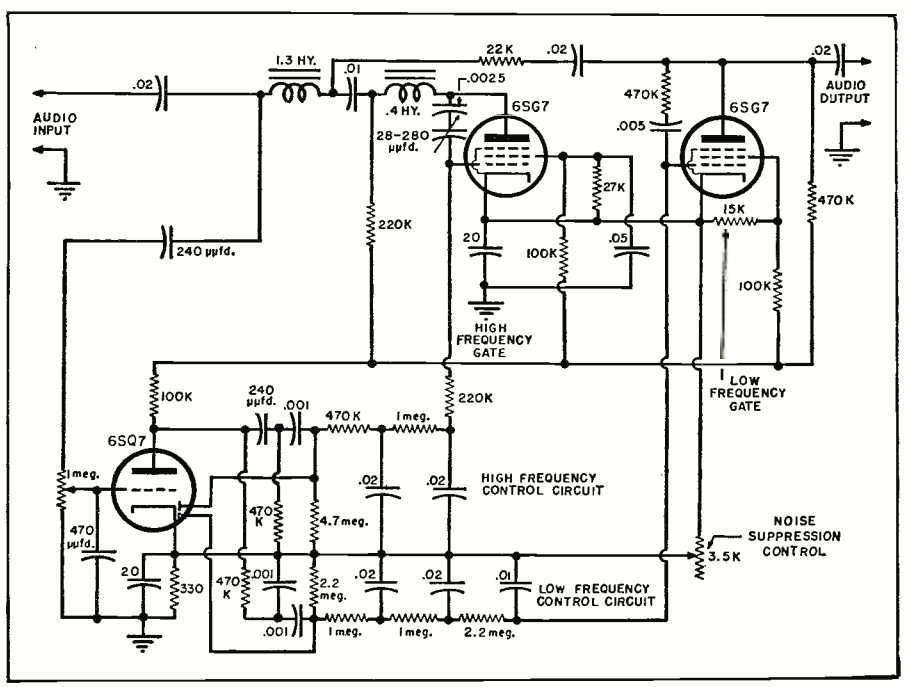


Fig. 10. Required frequency range for music at different levels. Curve A is the most probable frequency distribution in music at high levels. Curve B is same as A at lower volume. Curve C is the most probable frequency distribution with the orchestra playing soft passages.

Fig. 11. Circuit diagram of the Hermon Hosmer Scott dynamic noise suppressor which is particularly well adapted for use in a sound reproducing channel.



so that the plate resistance is low for low-level signals and high for high-level signals. The gain therefore increases as the audio level increases. This circuit is capable of giving up to 10 db expansion, and component values may be selected to give greater expansion if desired.

In the use of volume compression and expansion circuits, the time constants of operation are extremely important, and generally represent a compromise of several factors. The time of initial operation should be rapid to act properly on the initial peaks, but the release time presents a more difficult problem. If the release time is too short, a sort of "pumping" effect is obtained in which the gain is constantly adjusting to rapid changes in level; while if it is too long, sharp dynamic effects in the program material will suffer. Optimum conditions are a very rapid initial operation time, and a release time of about one-half second to one second.

The units which have been described can either be included directly in the amplifier, or be constructed on a separate chassis with the gains and levels adjusted for unity gain at some specified level (which will require the inclusion of additional amplification), and switched into the channel whenever they are required.

Noise Suppression

Another approach to the problem of background noise has been to attempt actually to remove the noise which has been introduced into the reproduced sound. A number of different methods have been developed for this purpose. The most widely accepted of these methods is the *dynamic noise suppressor,* whose operation is based essentially upon the fact that the frequency response of the ear changes with sound level.

Detailed curves which have already been reproduced in Part 1 (Fig. 4, page 50, September 1951 issue) of this series show the effects of different loudness levels on the human ear. The ear does not have the same frequency response for different acoustic levels, that is, at high levels its response is approximately flat, while at low levels the sensitivity to high and low frequencies is considerably reduced. The basic data from these curves is reproduced in Fig. 10, which shows the curve for the lowest levels which can be heard by the ear at each frequency. On the same graph are also shown the most probable frequency distribution in music at high levels (curve *A*), this same distribution at about a 25 db lower level (curve *B*), and the frequency distribution when the orchestra is playing softly (curve *C*) showing that the production of harmonics in soft playing is less than in loud. These curves show that all components which are outside the intersections of these curves with the hearing threshold curve are not perceived by the ear, and if a filter which cuts off at these frequencies is inserted in the channel

it will have no effect on the music. However, it will result in a tremendous decrease in the high-frequency and low-frequency noise, whose levels are well above the threshold of hearing. Of course, as the sound levels change, the cut-off frequencies will change correspondingly. A filter of this sort whose cut-off frequencies are controlled by the level of the reproduced sound forms the basis of the dynamic noise suppressor. Although it is extremely difficult to evaluate the degree of noise reduction resulting from such a circuit, it may be estimated to be in the neighborhood of approximately 20 db.

The circuit of a simple noise suppressor of this type is shown in Fig. 11. The audio signal is passed through a single section of low-pass and a single section of high-pass filter, each of which has a reactance tube forming one of its components. It is also amplified in an auxiliary amplifier whose output is rectified in two diode detectors to give a d.c. voltage proportional to signal level. These voltages are then filtered and applied to the control grids of the reactance tubes to control the cut-offs to the frequencies required by the signal level.

This circuit may be used either alone in the channel, or as part of a more elaborate preamplifier and tone-control unit.

(*To be continued*)

What's New in Radio

(*Continued from page 94*)

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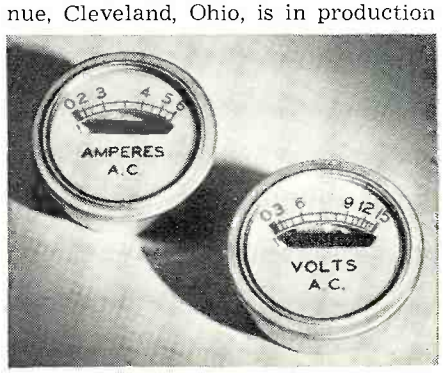

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WANTED! WANTED!

MILITARY TEST SETS & EQUIPMENT

TS-12, 13, 35, 14, 15, 146, 174, 175, 263, 268, etc. APR. ARC, ART, APS, APA, SCR, BC equipment and parts. Also TUBES, any quantity. WRITE. WIRE OR CALL.

R·H·S

SPECIALS OF THE MONTH

Coaxial Relay K-101 SPDT—24v DC5	$ 4.95
Set of 3-1 SP Coax-Connectors for Above	1.35
1000 KC Crystal BT cut	3.95
VS-2 Vacuum Switch	6.95
Sigma Plate Relay 8000 ohm SPDT	2.49
RG59/U Coaxial Cable—75 ohm	
150' roll ... $11.95. 300' roll	22.50
3" Scope Shield	1.29
2000-0-2000 V @ 800 MA xformer	24.95
15 HY @ 800 MA Choke	6.95
2 mfd 5000 V Condenser	4.25

TUBES!! BRAND NEW! STANDARD BRANDS! NO SECONDS! COMPARE! TUBES!!

0A3/VR75	$1.69	3C24	$2.25	217C	$8.95	812H	$6.90	8008	$7.95	WL616	$37.50
0B3/VR90	1.29	3C27	4.95	227A/5C27	5.95	813	8.95	8011	1.75	WL619	18.95
0C3/VR105	1.49	3C31/C1B	3.49	249C	3.95	814	3.95	8012	3.95	WL677	34.50
0D3/VR150	1.29	3C45	19.95	250R	12.95	815	2.95	8013	2.95	WL681	22.50
1B22	3.45	3CP1	2.25	250TH	22.50	816	1.36	8014	29.95	OA2	1.55
1B23	12.50	3CP1S1	2.95	250TL	21.50	826	.98	8020	1.29	OA4G	1.20
1B24	19.95	3DP1	4.95	274A	5.50	828	12.75	8025	5.95	OB2	1.65
1B26	3.95	3DP1A	6.95	274B	2.65	829	12.95	9001	2.25	OZ4	.75
1B27	24.50	3DP1-S2A	8.95	276A	9.95	829B	14.95	9002	2.25	O1A	.73
1B29	7.95	3D21A	1.98	293A	2.98	830B	14.95	9003	2.25	1A3	.73
1B32	8.95	3E29	14.95	294A	5.75	832	12.95	9004	.75	1A4P	1.30
1B36	24.96	3FP7	3.95	300B	9.95	832A	12.95	9005	2.95	1A5GT	.78
1B38	32.50	3GP1	4.75	304TH	14.95	833A	41.50	9006	.49	1A6	.85
1N21 Xtal	1.25	3HP7	3.95	304TL	14.95	836A	3.95	C1JA	9.95	1A7GT	.95
1N21A "	2.15	4-65A	34.95	305A	34.95	837	1.69	C5R	9.95	1AB5	.80
1N21B "	4.25	4-125A	26.95	307A/RK75	5.95	838	2.95	C6A	7.95	1B3/8016	1.25
1N22 "	1.35	4-250A	29.95	310A	8.95	841	.45	C6J	6.95	1B4	1.15
1N23 "	2.25	4AP10	4.95	316A	.65	843	.39	C100D	1.49	1B5/25S	.95
1N23A "	3.25	4B22/EL5B	9.95	323A/B	24.50	845	4.95	CK502AX	2.95	1B7GT	1.25
1N23B "	6.95	4B24/EL3C	7.95	327A/5C37	4.95	849	39.50	CK503AX	2.95	1C5GT	.85
1N26 "	5.95	4B25/6CF	8.95	328A	8.95	851	69.50	CK505AX	2.25	1C6	.73
1N27 "	1.69	4B26/2000	8.95	331A	12.95	852	29.95	CK506AX	2.25	1C7G	.73
1N34A "	1.40	4B28	4.95	350A	8.95	860	6.95	CK507AX	2.25	1D5GP	.73
1P22	3.95	4B32	9.95	350B	4.95	861	29.50	CK511AX	2.25	1D7G	.73
1P24	1.79	4C27/CV92	9.95	368AS	7.95	864	.39	CK517AX	8.45	1D8GT	.73
1P36	2.95	4C35	34.50	371A	1.49	865	1.45	CK1005	.89	1E5GT	.73
1S21	6.95	4E27/257B	17.95	371B	.98	866A	1.39	CK1006	3.25	1E7G	1.19
2AP1	11.95	5AP1	3.69	388A	2.75	866JR	1.39	E1148	.35	1F4	.73
2C21/RK33	.69	5AP4	3.69	393A	6.95	869B	49.50	EF50	.69	1F5G	.73
2C22/7193	.49	5BP1	5.95	394A	4.95	872A	2.95	F123A	8.75	1G4	.73
2C26A	.49	5BP4	5.95	417A	12.95	874	1.49	F127A	22.50	1G6GT	.73
2C34/RK34	.89	5CP1	4.95	434A	4.95	876	.59	F128A	89.50	1H4G	.89
2C39	24.50	5CP7	12.95	446A	4.95	878	2.25	F606	37.50	1H5GT	.85
2C40	12.95	5C22	55.00	446B	4.95	884	1.85	F660	79.50	1H6GT	1.05
2C43	14.95	5D21	24.50	450TH	47.50	885	1.49	FG17	3.95	1J6	.98
2C44	1.49	5FP7	3.25	450TL	47.50	905	3.59	FG27A	8.75	1L4	.73
2C46	7.50	5GP1	4.95	527	12.75	902A	10.95	FG32	7.95	1LA4	.85
2C51	1.39	5JP1	24.45	559	1.39	905	3.59	FG57	14.95	1LA6	1.15
2D21	1.79	5JP2	24.45	562	97.50	908	12.95	FG81A	3.95	1LB4	1.06
2E22	1.95	5JP4	24.45	575A	13.95	918	1.69	FG105	22.95	1LC5	.89
2E24	4.89	5J23	12.95	701A	5.95	919	2.79	FG172	34.50	1LC6	.98
2E26	3.69	5J29	12.95	702A	3.95	922	.98	FG186	8.95	1LD5	.98
2E30	2.95	5J30	49.50	703A	7.95	923	1.05	FG404A	4.95	1LE3	.85
2J21A	9.95	5J32	99.50	704A	1.05	927	1.59	FG451	.89	1LG5	.85
2J22	8.45	5LP1	15.95	705A	2.95	930	1.20	FG502A	1.85	1LH4	.89
2J26	29.50	5NP1	5.95	706BY	39.50	931A	4.95	FG562	97.50	1LN5	.95
2J27	29.50	6AS6	3.69	706CY	39.50	954	.39	FG592	14.95	1N5GT	.89
2J30	99.50	6C21	24.50	706FY	42.50	955	.45	GL502	1.85	1P5GT	.79
2J31	39.50	6F4	5.95	706GY	42.50	956	.45	HF125	14.95	1Q5GT	.73
2J32	39.50	6J4	6.95	707B	17.95	957	.45	HF300	19.95	1R4	.73
2J33	39.50	7BP7	8.95	708A	4.95	958	.45	HY114B	.79	1R5	.95
2J34	39.50	7DP4	17.95	709A	3.95	959	.69	HY115	.79	1S4	.73
2J36	97.50	7GP7	14.95	710A/8011	1.75	991/NE16	.39	HY615	.29	1S5	.85
2J37	12.75	9JP1	14.95	713	1.45	1603	5.25	KC4	37.50	1T4	.85
2J38	12.75	9LP1	19.95	714AY	6.95	1613	1.25	KG610	6.95	1T5GT	.73
2J39	39.50	9LP7	14.95	715A	7.95	1614	2.25	ML101	69.50	1U4	.89
2J40	39.50	10BP4	22.50	715B	9.75	1616	.98	RBL21	3.95	1V	.72
2J46	39.50	10	.49	715C	29.95	1619	.35	RK20	9.95	1X2	1.18
2J48	29.50	12DP7	16.95	717A	1.69	1622	3.25	RK25	4.49	2A3	.95
2J49	39.50	12GP7	16.95	721A	2.59	1624	1.98	RK33	.69	2A4G	1.25
2J50	22.95	12HP7	16.95	722A	2.95	1625	.45	RK34	.89	2A5	.73
2J54B	39.50	12LP4	22.50	723A	14.95	1626	.45	RK48A	4.49	2A6	.73
2J55	97.50	15E	1.19	723A/B	22.50	1629	.35	RK59	1.49	2A7	.75
2J61	49.50	15R	.89	724B	3.89	1630	.98	RK60/1641	2.25	2B7	.75
2J62	49.50	16AP4	42.50	725A	7.95	1631	1.29	RK65	24.50	2V3G	.79
2K25/ 723AB	29.50	16CP4	42.50	726A	6.95	1632	.79	RK72	.59	2X2	.65
2K28	36.25	19T8	2.90	726B	29.50	1633	.75	RK73	.59	2X2A	1.60
2K29	24.50	23D4	.45	730A	30.50	1634	.75	RN21A	2.95	3A4	.65
2K33	329.50	30 Special	.59	750TL	79.50	1636	3.25	RX120	8.95	3A5	.90
3AP1	12.95	35TG	4.95	800	1.95	1638	.65	RX21	8.95	3B7/1291	.59
3B22/Elic	2.95	45 Special	.39	801A	.49	1641	2.25	VR78	.69	3D6/1299	.59
3B23/RK22	4.85	53A	5.95	802	4.49	1644	.98	VR91	1.49	3LF4	.95
3B24	5.50	75TL	6.95	803	4.49	1654	2.35	VR92	.98	3Q4	.79
3B24W	7.95	100R	.89	804	9.95	1655	1.50	VT127A	3.95	3Q5GT	.85
3B25	4.65	100TH	9.95	805	4.49	1665	1.45	VT158	14.95	3S4	.85
3B26	3.95	121A	2.98	806	29.95	1851	1.89	VU29	2.95	3V4	.90
3B27	3.95	203A	8.95	807	1.98	1960	.79	VU111	1.49	5R4GY	3.75
3B28	8.95	204A	69.50	808	7.25	1961	4.99	WL468	12.95	5T4	1.95
3BP1	8.95	211	.69	809	2.45	2050	1.90	WL530	12.75	5U4G	.73
3C22	64.50	212E	49.50	810	9.95	2051	1.45	WL531	12.75	5V4G	1.12
3C23	9.95	215A	.19	811	3.25	5670	8.95	WL532	2.95	5W4	.81
				812	2.95	8005	5.95	WL578	1.29	5X4G	.89
										5Y3GT	.63
										5Y4G	$0.73
										5Z3	.89
										5Z4	.89
										6A3	1.25
										6AL4A	1.35
										6A6	.92
										6A7	.99
										6A8	1.05
										6AB7	1.20
										6AC5GT	1.20
										6AC7	1.15
										6AD7GT	1.35
										6AE6G	.89
										6AF6G	.89
										6AG5	.89
										6AG7	1.55
										6AH6	1.40
										6AJ5	1.15
										6AK5	1.50
										6AK6	1.10
										6AL5	.82
										6AQ5	.92
										6AQ6	.87
										6AR5	.79
										6AT6	.73
										6AU5	1.25
										6AU6	.93
										6AV6	.72
										6B6G	.99
										6B7	.98
										6B8G	.85
										6BA6	.85
										6BC5	.98
										6BE6	.85
										6BF6	.79
										6BG6G	1.18
										6BH6	.97
										6BJ6	.97
										6BQ6	1.35
										6C4	.79
										6C5	.79
										6C6	.79
										6C8G	.98
										6CB6	.98
										6D6	.85
										6D8	.89
										6F5	.79
										6F6	.95
										6F7	.89
										6F8G	.95
										6G6G	1.15
										6H6	.95
										6H6GT	.79
										6J5	.75
										6J5GT	.69
										6J6	1.20
										6J7	.82
										6K5GT	.98
										6K6GT	.79
										6K7	.73
										6K8	.73
										6L5G	.87
										6L6	3.00
										6L6G	1.75
										6L6GA	1.75
										6L7	.98
										6L7G	.95
										6N7	.89
										6Q7	.95
										6R7	.85
										6S7G	.98
										6S8GT	1.05
										6SA7	.85
										6SC7	1.30
										6SD7GT	.98
										6SF5	.89
										6SF5GT	.89
										6SF7	.98
										6SG7	.98
										6SH7	.98
										6SJ7	.89
										6SK7	.89
										6SL7GT	$0.98
										6SN7GT	.98
										6SQ7	.75
										6SR7GT	.85
										6SS7	.95
										6ST7	1.10
										6SU7GTY	2.15
										6SV7	1.25
										6ST7G	1.20
										6T8	1.18
										6U5G	.95
										6U6GT	.98
										6U7G	.95
										6V6	1.55
										6V6GT	.89
										6W4	.85
										6W7G	1.05
										6X4	.75
										6X5GT	.75
										6Y6G	.98
										6Y7G	1.25
										6ZY5G	.89
										7A4/XXI	.79
										7A5	.89
										7A6	.85
										7A7	.85
										7A8	.89
										7AG7	1.05
										7B4	.85
										7B5	.85
										7B6	.85
										7B7	.85
										7C4	.79
										7C5	.85
										7C6	.85
										7C7	.85
										7E5	.75
										7E6	.59
										7E7	.89
										7F7	.85
										7H7	.85
										7K7	1.20
										7L7	.98
										7N7	1.05
										7Q7	.83
										7R7	.95
										7S7	.98
										7W7	.95
										7X7	1.10
										7Y4	.75
										7Z4	.85
										12A	.65
										12A6	.73
										12A7	1.05
										12A8GT	.79
										12AH7GT	1.27
										12AL5	.93
										12AT6	.73
										12AT7	1.25
										12AU6	.95
										12AU7	1.15
										12AV6	.73
										12BA6	.85
										12BE6	.87
										12C8	.79
										12F5GT	.79
										12H6	.82
										12J5GT	.55
										12J7GT	.82
										12K7GT	.79
										12K8	.89
										12Q7GT	1.30
										12SA7GT	.93
										12SC7	.99
										12SF5	.89
										12SF7	.89
										12SG7	.79
										12SH7	.73
										12SJ7	.79
										12SK7	.98
										12SL7	$1.05
										12SN7	.98
										12SQ7	.85
										12SR7	.85
										12Z3	.85
										14A4	.98
										14A7	.95
										14B6	.95
										14F7	.95
										14F8	.95
										14H7	.95
										14J7	.95
										14N7	.95
										14Q7	.95
										14R7	.95
										19	.69
										24A	.75
										25L6GT	.85
										25Z5	.79
										25Z6GT	1.05
										26	.50
										27	.49
										28D7	2.25
										30	.45
										31	.85
										32	.95
										32L7GT	.89
										33	.93
										34	.89
										35/51	.83
										35A5	.89
										35B5	.89
										35W4	.65
										35Y4	.75
										35Z3	.85
										35Z4	.73
										35Z5	.69
										37	.95
										38	.60
										39/44	.40
										41	.75
										42	.75
										43	.75
										45	.89
										45Z3	.89
										45Z5	.80
										46	.82
										47	.89
										48	.98
										49	.95
										50A5	.95
										50B5	.95
										50C5	.95
										50L6GT	.85
										50Y6	.85
										53	.98
										56	.65
										57	.80
										58	.85
										59	.95
										70L7	.95
										71A	.75
										75	1.25
										76	.55
										77	.60
										78	.79
										80	.73
										82	.89
										83	1.15
										83V	1.15
										84/6Z4	.85
										85	.89
										89Y	.45
										117L7/M7	1.35
										117N7	1.35
										117P7	1.35
										117Z3	.89
										117Z6	.90

RADAR—COMMUNICATIONS—TEST EQUIPMENT

AN/APA10 Panoramic Adapter ... $175.00
AN/APA11 Pulse Analyzer.
AN/APN-4B Receiver ... 39.95
AN/APR4 Radar Search Receiver.
AN/APR5 Radar Search Rec. 1000-3,100 mcs ... 375.00
AN/APS3 Airborne X-Band Search Radar ... 875.00
AN/APS15 X-Band R.F. Head ... 99.50
AN/APT5 300-1500 mcs Xmitter ... 149.50
AN/CRT3 Dual Freq Victory Girl ... 129.50
Complete YJ Beacon Installations ... 19.95
AN/PPN-1 Portable Radar Beacon.
BC221AK Freq. Mtr. with Modulation ... 149.50
BC-433G Compass Receiver ... 39.95
BC-639 Receiver ... 285.00
BC-640B 100-156 mcs ground xmitter ... 1300.00
BC-733D Receiver ... 29.95
BC-1016 Tape Code Recorder ... 459.50
BC-1206 Beacon Receiver ... 4.95
MN26Y Compass Receiver ... 24.95
PE-75 2½KW Gasoline Generators ... 450.00
RA-34 Power Supply ... 250.00
SCR269G Automatic Radio Compass ... 129.95
SCR504 Portable D.F. 100 KC-65MC.
SCR522 Airborne VHF Transceiver.
SCR536 Handie-Talkie.
SCR694 Lightweight Field Radio.
SK-1M Radar Receiver Indicator ... 89.50
SQ Portable Radar 10 CM ... 850.00
T-50 Portable Radiotelegraph Xmitter ... 275.00
TCS Marine 2 Way Radio
TRC-1 Complete Antenna System.
RA-62 Power Supply for SCR-522
MD-5/APS-3 Modulators with Tubes ... 65.00

ARA 500-1500KC Receiver, good ... $24.95
R28/ARC-5 Receiver ... 29.95
BC455B 6-9 mcs. Receiver ... 19.95
BC433 200-1750KC Compass Rec. ... 29.95
ARB-2 3-4.98 mcs. Receiver ... 19.95
BC-454 3-6 mcs. Rec. w/tubes. New ... 16.95
T23/ARC-5 Xmitter ... 49.95
BC696-A 3-4 mcs Xmitter ... 29.95
TYPE O 5.3-7 mcs Xmitter ... 9.95
AVT-23 300-1500KC Complete. New ... 79.50
BC-950A 100-156 mcs. Xmitter, New ... $9.95
BC-456 Modulator, good ... 2.25
BC-450 Control Box (3 Rec.) used ... 1.25
BC-451 Control Box (Xmitter) used ... .98
BC-442 Relay Unit (Ant) Used ... 1.95

FLEXIBLE SHAFTING AVAILABLE.

HRU-28 28V 2000W Gasoline Generator
RG-8U Coaxial Cable. Per Thousand Feet ... $85.00
SCR-518 Altimeter. Complete installation ... 29.95
SCR-522 Trans/Rec. Complete installation 28V input. 12V input avail. ... 129.50
RCA Sound Powered Chest & Headsets. Pair ... 29.95
LARGE QUANTITY PE-104 VIBRAPACK FOR SCR-284 NEW EXPORT PACKED.
HS-30 Headsets ... 3.95
FT-154 (BC-348 Shock Mount) ... 2.98
HS-23 Headsets ... 4.95
BC-608 Automatic Keyer for SCR522 ... 5.95
BC1284 Lighthouse Tube Preamplifier ... 69.95
APA-17 D.F. Antenna. 300-1000 MC ... 59.00
BC-996 Interphone Amplifier ... 9.95
ART-13 Loading Condenser ... 4.95
CU-25 Loading Box for Art-13 ... 49.95
AS-27/ARN5 Antenna ... 4.95
SA-1/ARN-1 ... 2.95
ID-60/APA-17 Indicator ... 129.95
RM-29 Remote Control ... 18.95
RA-300 FM Exciter ... 32.50
A-55 Dummy Antenna ... 2.25
BC-1365 Control Box ... 3.95
FL-8 Filter ... 3.95
FL-5 Filter less Cables ... 2.65
3C-16D GSAP Gun Camera Computer, complete ... 19.95
AT-2/APN-2 Antenna ... 4.95
CG-(172/173)CPN-8 10CM Patch Cable ... 4.95

TS3/AP S-Band Freq & Power Meter.
TS10/APN Altimeter Test Set, Ex ... $35.00
TS11/AP.
TS12/AP V.S.W.R. Test Set for X-Band.
TS13/AP XA Band Sig Gen Pwr & Freq Mtr.
TS14/AP SA Band Sig Gen.
TS15/AP Flux Meter.
TS16/AP Altimeter Test Set ... $29.95
TS19/APQ5 Range Calibrator.
TS23/APN Test Set for SCR718 Altimeter.
TS32/TRC-1 70-100 mcs Sig Gen used to check ANTRAC Equipment.
TS33/AP X-Band Freq. Meter.
TS34/AP Synchroscope.
TS35/AP X-Band Sig Gen Pwr Mtr Freq Mtr.
TS36/AP X-Band Power Meter.
TS45/AP X-Band Sig Gen.
TS47/APR Sig Gen 40-500 Mcs.
TS59/APN Altimeter Test Set.
TS61/AP S-Band Echo Box ... $140.00
TS62/AP X-Band Echo Box.
TS67/AP I.L.S. Test Set.
TS69/AP Freq. Mtr. 300-1000 mcs ... $72.50
TS85/AP Voltage Divider.
TS102/AP Range Calibrator.
TS110/AP Echo Box.
TS111/AP S-Band Freq. Meter.
TS125/AP S-Band Power Meter
TS126/AP Synchroscope.
TS155/UP S-Band Sig Gen Pwr Mtr Freq. Mtr.
TS164/AR A.C. Version of BC221.
TS170/ARN I.L.S. Test Set.
TS174/AP Freq. Mtr. 40-400 Mcs ... $385.00
TS175/AP Freq. Mtr. 300-1000 mcs.
TS184/AP
TS189/AP
TS246/AP 300-1000 mcs Pwr Mtr.
TS268/AP Xtal Diode Test Set.
TS278/AP AN/APS13 Test Set.
BC-221 Frequency Meter.
1E-19 Test Set for SCR522.
1E-36 Test Set for SCR522.

AN/ARR-2X RECEIVER

Secret Transmission Receiver for reception of double modulated carrier. Will receive 235-258 mcs signals that have been modulated by a 600-750 KC signal. When carrier is heard on a standard receiver no modulation is heard on the carrier when actually speech is being transmitted. 12V DC input. Excellent condition.

SO-13 S-BAND MARINE RADAR

Compact Sea Search Radar for small vessels. P.P.I. indication is provided. Complete in original cases with complete sets of spares. Excellent condition.

AN/ARC-1 TRANS/REC.

Provides Radio-Telephone Communication between Aircraft or Aircraft & Ground. Complete with Shock Mount & Control Box. Input: 28V DC. Excellent condition. Available in either 10 or 20 Crystal Controlled Channels 100-156 MCS. checked out.

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The new meter fits a 1⅝" mounting hole while a back panel clearance of 1" from the flange is needed. These meters are available in ranges of 1 to 50 volts, 1 to 30 amperes, and 10 to 100 ma. They are designed to give a reading accuracy of 5 per-cent at any given point on the scale with a 10 per-cent over-all accuracy. Both a.c. and d.c. models are available.

HANDY SCREWDRIVER

Continental Screw Company, New Bedford, Massachusetts, is distributing

an ingenious and handy screwdriver which features removable low-cost *Phillips* insert bits for driving screws with *Phillips* recessed heads.

Designed to be used on the factory line or in the home workshop, the new screwdriver takes interchangeable bits. When one wears out it can easily be removed and replaced. Four different sizes of bits are available but the #2 size will drive from 75 to 80 per-cent of all screws with *Phillips* recessed-type heads.

AUDIO OSCILLATOR

Waveforms, Inc., 333 Sixth Avenue, New York 14, New York, is now marketing an extended range audio oscillator, the Model 510-B.

Small in size, the new instrument has a frequency coverage of from 18 cycles to 1.2 mc. in five overlapping ranges, low distortion (less than .2 percent over most of the useful range), constant output ± .5 db from 18 cycles to 100 kc., calibrated output voltage, 300 degree vernier-drive dial, and accuracy and stability ± 2 per-cent ±

1 cycle for all conditions of line voltage variation (± 10 volts) to 210 kc.

The entire unit measures 6" x 4¼" x 5¼". A type T-10 matching transformer is available for operation with balanced output permitting its use on balanced lines.

SPRAGUE FEEDTHROUGHS

Sprague Electric Company, North Adams, Massachusetts has announced the availability of a new feedthrough ceramic condenser for filtering leads passing through a chassis or shield partition.

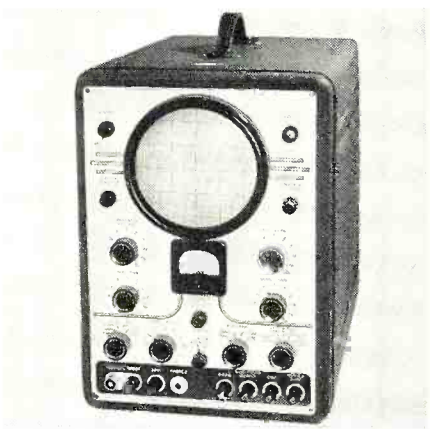
The Type 503C has the small ceramic disc element resin-sealed in a recessed cup at the top of the metal ferrule in order to provide maximum protection against humidity. The through-lead passes through a hole in the center of this dielectric disc. Thus, there is equal radial distribution to the grounded outer shell for all high frequencies being bypassed resulting in low inductance.

Rated at 50 volts d.c., capacitance values of the new units range up to 100 $\mu\mu$fd.

Full details on the Type 503C are contained in the company's Engineering Bulletin 605 which is available to interested persons on letterhead request.

TRIPLETT SCOPE

The Triplett Electrical Instrument Co. of Bluffton, Ohio, is currently introducing a new 5" oscilloscope which



has been designed for TV, FM, and a variety of industrial testing applications.

The Model 3441 features an illuminated calibration meter which makes it possible to view the percentage of positive and negative peak-to-peak volts in addition to reading peak-to-peak voltage directly in 8 ranges from 0 to 1000 volts. The frequency range of the horizontal amplifier is flat within ± 20 per-cent from 20 cycles to 150 kc., deflection sensitivity is .15 rms volt/inch. The response of the vertical amplifier is usable to beyond 4 megacycles.

The unit is furnished in a black suede-finished metal case which measures 15 11/32" x 11 1/32" x 16". Accessories include coaxial cables, a probe, and instruction booklet. A crystal signal tracing probe is available as an extra accessory and adapts the unit for a variety of r.f. uses. —30—

"Pre-Fab" Tuners

(*Continued from page* 52)

for assembling the kit. The chassis is completely prepared, with all cut-outs and screw holes drilled so that no work with a file or drill is necessary.

Each circuit or assembly is mounted, wired, tested, and aligned at the factory, and the same tubes that are used during the test are included with the kit when it is shipped. This precludes the necessity of intricate alignment procedures when the proper test equipment is not available.

Some of the design features include a heavy-duty power transformer, with a 30% safety factor, which delivers 220 volts of plate voltage instead of the usual 250 to 275 volts. This allows the tuner to operate much "cooler," which adds to the stability, lengthens the life of the tubes, and generally provides better performance. Heavy filtering is used for the absolute minimum of hum.

Physically, the tuner is well proportioned. It measures only eight inches in depth and is but a fraction over six inches in height. The chassis is seventeen inches long and is equipped with a large, easy-to-read slide rule dial.

The FM tuning unit is extremely stable, making it unnecessary to use a.f.c. on the oscillator. Drift is barely noticeable three to five minutes after the tuner is switched on. By not using a.f.c., a greater degree of selectivity is achieved, which allows the full sensitivity to be realized. For example, tests in our laboratory showed that the tuner was able to completely separate two stations, one channel apart, with acceptable performance from each; the one having a signal strength of 5000 microvolts being fifteen miles away and the other having a signal strength of 20 microvolts, located at a distance of seventy miles from the receiving point.

The tuning unit was specially designed for the ultimate in performance at FM frequencies. Permeability tuning, known for its superior performance at high frequencies, is used in this unit. The electroplated glass coils and tuning cores are held within 1% tolerance. The oscillator operates 10.7 mc. higher in frequency than the signal circuits and its stability is exceptionally good.

The mixer, or converter stage, is of conventional design. The oscillator voltage is injected directly into the mixer grid through a 68 $\mu\mu$fd. ceramic condenser from the oscillator plate.

The r.f. stage employs a 6J6 dual triode in a grounded grid circuit. At very high frequencies this type of circuit offers considerable advantage over the more conventional pentode stage. The loading effect of the tube on the coils is many times less than a pentode at these frequencies. Consequently, the "*Q*" of the circuit is improved, which increases both the sensitivity and image ratio.

With these design features, excellent sensitivity has also been achieved. An average sensitivity of 6 to 10 microvolts is realized which often places FM stations, which heretofore were out of range, within reach.

I.F. Amplifier

To provide top performance, there was no skimping in the design of the i.f. amplifier. Six tubes are used: Three i.f. amplifiers, two limiters, and a discriminator type of detector. The operating frequency is 10.7 megacycles. Distortion measurements show less than ½ of 1% harmonic content, and the frequency range includes 20 to 20,000 cycles with a variation of only 2 db. The de-emphasis network uses a 500 $\mu\mu$fd. condenser with a 100,000 ohm resistor giving a time constant factor of 50 microseconds. Although the standard FM de-emphasis characteristic is 75 microseconds, it was felt that a little advantage on the high frequency end was desirable, due to capacity effects in shielded wires used to couple the tuner to the amplifying equipment.

A "Pre-Fab" tuner, in combination with one of the better audio amplifiers now being produced, leaves little to be desired from a reproduction standpoint. The design of this tuner had the home builder and audio enthusiast in mind in presenting this versatile chassis for all applications from the laboratory of the experimenter to the control panel of a radio station.

—30—

TV ANTENNA COUPLER

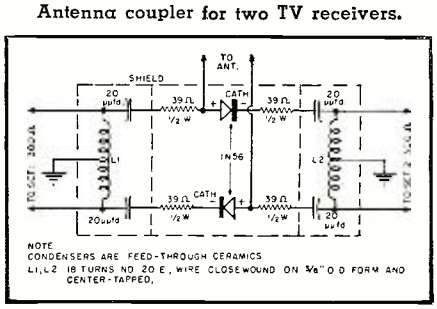
By WILBUR J. HANTZ

AFTER considerable experimenting to find some means of providing adequate isolation between television receivers when they are operated from the same antenna, I finally came up with the idea shown in the schematic.

In addition to providing a good impedance match between the two TV receivers and the transmission line, this gadget also prevents oscillator radiation from feeding back through the receivers. The 1N56 crystal diodes are strictly one-way devices as far as the signal is concerned but they present a very high impedance to any signal trying to come back from the receivers.

When constructing the unit, it is advisable to isolate each low-pass filter section in an individual can, grounded to each receiver's chassis. If the receivers are of the transformerless type, then ground through a 100 $\mu\mu$fd. mica condenser. —30—

Antenna coupler for two TV receivers.



FOLDED LONG WIRES

By BOB PERTHEL, W9MWD

Solve the problem of feeding long lines without resorting to complicated matching or end feeding.

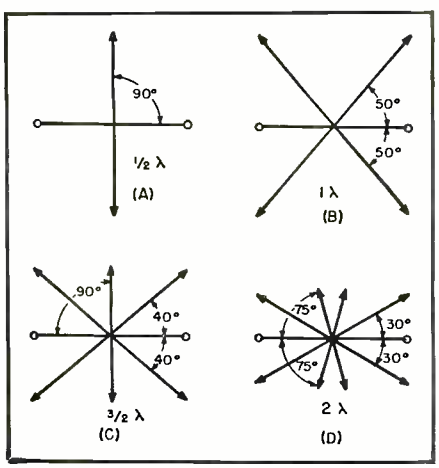
JUST what to do about an antenna for 20 meters if you can't put up a good beam because of space limitations has bothered me for some time just as I imagine it must be bothering other city dwelling hams, or those with cramped spaces.

The antenna I was using was a 20-meter half-wave doublet, with length determined by formula, fed with 50 feet of 75 ohm coax. Careful examination proved that great standing waves existed. Further observation led me to believe that the proximity of two houses and a tree were affecting the electrical length, and probably to a greater degree on one side of the feedline than the other.

A folded half-wave doublet could be expected to be broad tuning and, as a consequence, not affected as much by trees and houses. So up went a folded dipole, but a little more in the clear this time. It worked well, but only in two directions. It was observed during two months of operation that although the pattern was what might be expected locally, this did not hold true on skip and the only directions that could be worked consistently were directly broadside to the antenna. See Fig. 1A. Why a half wave should show such marked directional characteristics is probably because the vertical angles of the power radiated due to ground reflection vary throughout the normally expected pattern, but directly broadside to the antenna all desirable vertical angles are present in the pattern. Incidentally, this effect holds true for lobes of long wires.

The particular folded dipole that I used ran directly east and west, permitting reliable communication with only a few stations because of my central U.S. location. Since it was impossible to change the direction of the dipole, the possibility of using folded antennas of other than a half wave to obtain a different pattern was pondered. Folding a half-wave antenna broadens its resonance and multiplies its radiation resistance by a factor of 4. These characteristics hold true for folded antennas of other lengths too. The curve in Fig. 2 shows how radiation resistance varies with the length.

Fig. 1. Angles of maximum radiation to be used in orienting folded long wire units.



Folded antennas of 1, and 3/2 waves were tried at W9MWD and these, too, showed marked directional effects as shown by Figs. 1B and 1C. In addition to permitting operation in desirable directions these antennas also have a slight gain over a half-wave antenna.

Another nice thing about these antennas is that the lengths can be calculated by formula and fed with a flat line that requires no tuning, just link it to the final. On even harmonics these antennas can also be worked by using voltage feed and tuning the feed line in the conventional manner but, of course, with standing waves on the feedline and a different radiation pattern. When voltage-feeding an antenna of this sort its radiation pattern is difficult to predict as the waveforms on it may differ in regard to phase from what might normally be expected.

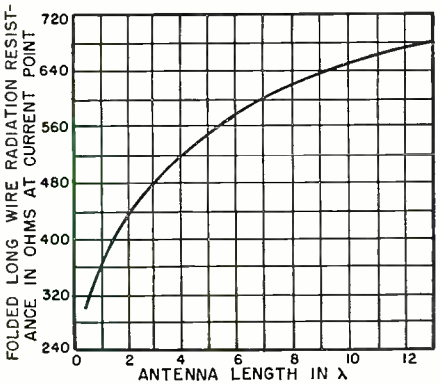


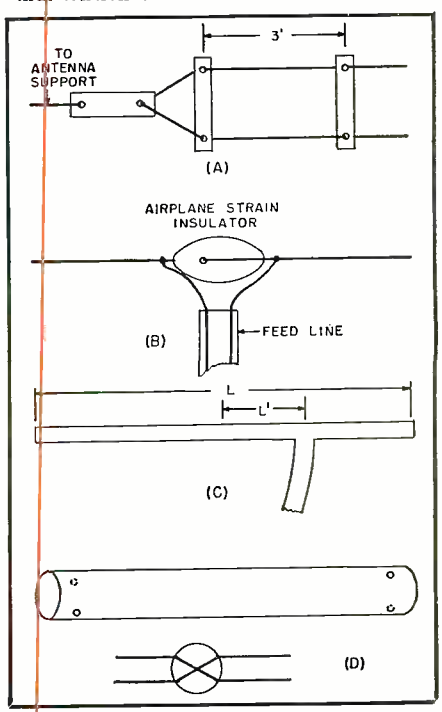
Fig. 2. Radiation resistance curve.

The folded antennas used at W9MWD were all for 20 meters and constructed of number 16 wire spaced 4 inches by 6-inch lengths of plastic tubing at 3-foot intervals. The insulation need not be the best and even wood would do. Plastic tubing was used only because it was the lightest material available. Regular 300-ohm line was used to feed these antennas, and it provided a satisfactory flat line in all cases. Open wire line could be constructed to match the impedance with less line loss but the line loss with 300-ohm line is so low that it wasn't considered worth the added effort. With folded antennas longer than 3/2 waves, an open wire line of the proper impedance should be constructed to prevent standing waves on the feed line. Since end effects occur only once, the formula, L (*feet*) $= 492\ (N-.05)/f$ (*mc.*), where N is the number of half-waves, must be used to determine the length. In order to current-feed these antennas properly, which can be at any convenient current loop, the fact that end effects occur only at the end must again be considered. Start at the center and using the free space formula L (*feet*) $= 492/2f$ (*mc.*) calculate the distance to the current loop.

There is no reason why folded long wire antennas couldn't be designed for use on any of the amateur bands with equal success, however different spacing of the antenna itself would probably be better than the 4 inches used on 20; 8 inches for 80 and 2 inches for 10 meters is suggested. Varying the spacing does not affect the radiation resistance of the antenna. The step-up in impedance is due to the current dividing between the two conductors of the antenna.

A folded full wave is in use at the present time on 14,206 kc. This antenna provides lobes through Central Europe, Eastern South America and Africa, Alaska, and Australia, and long 100% QSO's to all these places have become a reality with only 90 watts input to the transmitter on 20 meter fone. —30—

Fig. 3. Construction details. Note that (D) shows method of drilling plastic tubing so that tension of antenna will hold spacers.



Speaker Enclosure

(*Continued from page 49*)

with a pencil draw the inside outline of the frame on the front piece.

Probably the neatest way to finish the enclosure is to paint it exactly the same color as the wall. If that is not possible or desirable, it can be painted some other color or an ambitious builder can put a furniture finish on it. Matching it to the wall, however, as was done here, makes it most unobtrusive and eliminates the necessity for furniture finish without giving the job a "homemade" look.

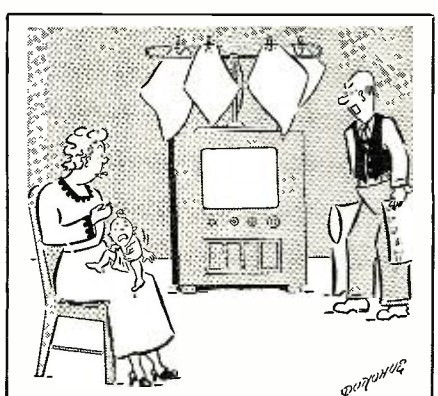
In any case, paint the area of the front that will be within the frame a dark color. Then when a cloth is put in the frame and the frame mounted, the outlines of the speaker holes will not show.

Lumite, a plastic cloth made especially for this purpose is ideal; it can be obtained from parts suppliers. Another cloth can be used, however, with the proviso that it should (*a*) not be soft and (*b*) have a very loose weave. Soft cloth will absorb highs and tight weaves will block off the sound. If in doubt, try sample pieces, placing them by hand in front of the speaker and then removing them. They should not alter the sound quality.

One hint for those not familiar with painting wood. Before painting apply a coat of shellac—very, very thin shellac—and let it dry for a couple of hours. This fills the wood so it does not absorb the paint and require several coats. The paint itself can be flat wall paint of good (not ordinary apartment-house) quality to match the wall exactly, but easier and better results are obtained with enamels such as the painter uses on doorframes and other woodwork. The enclosure in the photos was painted flat, however (three coats) and turned out nicely.

Mount the crossover network and any other parts such as the high-frequency volume control inside the enclosure on the front panel or perhaps on the woofer frame. Lead the audio line out through a small hole at one bottom corner of the front piece.

The lady of the house should now be properly impressed. —30—



"I keep telling you, Madge . . . that antenna is a dipole, not a didy-pole!"

Crystal Diodes

(*Continued from page 57*)

age the tube is cut off. Thus the sync pulses will always cut off the picture and variations in signal strength will always adjust automatically to this condition. An attempt is made to help you visualize what happens in the diagram of Fig. 3B.

Fig. 4 shows a comparative set of current-voltage curves for the 1N34, 1N65, and ½ a 6AL5. The slopes of the crystal diode characteristics are materially greater than the slope of the 6AL5 characteristic at any com-

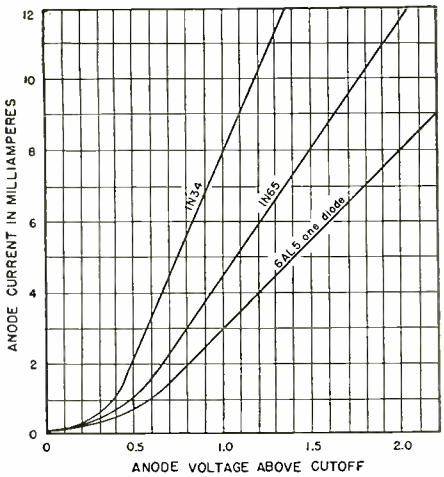


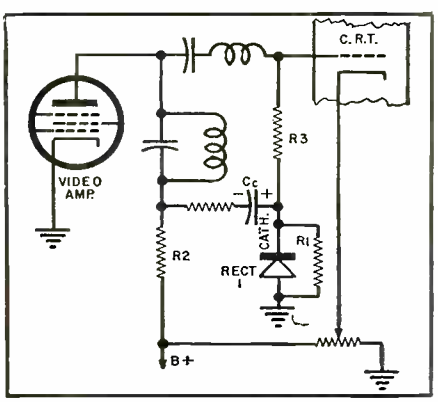
Fig. 4. Characteristics of the IN34 and 1N65 crystal diodes and one-half of a 6AL5 tube.

parable point on the graph, including the low signal levels from .5 to .05 volts.

Fig. 5 is a circuit used in a number of modern receivers and employs a 1N65 germanium diode for d.c. restoration. Note that the germanium diode is not placed across the entire output of the video amplifier, but only across the portion obtained from R_2. Any variations of the video signal extending below the a.c. axis would result in a current flow through the d.c. reinsertion diode, charging condenser C_c to the peak level of the applied voltage. During the positive portions of the signal the charge accumulated on C_c may discharge through R_1 to ground, but it is likely to hold its charge or most of it.

The time constant of the C_c, R_1 com-

Fig. 5. The G-E Model 10T1 d.c. restorer.



bination is long enough for the voltage on C_c to remain practically constant throughout each horizontal line. This biases the picture tube in series with the picture signal as it varies with the height of the pulse peaks. Thus all the pulse peaks are lined up at the picture tube grid. R_3 is used to isolate the diode from the cathode of the picture tube so that the diode capacity will not reduce the high frequency response of the video output.

Defective restorer action is not usually apparent unless there is considerable change in background during a program. The usual sign of trouble is that the brightness control must be readjusted continually. Try a new diode first, then check the resistors and condensers.

A factor in favor of diode use is the interpretation of maximum crystal ratings in connection with their application as d.c. restorers. Since the published ratings are in terms of d.c. conditions, which imply a duty factor of unity, these ratings may be exceeded by a large percentage in pulse operation with no detrimental effects. This holds particularly true with respect to the maximum peak inverse voltage rating.

Some engineers disagree with this concept but since reverse current during a break-down of the crystal is limited by the circuit, it probably will not hurt the crystal too much to exceed the peak inverse voltage rating.

The peak signal available at the grid of the picture tube is usually about 40 volts, of which 10 volts is in sync and the other 30 represents video signal. Under the worst possible condition with an all white field prevailing the restored d.c. is approximately 24 volts; this, plus the sync pulse of 10 volts, subjects the diode to a maximum peak inverse voltage of 34 volts. Germanium diodes will easily withstand this type of service use provided certain precautions are taken regarding temperature.

The temperature rise in the hottest portions of the television receiver seldom exceeds 40 degrees Centigrade, or 104 degrees Fahrenheit. Above 55 degrees Centigrade, or 131 degrees Fahrenheit, the change in d.c. output becomes an appreciable percentage of the initial voltage. Therefore, it is advisable to locate a reinsertion diode (or any crystal, for that matter) at some point on the chassis where the temperature rise will be at a minimum. Below 40 degrees Centigrade, the changes in germanium diode characteristics are not a problem.

—30—

OSCILLOSCOPE PATTERNS QUIZ

By ED BUKSTEIN

Northwestern Vocational Institute, St. Paul, Minn.

(For Answers to the Quiz, See Page 137)

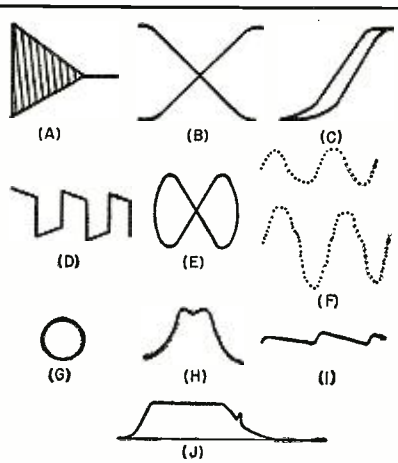
THE cathode-ray oscilloscope is to the radio-electronic technician what the stethoscope is to the doctor. Both of these instruments reveal, to the trained observer, vital information concerning the condition of the circuit or organ in question.

The technician works with invisible forces. He cannot see the high frequency currents surging back and forth in the tank circuits, he cannot see a charge of electrons accumulating on a condenser plate, he cannot see the counter e.m.f. generated in an inductance—he cannot see these things unless he uses an oscilloscope. To work without this instrument is to work blindfolded and handicapped.

The technician who has mastered the use of the oscilloscope, who has learned to interpret its patterns, who knows its capabilities and limitations, is a competent technician. He can "diagnose" an ailing circuit with the rapidity and sureness of an experienced physician diagnosing an organic disorder.

You can check your knowledge of the applications of the oscilloscope by pairing the words and definitions listed below with the patterns they suggest. Record your answers in the boxes provided and then check your score against the correct answers given on page 137. Your numerical score can be translated into its verbal equivalent as follows: 10 correct is excellent; 9 correct is very good; 8 correct is good; 7 correct is fair; and 6 or less correct is poor. —30—

- ☐ 1. Hysteresis measurement
- ☐ 2. Power supply ripple
- ☐ 3. Overmodulation
- ☐ 4. Phase measurement, 90°-angle
- ☐ 5. Frequency comparison, 2:1 ratio
- ☐ 6. Overcoupling
- ☐ 7. TV alignment
- ☐ 8. Electronic switch
- ☐ 9. Audio amplifier testing
- ☐ 10. Discriminator alignment



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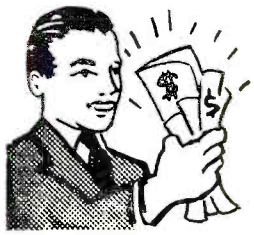

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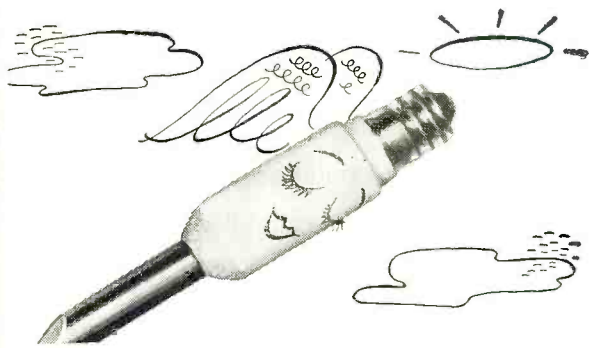

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5Y3GT	.46	6W4GT	.65	25L6GT	.74
6AL5	.58	6X5GT	.52	35W4	.46
6AU6	.64	12AT6	.55	35Z5GT	.54
6AV6	.55	12AT7	1.04	50B5	.74
6BG6G	1.92	12AU7	.80	50C5	.74
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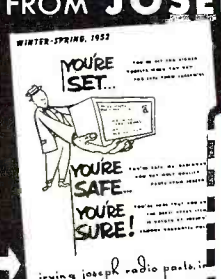

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Electrostatic Focus

(*Continued from page 63*)

accelerating grid, G_2, is recommended for the focusing anode. To obtain this higher voltage it may be necessary to connect the focus control to the horizontal boost voltage. Actual practice has shown that the first value, the approximate center of the voltages shown in Table 1, gives the best focus and the entire range indicated here is hardly needed. The table also shows that there are two types of low voltage focus tubes available and their major difference is the focusing voltages required. The 17RP4 and 20LP4, for example, would best be used in a receiver where the cathode of the picture tube is close to ground potential and the "B plus" supply has a negative bus which is below ground potential. However, the intelligent technician will be able to determine the best tube type for each replacement job by checking the d.c. voltages on the picture tube elements and referring to Table 1 for the closest approximation to the receiver voltages.

To make the actual installation an additional wire must be brought to the picture tube socket and a new prong must be fitted to make contact with pin #6. If a half round type socket is used it is usually better to install an entirely new, circular type socket than to hook up some makeshift arrangement.

In general, the problems of servicing electrostatically focused picture tubes will be less than for the magnetic types. Such common defects as a burnt focusing control or a shorted focus coil will not be found in the new type tubes. But some new and peculiar features deserve special attention.

The ion trap used in all electrostatic focus tubes is of the single magnet type. Its adjustment on the neck of the tube is much more critical than on magnetic focus tubes because the ion trap location can influence the focus to a large extent. The ion trap should be adjusted only for maximum brightness and when all other tube elements are functioning properly, good focus will be obtainable by adjusting the focus control only. In an electrostatically focused tube it is possible to obtain brightness with incorrect voltages on G_2 and the focusing anode, if the ion trap is also misadjusted slightly. The resulting picture may have some focus in the very center of the screen, but the edges certainly will appear fuzzy. If improper focus is observed at any time with an electrostatic focus picture tube, measure not only the focusing voltage but the voltage on G_2 and the second anode as well and remember that they should be measured with respect to the cathode of the tube.

In magnetic focus tubes the centering of the picture is often accomplished by tilting the focus coil or otherwise varying the symmetry of the magnetic field. For electrostatic focus tubes a small PM centering device is usually employed to provide the centering action. Various types of PM rings, small PM tabs on cardboard discs, and similar devices are used by different manufacturers. The correct location for this centering device is as close to the deflection yoke and as far from the ion trap as possible. More centering action will be obtained if the magnets are closer to the ion trap, but at the same time some interaction takes place between the two magnetic fields resulting in less brightness, corners cut off, or even poor focus.

All of the new electrostatic focus tubes use a wide deflection angle, 66 degrees horizontally and 70 degrees diagonally, and this requires a short, wide angle deflection yoke. In most 1952 receivers these deflection yokes feature a special winding system which provides even focus over the entire screen area. Sometimes these "Anastigmatic," "Cosine," or "True-focus" yokes cause pincushioning at the top and bottom of the screen. To overcome this effect several manufacturers use small correcting magnets on the top and bottom of the deflection yoke. These anti-pincushioning magnets are currently found in some *Philco, RCA,* and similar models.

Aside from defective focus, the electrostatic focus tubes are subject to all of the usual picture tube defects such as becoming gassy, losing their vacuum, or going "soft." Internal arcing can occur on even the latest models if the second anode voltage is excessive or is not properly filtered d.c. For example, if the HV filter condenser were open the anode voltage would contain large positive pulses exceeding the 16 kv. limitation. Arc-over could then occur from the second anode to the focusing element. On checking the HV with a d.c. meter, only the average value would be read, giving no indication of the trouble. The only method of approaching this sort of defect is to replace the HV condenser and again measure the d.c. voltage across it. With a good filter condenser the arcing should then stop, unless the defect is due to the picture tube itself. In the HV type of electrostatic focus tube internal arcing is less likely but additional HV troubles can be encountered in the focus control circuit. Defects in any of the components in the control circuits, failure of the HV rectifier, etc., can result in loss of focus or, if the focus element were grounded, internal arc-over could occur. Measuring the voltage and resistance values in this section will invariably show up the defect at once.

All-in-all the new electrostatically focused picture tubes promise no additional burden on the service technician and certainly represent a reduction in the weight and complexity of TV sets. Born of the necessity for conserving scarce materials, these new picture tubes are a major advance towards better, cheaper, and simpler television receivers. —30—

Technical BOOKS

"REFERENCE DATA FOR RADIO ENGINEERS" by Federal Telephone and Radio Corporation Staff. Published by *Federal Telephone and Radio Corporation,* New York. 640 pages. Price $3.75. Third Edition.

The third edition of this popular reference work is the largest and best of the series. It is more than twice the size of the preceding edition and is three times as large as the initial publication.

The book is packed cover-to-cover with pertinent data which has been set up, in most cases, in tabular form to facilitate its use. The book is divided into twenty chapters which cover such subjects as frequency data; units, constants, and conversion factors; properties of materials; components; fundamentals of networks; selective circuits; filter networks; attenuators; bridges and impedance measurements; rectifiers and filters; iron core transformers and reactors; electron tubes; amplifiers and oscillators; modulation; Fourier waveform analysis; transmission lines; wave guides and resonators; antennas; radio wave propagation; radio noise and interference; radar fundamentals; broadcasting; wire transmission; electroacoustics; servomechanisms; miscellaneous data; Maxwell's equations; mathematical formulas; and mathematical tables.

* * *

"TELEVISION ENGINEERING" by Donald G. Fink. Published by *McGraw-Hill Book Company,* New York. 702 pages. Price $8.50. Second Edition.

Although technically designated a "second edition," this volume is an almost completely rewritten version of the author's "Principles of Television Engineering" which appeared some 12 years ago.

The author has followed the same basic pattern in preparing this material that prevailed in the first edition. He has assumed that the reader is familiar with the elementary principles of vacuum tube circuits and the processes of amplification, modulation, carrier transmission, and demodulation. Circuits and theories that are peculiar to television are covered thoroughly, beginning with the basic concepts.

The text material is divided into eleven major categories covering the television system as a whole, analysis and synthesis of images, cameras and picture tubes, scanning and synchronization methods, transmission of the video signal, video amplification, carrier transmission of picture and sound signals, color fundamentals, color TV systems, television broadcasting equipment, and television receiving equipment. An appendix carries the FCC "Standards of Good Engineering Practice" in abbreviated form as a reference. —30—

Mac's Service Shop

(*Continued from page 70*)

"Check the filament drop across that 12BA6," he ordered importantly.

Mac turned his head aside to conceal a grin as he obediently hooked the v.t.v.m. across the filament prongs of the tube. "Well I'll be—" he exclaimed. "There's only about five volts drop here."

"I thought so," Barney said complacently. "I had one just like that the other day except that a 12BE6 was the joker then."

"What do you think happens?"

"I think that a loop of the filament shorts out after the tube reaches a certain temperature. That cuts down the heat delivered to the cathode and reduces the emission."

"Why didn't the tube checker burn out the part of the filament being heated?"

"Because you checked the tube the first thing, before it got hot enough to short out. I'll bet if you yank it out of the set and pop it into the checker before it has time to cool down it will burn out now."

Mac quickly jerked the tube from the set and stuck it into the tube tester. The filament glowed brilliantly for a second or so and then went dark.

"Aw, quit trying to look as though you just invented perpetual motion," Mac said in mock disgust at the self-satisfied look on Barney's face.

"Say, Boss, not to change the subject," Barney said with more interest and enthusiasm than he had shown in weeks, "but where were you last night? I called and called because I wanted to double-check with you on some transmitter trouble on Channel 6 that was making the picture cut some funny didoes, but nobody was home."

"I was over fixing Old Man Bennett up with an earphone on his TV set. He is pretty hard of hearing, you know, and all he was getting out of his set was what he could see. Wrestling matches and prize fights were about all that made sense to him."

"Couldn't he listen with his hearing aid?"

"Not to do any good. If you ever played with one of those things, you would know that the microphones they use do the same thing any microphone does: exaggerates echoes. You've doubtless noticed that a person standing a few feet away from a broadcast microphone in any room except a studio always sounds as though he were talking in a huge hall, even though the room may be quite small. Exactly the same thing happens when you talk to a person wearing a hearing aid from a few feet away from him, and this echo is just enough to confuse a person whose hearing is not up to par. When Mr. Bennett sat right up against his TV set, he could hear pretty well; but when he backed off far enough so that the picture looked good, he could

not understand what was being said."

"What kind of an earphone did you use?"

"A regular hearing-aid earphone that would snap into the moulded plastic earpiece he has. It so happened that he had an old hearing aid he no longer uses, and I got the earphone from that. I measured it and found that it had a d.c. resistance of about 30 ohms; so I tried it right across the voice coil of the speaker, and it worked beautifully. When the set is adjusted to just normal room volume from the speaker it is also just right for Mr. Bennett and his earphone, and the extra load represented by the earphone is so light that you cannot notice any difference when it is connected across the speaker. I ran a couple of leads from the voice coil to a jack on the back of the cabinet. From a plug in this jack a length of lampcord runs down through a small hole in the floor behind the cabinet, across the joists in the basement, and then back up through another small hole in the floor to a jack mounted on the baseboard right beside Mr. Bennett's favorite chair across from the TV receiver. A few feet of flexible cord and a plug allows him to plug his earphone into either this jack by his chair or the one on the set."

"Why both jacks?"

"Well, usually his wife tunes the TV set, but there might be times when he will have to do this for himself. Then all he has to do is pull the earphone plug from the jack beside his chair and walk over and plug into the jack on the receiver. When he has the set correctly tuned, he can replace the lampcord plug in the cabinet jack and go back and plug his earphone into the baseboard jack. On top of that, the jack on the cabinet allows the lampcord to be disconnected when it is necessary to pull the set away from the wall."

"What did he think of it?"

Mac smiled reminiscently as he replied, "Barney, when I saw that old man sitting there chuckling and slapping his leg at some of Bob Hope's fast-talking nonsense, I felt I had been repaid for all of the headaches we have in this wacky business. The few minutes spent attaching that earphone to the TV set meant hours and hours of pleasure and entertainment for that old fellow."

"Yep, Boss," Barney agreed, "this radio and television game is a pretty good one at that. There are times, of course, when a fellow feels a little low and discouraged as I did a couple of hours ago—although I'll be darned if I can see *why* now—but most of the time I feel as I do right this minute when I can hardly wait to get at the next set."

"Hold that mood!" Mac shouted as he dashed across the room, snatched a small set from the set-to-be-repaired group, and rushed back to place it on the bench in front of his broadly-grinning, red-headed assistant.

—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.

RECTIFIER REPLACEMENT

The Selenium-Intelin Division of *Federal Telephone and Radio Corporation,* 100 Kingsland Road, Clifton, New Jersey has just issued a "Selenium Rectifier Replacement Guide" designed to facilitate receiver servicing.

This 32-page book is divided into nine sections covering TV replacement part numbers, radio replacement part numbers, code numbers and miscellaneous replacements, operating characteristics of *Federal* units, fundamental circuits and servicing information on *Federal* rectifiers, servicing information, data on how to replace the 35Z5 with the company's 100 ma. selenium rectifier, "packaged power," and a cross index of part numbers.

Copies of this guide are available from the company at a charge of 50 cents each.

"REPS" DIRECTORY

The Los Angeles Chapter of "Representatives, Inc." has issued its 1952 directory, containing 40 pages and covers.

This seventh edition carries a comprehensive product index with 310 subheads and upwards of 4000 listings under various classifications. The data includes an alphabetical list of manufacturers represented, the officers and committeemen for 1952, and a list of senior members and associates.

Copies of this new directory are available from the chapter's publication office at 767 Castelar Street, Los Angeles 12, California. Requests should be addressed to the attention of the executive secretary-treasurer, Dr. Ralph L. Power.

RCA TV BOOKLETS

The Tube Department of *Radio Corporation of America,* Harrison, New Jersey has released two of its new television data books to all technicians.

The first booklet, *"RCA* Kinescopes," is a comprehensive manual containing data on more than 100 different kinescope types now in use. The publication provides such reference information as characteristics of the company's complete line of kinescopes, a replacement directory listing competitive units and the corresponding *RCA* "direct replacement" type or the company's "similar type," and a picture tube conversion chart. This book is listed at 25 cents.

The second publication is entitled "Television Servicing" and comprises a collection of special articles prepared by *RCA's* John Meagher and Art Liebscher. In addition to new articles on TV servicing by Mr. Meagher and a new paper on TV tuner alignment by Mr. Liebscher, the book contains all of the Meagher articles on TV servicing which originally appeared in the *"RCA* Radio Service News." Subjects covered include r.f.-i.f. alignment, troubleshooting, and circuit analysis. This book sells for 35 cents.

Either or both of these new publications are available from the company's tube distributors or from the Commercial Engineering Section of the Tube Department.

DESIGN INDEX

Thordarson Meissner Manufacturing Division, Mt. Carmel, Illinois has issued a comprehensive reference work covering more than fifty-thousand field-proved transformer designs.

The new publication, which covers virtually the entire field of filters, chokes, and transformers presently required by the industry, has been issued in book form and is available to engineers.

Inquiries regarding this new "Transformer Design Index" should be addressed to the company at Mt. Carmel.

NEW ASA STANDARD

The American Standards Association, 70 East 45th Street, New York 17, N. Y. has released its new standard covering "Graphical Symbols for Single Line Electrical Engineering Diagrams."

The new standard (Z32.1.1-1951) coordinates and modifies the single line diagrams contained in the "American Standard Graphical Symbols for Electrical Power and Control (Z32.3-1946) and for "Telephone, Telegraph and Radio Use" (Z32.5-1944).

For the first time single-line diagrams for use in both power and communication work are combined and contained in one volume. They represent an agreement reached by representatives of the electric, telephone and telegraph, radio, public utilities, and the government on standard single-line symbols.

Copies of this new standard are available from the ASA at $1.40 per copy.

COAX CONNECTORS

Transradio Ltd., 138A, Cromwell Road, London, S.W.7, England has issued a bulletin describing its line of precision coaxial connectors.

The publication, which has been designated TR-7B, pictures several different types of units and provides comprehensive data on the company's

complete line in tabular form. A few types of U.S. JAN connectors are also listed on this data sheet.

Requests for copies of publication TR-7B should be sent direct to the company.

WRL 1952 CATALOGUE

World Radio Laboratories, Inc., 744 W. Broadway, Council Bluffs, Iowa is now offering copies of its new 1952 catalogue to interested persons.

Designated Catalogue No. 12, this new 140-page publication lists transmitting equipment, converters, tubes, amateur gear, test equipment, television accessories, books, service manuals, etc. It also carries a listing of reconditioned equipment available from the company.

The catalogue is indexed by both manufacturer and product to facilitate reference. Copies of this publication are available without charge.

HIGH-MU POWER TRIODE

Lewis and Kaufman, Inc., Los Gatos, California now has available a technical data sheet describing its Type 100TH high-mu power triode.

The tube is illustrated and described with dimensions, operating curves, and electrical characteristics. Typical operation and maximum ratings are given for the tube in service as a class AB audio frequency power amplifier and a class C power amplifier and oscillator.

SURVEY OF LUMINESCENCE THEORIES

The possibility of better television tubes and fluorescent lamps is suggested in a survey by Navy researchers on the theories of luminescence which is now available in booklet form from the Office of Technical Services of the U.S. Department of Commerce, Washington 25, D. C.

The report provides a fairly extensive theoretical background based on existing theories as they apply to individual systems of luminescence. These theories reveal how luminescence problems have been treated gen-

(*Continued on page* 136)

erally and may be used as a guide in understanding the processes involved.

Major subjects covered include activators, electron traps, efficiency of luminescent materials, etc.

Orders for report PB 102 597 must be accompanied by check or money order for $1.00, made payable to the Treasurer of the United States.

SHOCK TESTING

Haines Designed Products Corporation, 117 North Findlay Street, Dayton 3, Ohio has available copies of its 4-page technical bulletin, "Instrument Shock Testing Theory and Measurement" which it will distribute to interested persons.

The booklet describes in detail the use of the company's shock testing mechanism (conforming to JAN-S-44 specification). Calculations, operation, and instrumentation are fully covered.

REPLACEMENT CONDENSERS

Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey has just released its 28-page catalogue covering service replacement condensers.

Known as Catalogue 200C, the new publication lists several new *C-D* condenser types, extends the regular listings to include additional popular sizes and values, and carries data on the company's complete line of electrolytic photoflash units and commercial mica transmitting and replacement transmitting condensers.

Indexing and listings have been simplified, making for quicker and easier identification of the products.

Copies of this catalogue are available from *C-D* jobbers or from the Jobber Division of the company at South Plainfield. Specify Catalogue 200C.

CABINET DATA

G. & H. Wood Products Company, 75 North 11th Street, Brooklyn 11, New York now has available for distribution a folder covering its "Cabinart" line of cabinets for radio and television.

Twelve individual sheets are included in the folder which provide complete data on a wide variety of cabinet units. Speaker housings, radio-phonograph cabinets, television cabinets, and combination units are included.

Copies of this folder and data sheets on the company's corner folded horn enclosures (both assembled and in kit form) are available from the company.

ASTRON CATALOGUE

Astron Corporation, 255 Grant Avenue, East Newark, New Jersey has issued a new catalogue which gives performance data and test characteristics on its line of condensers and r.f. interference filters.

Designated Catalogue AC-3, the new publication lists and illustrates a comprehensive line of dry electrolytics, along with all applicable engineering data. The "Metalite" section covers, in addition to pertinent data, the history of the use of metallized paper in

condensers, advantages, and engineering performance data, curves, and test procedures.

A request on organization letterhead will bring a copy of Catalogue AC-3.

RADIO-RECORDER SLIDES

Grant Pulley & Hardware Company, 31-85 Whitestone Parkway, Flushing, N. Y. is currently offering a new, four-page circular describing the uses, application, and installation of the company's "radio-recorder slides."

These slides enable the radio, recorder, or phonograph unit of a console to slide in or out of its cabinet. The booklet describes the two different models that are currently available —one for underneath mounting and one for side mounting.

JOHNSON CATALOGUE

E. F. Johnson Company, Waseca, Minnesota has announced the availability of its new "General Products Catalogue #972."

Products listed for the first time include the company's "Viking 1" transmitter, the "Viking" v.f.o., the Faraday shield for the company's plug-in links, #229-201 rotary inductor, #126-105 crystal socket, and the company's new knob and dial line.

NEEDLE GUIDE

M. A. Miller Manufacturing Company, 1169 East 43rd Street, Chicago 15, Illinois has issued a revised needle replacement cross reference guide which has been brought up-to-date as of December 1951.

The guide clearly presents the catalogue numbers of all cartridges and correlated needles. Included are the company's catalogue numbers and also catalogue numbers of other leading needle manufacturers.

The material is presented in tabular form to facilitate the use of the catalogue by dealers, service technicians, and jobbers.

MOTOR GENERATORS

A copy of Bulletin 440 describing the company's complete line of 400 cycle motor generator sets is now available without charge from *Bogue Electric Manufacturing Company,* 52 Iowa Avenue, Paterson 3, N. J.

These motor generator sets, which have been designed for use in laboratories, factories, in industrial operations for testing electronic equipment, and operating high frequency motors and radar equipment, are comprehensively discussed in this new publication.

Requests for copies should be addressed to L. G. Sands, general sales manager of the company. —30—

ANSWERS TO QUIZ

(See page 128)

1	C	4	G	8	F
2	I	5	E	9	D
3	A	6	H	10	B
		7	J		

R. F. Amplifier

(*Continued from page* 55)

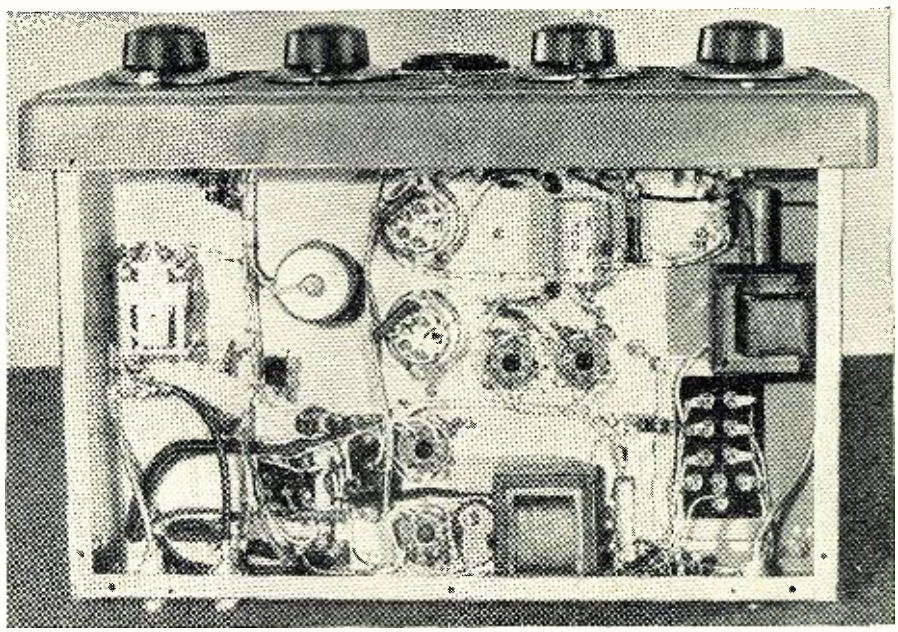
The three self-contained power supplies furnish all operating voltages, plus regulated power for the exciter. The high voltage power supply uses a single 5R4GY, the high vacuum type being preferred over mercury vapor rectifiers to prevent the radiation of "hash." The filter choke and plate meter are connected in the "B-minus" lead to reduce the shock hazard. A double-pole, double-throw antenna relay is installed under the chassis to switch the antenna to the receiver coax and open the high voltage transformer center tap when S_1 is thrown. The output condenser, C_{21}, on the high voltage power supply should have a capacity of at least 8 μfd., not because of hum, but to assure low output impedance to supply the peak currents to the class B r.f. amplifier. The high voltage should measure 750 volts.

The low voltage supply delivers 300 volts to the 6AG7 and the 807 screens. It is important that this voltage be within five per-cent of this value. The transformer used in this unit had a rather low a.c. voltage output, so a 5Z4 rectifier was used. This tube has a very low internal voltage drop. Most small transformers of the type suitable for T_1 deliver about 350 volts a.c. each side of center tap, so the d.c. output would probably exceed 300 volts. If this is the case, a 5Y3 rectifier could be substituted to reduce the d.c. output. S_1 opens the center tap of the low voltage supply on standby. An additional switch, S_2, closes only the low voltage supply center tap through a resistor, leaving the high voltage off. This gives a low voltage to the exciter for spotting the exciter signal in the receiver, while the voltage is too low to harm the screens of the final amplifier. Two VR105 tubes are used to stabilize the exciter "B" supply voltage.

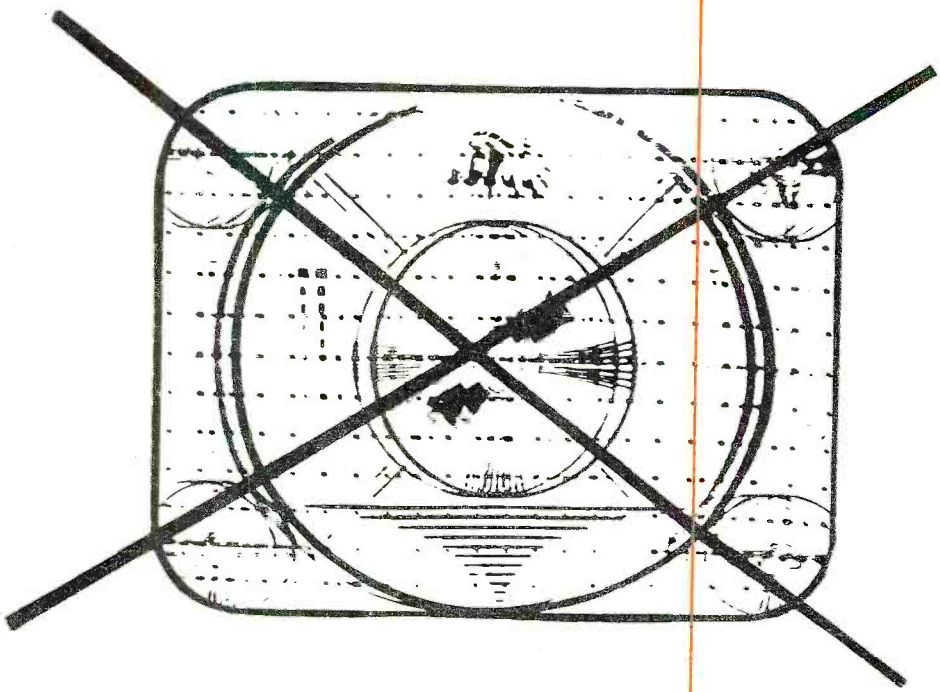
The bias supply is turned on by the line switch, S_3, and remains on at all times. This supply uses a half-wave selenium rectifier so the bias appears almost instantly when the transmitter is turned on. T_2 should have a secondary voltage of between 50 and 110 volts. Because of the half-wave rectifier, it is possible to vary the bias over a wide range merely by adjusting the load resistor, R_5. Transformers of this type are rather scarce, but a filament transformer operated backwards from the filament supply will make a satisfactory substitute. The value of R_5 is adjusted to provide a bias voltage of approximately 30 volts on the 807's. The best way to adjust this resistor is to set its value at the point where the total plate current with no excitation is 60 ma. to the two final tubes. The plate voltage should be 750 or near this value, and the screens should be set at 300 volts. A variable slider type resistor may be used for R_5 in determining this resistance, after which a fixed resistor of the proper value may be permanently wired in. About 500 ohms is the maximum value of resistance which should be used to avoid poor regulation of the bias voltage.

Tuning the transmitter is quite simple. One precaution—don't try to operate the 6AG7 as a doubler. The harmonic output of a class A stage is practically nil and if you are getting excitation to the final from the driver as a doubler you have too much excitation to the 6AG7. Of course you cannot double an AM signal. For c.w. and FM, the transmitter is tuned in the usual manner, adjusting the swinging link to load the final to about 200 ma. or 150 watts input. After the rig is tuned up it is good practice to reduce the r.f. gain control until the output just begins to drop off. This will in-

Under chassis view. The selenium rectifier disc is mounted under the chassis with the antenna-power supply switching relay. An unpainted chassis is recommended.



what's wrong with this picture?



Television service can be speeded up by correct diagnosis of test patterns. HOW TO INTERPRET WHAT YOU SEE reveals how one leading manufacturer has obtained good results from this type of circuit analysis. Actual photographs illustrate effects of circuit faults on picture quality.

plus—in the big April Issue:
14 other important articles, including:

A SINGLE-SIDEBAND TRANSMITTER ADAPTER which can be used as a companion unit to the "Low-Cost Exciter Unit," and the "150-Watt Universal R. F. Amplifier" as discussed on page 53 of this March issue.

CRYSTAL DIODES IN MODERN ELECTRONICS. A continuation of the series on crystal diodes. This article deals with their use for sync stripping in television receiver circuits.

SERVICING NOISE-REJECTION CIRCUITS. Down-to-earth, "how to fix it" instructions covering one important television receiver servicing problem.

A HIGH QUALITY AUDITORIUM AMPLIFIER. Construction data on a p.a. unit which features two mike inputs, a radio input, and a master mixer.

A MOBILE 75 METER V.F.O. For the ham who operates mobile. This article gives complete construction details on a compact unit which covers the 75 meter band.

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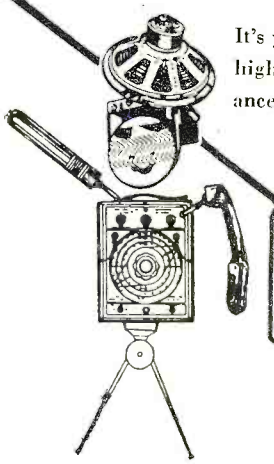

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sure low harmonic output. To adjust the transmitter to amplify AM, excitation without modulation is first applied and the transmitter adjusted for maximum output with plate current of not over 240 ma. The r.f. gain control is then reduced until the plate current drops to 120 ma. and the adjustment is complete. Modulation of the input signal with speech should cause the r.f. output to increase approximately 25 per-cent as indicated by a pilot bulb coupled to the antenna tuner. Power input when amplifying AM is limited to about 90 watts. To amplify single-sideband, the transmitter is first tuned up with carrier input only to an input of 180 watts. The carrier injection is then reduced to completely balance out so that the resting plate current of the 807's is 60 ma. The single-sideband signal is then set at the proper level with the r.f. gain control so that voice peaks will give peak currents of 240 ma.

The universal amplifier has been very satisfactory in operation on 80, 40, and 20 meters with the "A Low Cost Exciter Unit" described in the February, 1952 issue of RADIO & TELEVISION NEWS. On ten meters, the TVI-proofed FM exciter described in February, 1951 *"CQ"* has been used with excellent results. The SSSC adapter, for use on 20 and 75 meters, is inserted between the exciter and the universal amplifier. This unit will be described in a forthcoming article. -30-

EXTENSION TEST LEADS

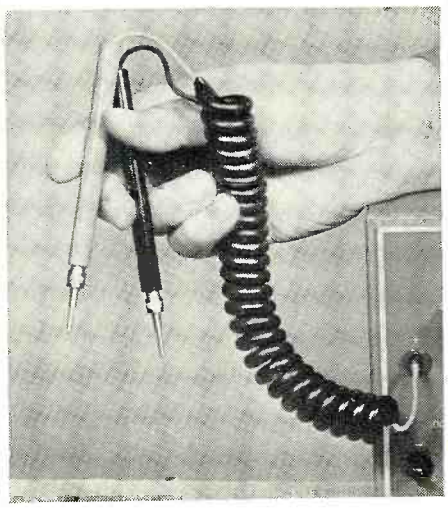
By H. LEEPER

WHILE certain loosely coiled test leads are on the market, for a real compact set of leads try a short length of coiled cable, obtainable from some representative of Western Electric Company.

The coiled cable shown in the photograph is only 7 inches in length and was purchased at a camera shop, which sells the cord for flash guns.

With proper terminals and test prods attached, such twin conductor cable may be pulled out as much as 30 inches and it will then return to original form keeping leads from under foot as ordinary leads usually are found. -30-

Coiled cords make handy service test leads.



International Short-Wave

(*Continued from page* 110)

Gold Coast—Although some sources report Accra using 15.43, in a recent QSL the station said is using *only* 6.049, 4.915; 6.049 is scheduled 0528-0700 and 4.915 at 1013-1330 (Saturday 1043-1330). (Ridgeway, South Africa) Pearce, England, reports the 4.915 channel now closing 1300; has Gold Coast news 1245. According to a station announcement, Gold Coast Time now is the same as *GMT* (5 hours *ahead of EST*), Pearce reports; formerly was *GMT plus 30 minutes.*

Greece—A *new* Armed Forces Station at Khios has been heard in Sweden on 6.590 at 1400-1700. "The Voice of Greece," Athens, now broadcasts to North America 2000-2100 on 7.300, with news 2035-2045A. Programs in Russian are transmitted on 15.345 at 0915-0930; these additional programs are radiated on 7.300—1030-1300 Greek; 1300-1400 Balkan languages; 1430-1445 *English;* 1445-1500 French, and 1530-1700 Greek. (Radio Sweden)

Greenland — Radio Sweden says Gronlands Radio, Godthaab, has replaced 5.942 with 7.094 according to verification card recently received; programs are daily 1630-1845.

Guatemala—TGDA, 7.471, Quetzaltenango, noted with announcement by man as "Radio La Voz de Occidente;" signed off 2203; is audible almost every evening *after* 1900 but is difficult to find due to QRM. (Machwart, Mich.) TGTA, 6.335, noted with musical program 2130-2200. (Sutton, Ohio) TGWA, 9.758, noted ending *English* programs Mon., Wed., Fri. at 1930. (Niblack, Ind.) TGLA, 6.295, Guatemala City, heard 1950-2035; all-Spanish. (Patterson, Ga.) TGNA, 11.85, is fine level in Mass. in *English* 2200-2230. (Van Gilder) Still noted on 9.668 (parallel 11.85) on Wednesdays with Mail Bag in *English* 2230-2300A. (Hoffman, N. Y.)

Haiti—4V2S, 5.950, Port-au-Prince, heard 1900-2000 with fair level but some QRM. (URDXC) Leary, Ind., reports 4VRW, Port-au-Prince, now on 9.965A at 1800. Also is noted mornings; is a "wanderer."

4VPL, *Radio Petionville,* is still using 8.995; is heard by 1600 and probably still signs off 2200; weak with much QRM. (Stark, Texas) 4VWA, 6.300, Cap-Haitien, noted recently 1800-2100 sign-off; 4VCN, 6.406, *Radio Fides,* Port-au-Prince, noted at fine level 1830-2100 sign-off. (Saylor, Va.)

Holland—Latest Hilversum schedules for *English* broadcasts are 0530-0610 to Australia, New Zealand, Pacific Area, 21.48, 17.775, 15.22, 6.025; 1100-1140 to South Asia, 11.73, 9.59, 6.025; 1500-1540 to Africa, Great Britain, Ireland, Continental Europe, 11.73, 9.59, 6.025; 2130-2310 to United States, Canada, 9.59. 6.025. The *"Happy Station Programs,"* produced and presented by Eddie Startz, are Sundays (*only*) at 0530-0700 to Far East Pacific Area,

Europe, 21.48, 17.775, 15.22, 6.025; 1100-1230 to Near and Middle East, Europe, 11.73, 9.59, 6.025; 1630-1800 to South and Central America, 11.73, 9.59, 6.025, and 2130-2300 to North America, 9.59, 6.025.

Honduras—HRP1, 6.351, San Pedro Sula, noted with good level when tuned 2245; announcements in *English* with North American recordings; at 2256 had closing announcements and asked for reports; strong signal in North Carolina. (Ferguson) La Ceiba, 6.235A, signs off 2200. (Stark, Texas) HRXW, 8.982A, Camayagua, noted 1730-1800. (Foerster, Ill.) HRA, 5.925, Tegucigalpa, heard 2000-2245 with music and speech; all-Spanish. (URDXC)

Hong Kong—ZBW3, 9.525, noted 0500 in language by man; heavy QRM. (Winch, Calif.) Heard in South Africa 0900 relaying Radio Newsreel from the BBC, London; closes 1030 with weather report and "God Save the King." (Ridgeway)

Hungary — Radio Budapest noted 1615 in *English* on 6.247A and 7.222A. (Leary, Ind.) Other channel in use is 9.833A which usually has bad QRM from Cuban now on that spot.

Iceland—TFJ, 12.174, noted a recent Sunday signing off 1124. (Catch, England) Is now scheduled (Sundays *only*) at 1115-1130A. Formerly ran 1115-1145. (Oskay, N. J.)

India—AIR is now sending out a QSL card showing the Parliament Building. (Machwart, Mich.) The 1030 news noted on 4.940; 3.495 carries native at that time; noted closing on 4.940 at 1330; and signing on in *English* for Europe 1400 (runs to 1515 now) on 5.990, 7.190, 7.170. Heard on 9.72 with Indonesian music at 1745 tune-in; closed 1800 after announcements in *English*. (Pearce, England) AIR noted on 7.21 at 0345-0415; at 0334-0345 played interval song repeatedly. (Stein, Calif.) Heard on 7.18A around 0730 with woman announcer in *English*, fairly strong signal in New York State. (Chatfield) Leary, Ind., reports AIR on 15.160 at 1630 with good level.

The 0730 news on *measured* 15.380. (Ferguson, N. C.) And heard here in West Virgina parallel on 17.740.

New channels for AIR's External Services include 3.250. 5.960, 7.125, 9.530. (*WRH Bulletin*) AIR, 21.70, has news 0300, is high level in South Africa. (Ridgeway)

Indo-China (*Vietnam*)—"La Voix du Vietnam" noted near 7.090 from 1800 when has news in French; in oriental language 1830. (Pearce, England) This one noted 0645 at good level. (Ferguson, N. C.) Saylor, Va., reports *Radio Dalat* 0130-0145 sign-off, good level on occasion.

Iran—Radio Tabriz is again noted on 6.090A with *English* lesson weekdays 1215-1230. (*WRH Bulletin*) Heard in New York 2340 in native. (Bellington)

Iraq—Radio Baghdad, 11.724, noted 2300 signing on, S7 with preamplification in use; man chanting; good to 2330. (Oskay, N. J.)

Israel—"Voice of Israel," Israeli

Broadcasting Service, Box 1082, Jerusalem, Israel, now has an attractive verification card. (ISWC, London) Tel-Aviv, 9.010A, noted in *English* 1630-1715 sign-off. (Hoffman, N. Y., others) Has news 1430 now on both 9.010A, 6.833. (Pearce, England)

Italian Somaliland—Mogadishu, 7.383, is broadcasting daily 1115-1300 and is heard in South Africa; Arabic 1115-1200 when goes into Italian after set of two-toned chimes; chimes strike 7 o'clock local time; plays recordings 1200-1225 when woman gives news in Italian; continues with recordings to closedown 1300 after station call; identifies in Italian 1115, 1200, 1225, 1300 sign-off; sometimes has QRN but usually is in clear. (Ridgeway)

Italy—Rome has been noted afternoons in Italian on 7.10A; strong signal when has no CWQRM; *no English noted.* (Chatfield, N. Y., others) Heard with *English* 1400-1430 on 11.810. (Sutton, Ohio) Rome noted with *English* for South Africa on 11.81, 9.63 at 1505, off 1530 in *English;* heard on 11.91 with *English* for Far East 0515-0615, another day noted signing on to Far East at 0545 on 11.91, 15.400, 17.80, had news 0600. (Pearce, England)

Jamaica — Radio Jamaica, 4.950, signs on around 0630 with march; a program of popular recordings follows. (Newcomb, Mo.) The 3.360 outlet is good evenings; runs to 2300A. (Leary, Ind.)

Japan—At the time this was compiled, *Radio Tokyo* had not yet resumed its Overseas Services although press dispatches from Tokyo indicated resumption was to have been effected not later than late December. According to *Radio Australia,* plans call for two 50 kw. transmitters for the Overseas Services; tentative schedules call for 0000-0100 to North America in the 49- and 31-m. bands; 0600-0700 to North China and 0700-0800 to Central China on two channels in the 49-m. band; 0900-1000 to Philippines and Indonesia in the 31- and 25-m. bands; 1040-1140 to India in the 25- and 31-m. bands.

JBD3, 15.225, and JBD4, 15.235, noted in parallel with "NHK" programs around 2330-2345. (Ridgeway, South Africa) JKI, 4.910, noted 0530 with "NHK" identification; JKJ, 7.285, heard 0355 with operatic recordings and announcing "NHK" at 0359. (Winch, Calif.)

Kashmir—Radio Kashmir, Srinagar, which recently changed frequencies, now can be heard 2130-2330, 0630-1200 on 3.335 and 0100-0230 on 6.110, according to a *WRH Bulletin.*

Kenya—Nairobi, 4.855, now appears to close at 1500; ends session with "God Save the King" after time pips; formerly ran to only 1400 except on Wed., Sat. (Pearce, England)

Korea (South) — HLKA, 7.933A, noted recently 0700-0730 with weak signal, in native. (Stein, Calif.)

Lebanon—Beirut, 8.035A, is audible with recorded music 1455-1515; has bad CWQRM. (Sutton, Ohio)

Liberia—ELBC, 6.025, Monrovia, still

noted to 1845 sign-off. (Saylor, Va.) Usually has bad QRM; some days is buried completely.

Madagascar—Radio Tananarive, 9.515, noted from around 1100 to after 1230; uses French. (Pearce, England) *GDX-aren,* Sweden, says this one signs off 1430.

Mauritius—Forest Side, 15.100A, now has its "morning" session 2200-2315. (Ridgeway, South Africa, via Radio Australia)

Mexico—XEQQ, 9.68, noted in South Africa from 2230-0000; at 2300 gives call preceded by 4 chimes. (Ridgeway)

Monaco—Radio Monte Carlo, 6.035, 9.785, noted on Fridays around 1745 with "Back to the Bible" program in *English.* (Pearce, England) This feature ends around 1800 and station usually signs off (Fridays) 1803. (Boice, Conn., others)

Mozambique—Lourenco Marques, 9.720A, is widely reported afternoons in *English* to 1600A sign-off, good signal in most areas of USA. (Dalton, W. Va.; Stark, Texas; Bellington, N. Y., others) Heard with Portuguese programs from 0000 on 9.850A. (Sutton, Ohio; Niblack, Ind., others) Catch, England, says CR7BV has again moved to 4.830 where is noted with chimes and call 1215 after giving African news in Portuguese; fair level; CR7BG, 15.283, noted 1220 in parallel with CR7BV with all-Portuguese program; popular recordings (mainly *English*) until *after* 1330. Bellington, N. Y., reports Lourenco Marques heard recently on 15.27 from 1310 tune-in to 1500 when closed with "A Portuguesa;" all-Portuguese session. Pearce, England, says Lourenco Marques is heard on 15.275A at 1200 with news in Portuguese, chimes; call at 1210; he also notes Lourenco Marques on 4.925A at 1245.

New Caledonia — Radio Noumea, 6.034A, is coming through at nice level around 0330-0530A sign-off. (Saylor, Va.)

New Zealand—ZL2, 9.54, and ZL3, 11.78, noted 0250. (Pearce, England) ZL4, 15.280, heard 2135 recently with cricket results; signal still good 2205. (Ferguson, N. C.)

Nicaragua—YNZZ, 6.464, Managua, *Radio Mundial,* noted 2112-2146 with moderate QRM from COCY, 6.450, Havana, Cuba; all-Spanish; YNHB, 6.550, Managua, *Radio Panamericana,* heard 2208-2245. (Patterson, Ga.) YNVP, 6.760, Managua. heard 1900-2245 with music and speech in Spanish. (URDXC) A station on *measured* 7.8489 has been identified as Managua; may be YNSO, *listed* 7.860; noted 1946. (Oskay, N. J.)

Nigeria—Radio Nigeria, 7.255, Lagos, noted with interval tune around 2329 prior to 2330 sign-on. (Bellington, N. Y.)

Northern Rhodesia — ZQP, Lusaka, transmits on Sundays a "morning" program on 9.710 at 0300; announcements are in *English* with native recordings and BBC-transcribed programs; has South African news 0500 followed by talk in *English;* closes 0545 after playing "God Save the King;" broadcasts

daily on 7.220 and 3.914 at 0900-1230. (Ridgeway, South Africa, via Radio Australia)

Norway—Oslo, 11.735, noted signing off 2100 in Norwegian and *English*. (Stein, Calif.)

Pakistan—*Radio Pakistan*, 6.234, is heard at high level in South Africa 1130 in foreign language; closes 1200 after identification. The 1210-1230 news at dictation speed is now noted on 9.478A. (Ridgeway, South Africa) Noted 1015 with news on 11.675. (Sutton, Ohio) And in parallel then on 4.805. (Pearce, England)

Panama—HOLA, 9.505, Colon, heard with *English* request program 2118-2136. (Machwart, Mich.) HP5B, 6.030, Panama City, heard opening 0615 with announcement in Spanish that is relaying HOX. *Radio Mirimar*, P.O. Box No. 124. (Ferguson, N. C.)

Paraguay—*Radio Nacional de Paraguay*, 6.270, Asuncion, goes off the air just *after* 2200; has local clock striking 11 p.m., then identifies as ZP1 and ZPA1. (Stark, Texas) ZPA3, 11.850, noted 1900-1945. (Sutton, Ohio)

Peru—OAX1A, 6.155, *Radio Delcar*, Chiclayo, noted to 2330 sign-off. (Stark, Texas) OAX4Z, 5.887, Lima, *Radio Nacional del Peru*, heard 1915-1930; all-Spanish; QRM. (Patterson, Ga.) OAX4W, 9.4045V, Lima, noted 2205 with weak signal; had news in Spanish. (Oskay, N. J.) OAX4Z, *Radio El Sol, listed* 15.105, is heard 2300-0100 some days but appears to be on approximately 15.112. (Ridgeway, South Africa)

Philippines—When this was compiled, *WRH Bulletin* reported that the short-wave transmitter of "The Voice of Davao," Davao City, Mindanao, DXH2, 7.280, was off the air, and that the station was broadcasting only on m.w. 900 kc. with call DXMC.

The Far East Broadcasting Co., Manila, now uses 3.320, 6.030, 9.730, 11.855, and 15.300 with *English* weekdays 0000-0100, 0300-0515, 0700-0900, 1830-2030, Sundays 0030-0530, 0630-1100, 1800-2330. (Radio Sweden)

Poland—Warsaw noted on 6.115 at 2314 with interval signal, music, then start of *English* session. (Machwart, Mich.) Current schedule for *English* broadcasts to North America is 1700, 1730, 2315, and 0030 on 6.115. Asks for reports and comments to Polskie Radio, English Language Transmissions to North America, Aleja Stalina 21, Warsaw, Poland.

Portugal—Leary, Ind., reports Lisbon on 15.125 to 0945 sign-off. Noted by Niblack, Ind., to 1530 closedown on 11.996A, usually excellent volume.

Lisbon noted on 15.130 signing off 1130 with "A Portuguesa" after clock chimes; heard another day signing on with "A Portuguesa" 0915; noted 1700 on 11.96A and leaving the air 1800 with "A Portuguesa," parallel with 9.740; noted on 11.99 at 1445 with a broadcast in Portuguese for Angola-Mozambique and signing off on that channel with "A Portuguesa" at 1530, in parallel with 9.740. (Pearce, England)

Radio Free Europe, 6.095, heard with

Eastern European languages 0155 tune-in; leaves the air 0203-0205 and has no signature tune then; also heard 1500 and still on the air 1805. (Pearce, England)

Portuguese China—Serrano, Brazil, airmails that he has definitely confirmed that a short-wave station called *Radio Vila Verde* is now operating from Macau, probably around 9.500. He hopes to have further data on this one soon.

Sao Tome—The 17.6775 channel noted a recent Sunday with light recordings 0750, program details in Portuguese with guitar musical background 0800, and closing 0803 with "A Portuguesa." (Pearce, England) Also heard in North Carolina. (Ferguson)

Saudi-Arabia—Djeddah, 5.975, noted signing on 2306 recently, in the clear. (Bellington, N. Y.) This one heard in Virginia in Arabic 0300-0400 sign-off. (Saylor)

Sierra Leone—GDX-aren, Sweden, says Freetown has an *experimental* station of 0.3 kw. sending on 9.630; noted with BBC's General Overseas Service from London to 1700 sign-off. *Not confirmed.*—KRB.

South Africa—SABC's African Service noted from Johannesburg, 15.230, at 1000 with light music and opera; closed 1045; poor level and jamming QRM. (Catch, England) Heard in *English* 1130 on 11.937. (Pearce, England)

Southern Rhodesia — Salisbury, 3.320, noted closing 1500; has BBC news relay 1300; home news 1310; weather forecast, local, and South African news 1315. (Pearce, England)

Spain—Radio Nacional de Espana en Malaga, 7.01A, noted with call 1340. (Pearce, England) Cadiz, 7.200A, heard most days around 1700-1800; plays many North American dance and popular tunes with *English* lyrics from 1730. When this was compiled, *Radio S.E.U.,* Madrid, was still operating near 7.09; *Radio Tullent Murcia* near 7.105, and *Radio Merida* between them. (Pearce, England)

Spanish Morocco — *Radio Tetuan* heard recently on 6.063A at 1755 with program preview for next day; off 1800; heard another day as early as 1700. (Pearce, England)

Surinam — PZX5, 15.405, Paramaribo, noted recently with good level in Eastern-type musical program when tuned 1520; at 1531 had announcement followed by a VOA program. (Ferguson, N. C.)

Switzerland—United Nations Radio, 6.672, is heard daily 1330 with news in *English;* news in French 1345; leaves air 1400; has woman announcer. (Ridgeway, South Africa) Berne, 15.305, has fine level in *English* for India-Pakistan 0945.

Syria — Damascus, 11.913A, still noted to 1735 sign-off; asks for reports to SBS, English Section, Damascus, Syria. (Leary, Ind.) Last hour is in *English.*

Tahiti—Radio Tahiti, 6.135, Papeete, noted with news in French, music, around 0015; fair level in Calif. (Winch)

Taiwan—Radio Free China, BED3, 15.234, BED6, 11.735, Taipeh, has its North American transmission in *English* 2300-2400; opens with chorus singing and call by woman announcer. (ISWC, London) The 7.135A outlet noted with fair level around 0700-0800. (Stein, Calif.) Ferguson, N. C., recently checked 11.735 and 7.135A channels around 0630-0735 but found no *English* at any time during the check period; formerly had *English* 0630, 0700, or 0730.

Tangiers—Radio International noted on 6.110 at 1515 tune-in; news in French 1530; still on the air 1600. (Pearce, England) *Radio Africa,* 7.127A, noted to 1900. (Leary, Ind.)

Thailand—HS8PD, Bangkok, broadcasts Home Service programs in Thai 0700-1000 on 11.910. (WRH Bulletin)

Trinidad — Radio Trinidad, 9.625, noted with music 1745, BBC news relay 1800; poor signal in Missouri. (Newcomb) has bad QRM evenings; still signs off 2200. (Patterson, Ga.) Noted with news 0545 and identifying as "Radio Trinidad and the Radiodiffusion Golden Network." (Rosenauer, Calif.)

Trans-Jordan—Nattugglan, Sweden, reports Ramallah heard on 7.030 to 1421 sign-off with march.

Turkey—A station of the Physical Institution of Istanbul University is audible *irregularly* on 7.750 with Oriental and Western music. *Radio Ankara* now broadcasts in 14 languages in addition to Turkish. (Radio Sweden) TAV, 17.83, is heard with good level to Far East in *English* 0730-0815. (Ridgeway, South Africa) Noted with weak level in North Carolina. (Ferguson) TAT, 9.515. still heard at fine level in *English* to North America 1815-1900. (Van Gilder, Mass.) TAS, 7.285, heard in *English* for Western Europe 1600-1645. (Green, Ontario) TAP, 9.465, is scheduled in parallel.

Uruguay—Radio Carve. 6.157, Montevideo, noted 1930; QRM. (Stark, Texas)

USI (Indonesia)—YDQ. 9.552, Makassar, Celebes, heard at fair level 0900-1000 sign-off. (Ridgeway, South Africa) Jogjakarta, 7.098, noted with fair signal recently 0700-0830 fade-out; gave call of YDJ2. (Saylor, Va.) Djakarta, 6.045, noted around 0557 with popular American songs with *English* lyrics. (Bellington, N. Y.) The Djakarta station *Radio Andir* verified for its 7.165 outlet; transmitter is *RCA,* 7.5 kw., with beams on Northeast and West Java; schedule on 11.940 now is 0430-0630; verification cards will be issued from Djakarta shortly. (Cushen, N. Z.)

USSR—Short Wave News, London, says a Soviet station heard on 5.484 around 1450 is believed located at Molotov.

A *new* transmitter in Petrozavodsk has been heard on 4.950 with programs in Finnish and Russian. *(WRH Bulletin)* Khabarovsk, 9.378A, has Chinese program 2100-2200, weak level in Virginia. (Saylor) *Radio Moscow* is good signal 0800-0830 in *English* to

North America on 11.910, 11.960, 15.120. (Leary, Ind.) Noted in *English* 0430-0445 on 11.820, 11.630, 9.790. (Rosenhauer, Calif.) Best Moscow channels in Washington State for North American *(English)* transmission around 2000-2300 are 15.12A and 7.25A. (Oestreich)

Three Russian Home Service programs from Moscow are now on the air—First Program until 0830 on 9.720, 9.800, 11.765, 11.790, 11.880, 11.900, 11.905, 12.220, 15.170, 15.390, 15.440; from 0830 on 5.912, 5.955, 5.970, 5.980, 6.030, 7.175, 7.225, 7.260. Second Program until 0900 on 11.945; from 0915 on 7.115; from 1000 also on 6.130. Third Program until 1530 on 6.070. The news agency Tass uses these channels for its news service at dictation speed (in Russian)—5.780, 5.922, 5.940, 8.910, 9.145, 9.850, 12.020, 12.270, 15.040. *(WRH Bulletin)* Radio Tashkent, *measured* 6.8256, noted 2110 in foreign language. (Oskay, N. J.)

Vatican—HVJ broadcasts programs in *English* daily 1000 on 1529 kc., 9.646, 11.740, 15.120, and 1315 on 1529 kc., 5.968, 9.646, 11.740. (Radio Sweden) Has transmission for India each Tuesday 1030 over 11.740, 17.840. (ISWC, London) The 9.646 outlet noted 1345 beginning French session; in Italian 1430; heard dual on 5.97A at 1450 but at weaker level. (Bellington, N. Y.)

Venezuela—Radio Cabimas, YVMK (relaying YVML), is noted to *after* 2130, now on 3.410 (Stark, Texas) This one heard in Missouri at 1700 with fair signal. (Newcomb) YVKF, 4.880, Caracas, noted with news 1824-1830 when resumed in Spanish; announced *English* news for Mon.-Fri.; YVQA, 4.960, Cumana, noted 1907-1940, identification announcements by man included call of "Radio Sucre." (Machwart, Mich.) YVKT, *listed* 3.350, *Radio Libertador,* Caracas, goes *past* 2200 on Sundays; YVKX, 3.390, Caracas, is heard to *after* 2200; *Radio Tropical,* 3.400, Caracas, noted evenings; *Radio Maracaibo,* 3.440, runs to *after* 2130; *Radio Valencia,* 3.460, runs to *after* 2130 now. (Stark, Texas)

Yugoslavia — Belgrade, 6.100, has *English* 1145-1200 and 1400-1415; French 1415-1430, 1700-1715; appreciates reception reports and will verify if IRC is enclosed to Radio Yugoslavia, 6, Mose Pijade, Belgrade 2, Yugoslavia. (ISWC, London) Heard on this schedule. (Pearce, England)

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Press Time Flashes

Radio Pakistan, 7.003A. Karachi, noted 1115 with news in native; high level; closes 1200. (Ridgeway, South Africa)

"Wir rufen den Osten! Wir rufen den Westen! . . . Sie horen den Kurzwellensender Freies Russland!" is the announcement in German of the *Free Russian Radio* said to be on the air in Russian and German daily 0730-0810 between 6.350-6.615. (Radio Sweden)

Ridgeway, South Africa, says *Radio A.E.F.,* French Equatorial Africa, uses *two* transmitters in parallel in its 1230 session (9.960 and 15.596); programs

are in French; also uses 9.960 and 17.845 at 0600-0805 with programs in native to 0645, then in French. (Radio Australia)

"La Voz de la Falange," Madrid, 7.380, 1 kw., is on the air 1400-1530, 1700-1930; during July and August the station will broadcast *only during the second period. (WRH Bulletin)*

* * *

Acknowledgement

Thanks, fellows, for the fine reports. Keep sending them to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Good listening! . . . . . KRB.

BOOSTER FOR FM SETS

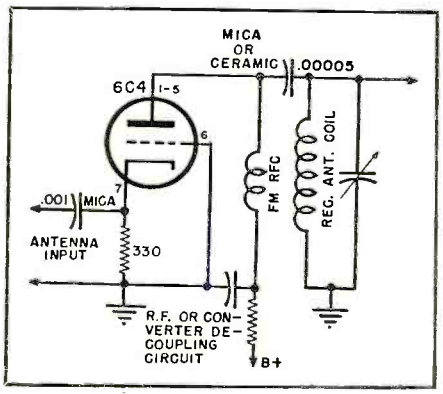
By CHARLES ERWIN COHN

MOST present-day FM receivers, even the more elaborate ones, couple the antenna to the set with a turn of wire around the antenna coil. This does not provide a very efficient coupling and it is often beneficial to make different arrangements for handling this.

One approach to this problem is shown in Fig. 1 where a 6C4 triode is used as a grounded-grid amplifier. The circuit is quite simple, the 330 ohm resistor in the cathode circuit providing a good termination for the transmission line. If a transmission line with other than 300 ohm impedance is used, the resistor will have to be changed to conform to the line employed.

The .001 ufd. condenser is used to keep the d.c. bias, which is built up across this resistor, from being shorted out by the antenna. Although a 6C4

Fig. 1



tube is shown, any good v.h.f. triode or triode-connected pentode can be used. The "B+" connection shown should be taken to the converter "B+" point or to the r.f. stage "B+" point if the receiver has one. In other words, the connection should be made at the bottom of the r.f. or i.f. coil, ahead of the decoupling resistor. This will prevent interaction with the rest of the receiver.

This circuit is capable of improving the performance of any FM set. For those receivers which already have an r.f. stage, it will improve the noise figure due to the lower noise of triodes.

For the set with no r.f. stage, the extra gain will be helpful as will the reduction in oscillator radiation. This is especially true of "Fremodyne" sets in which the performance improves rapidly with increased signal input.

—30—

Saturable Reactors

(*Continued from page 69*)

light bulb of the proper wattage as the load so that the control effects can be observed visually.

When all the connections have been made, with the d.c. power off, plug in the a.c. load circuit. At this point the bulb will be either completely extinguished or else very dim. Now turn on the d.c. power supply and slowly increase the current. The brightness of the bulb will increase in proportion to the current, reaching its maximum brightness at approximately 44 ma.

When the core is fully saturated at full d.c. current and the bulb is at its maximum brightness it will be found that the voltage appearing across the bulb is less than the actual line voltage (approximately 100 v.). This is due to the fact that the reactance of the coils cannot be decreased to exactly zero. As a result there will always be some drop across the reactor. In commercial applications this is corrected by providing a supply voltage which is about 5% higher than the normal operating voltage of the controlled unit.

At the other extreme it will be found that the lamp voltage does not drop to zero, since the reactor cannot be infinite in value. This of course means that the load current cannot be decreased to exactly zero. However in the case of a lamp load it will "black-out" at approximately 15% of full line voltage. When a resistive load is used the two voltages, across the reactor and across the resistive load, are 90 degrees out-of-phase. When the load is also reactive, for example a motor, the voltages will be in-phase. The net result of all this is a slight reduction in the control range.

In the next arrangement the two a.c. coils will be connected in parallel. Again following standard convention the finish of primaries #1 and #2 are connected together and the start of these same windings are connected together. The start ends are connected to the a.c. line and the finish ends are connected to the light bulb and then to the other side of the line (coils in series with load unit). The d.c. coil connections are not changed. The actual schematic of this circuit is shown in Fig. 6B.

When using this connection it will be found that the d.c. control current needed is only one-half of that required for a series connection of the a.c. coils. It will also be found that the unit will operate much more efficiently in this arrangement. This results from the fact that the primaries were originally designed to operate on 117 volts.

If desired, a small fractional horsepower motor can be substituted for the light bulb. Its power rating must be approximately the same as the light bulb used. For this purpose, the type of motor used in erector sets or small movie projectors is the proper size, but it must be a 117 volt a.c. type.

It is necessary to observe certain precautions, because when a motor first starts it draws an excessive line current which is higher than its normal value at full speed, with the consequent danger of overloading the unit. To avoid this a shorting switch is connected across the a.c. coils so that full line voltage can be applied to the motor. Once the motor is started the switch is opened, changing the control of the motor to the saturable reactor.

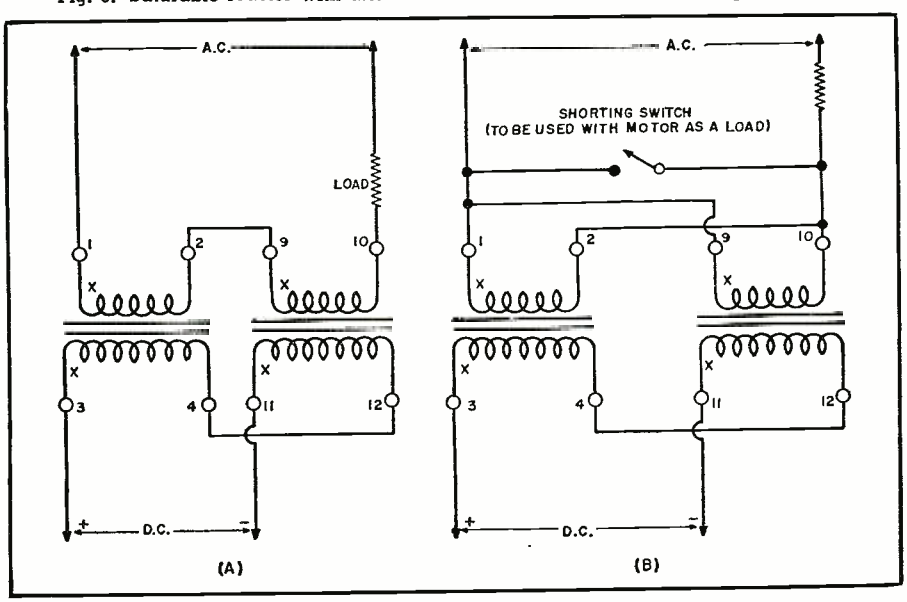
In order to simplify specific arrangements and procedure the foregoing explanation has been based on the ratings of a 40 ma. power transformer. However, units have been built using 70 ma., 90 ma., and 150 ma. transformers and the system is exactly the same when any of these are used.

The gain of the unit can be calculated by the following formula:

$$gain = \frac{output\ power\ (a.c.)}{input\ power\ (d.c.)}$$

The gain of the small unit is relatively

Fig. 6. Saturable reactor with a.c. coils connected in series (A) and in parallel (B).



low, but as the size of the unit is increased the efficiency also increases which means that the gain is higher. The cores used are made of 4% silicon steel which operate best at high power levels.

Manual control has been used in this presentation to avoid complications. There are several very interesting ways in which these units can be controlled by means of regular electron tubes.

In the beginning of this article it was pointed out that a multiple control unit can be made by making use of the low voltage windings, making possible control based on multiple input signals. Once the unit is assembled it is merely necessary to connect the proper type of control unit to each set of windings. Since the windings are different from the high voltage windings the control conditions are entirely different. Therefore it would be necessary to experiment in order to determine the best control conditions for each of the various voltage windings. -30-

SERVICE HINT

By H. LEEPER

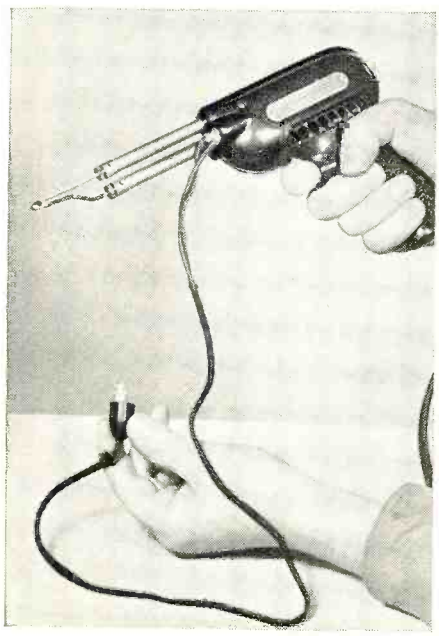
IN order to see clearly in some remote corner of the TV or radio chassis when soldering, additional light other than that furnished by the usual solder gun is required.

Such light is easily obtained from the gun itself, by making an extension lead as shown in the photograph below.

The base from an old flashlight bulb with two wires attached is inserted in the socket of the gun instead of the regular bulb. The bulb which was removed is placed in a socket soldered to the other ends of the wires. A portion of the rubber insulation from a test clip may be slipped around the extended socket so that it may be used any place without danger of shorting to the chassis.

-30-

Add an extension light to your solder gun.



Interlacing Troubles

(*Continued from page* 65)

cuits are available which provide more accurate vertical synchronizing than does the integrator.

Vertical A.F.C.

Most current television receivers use flywheel synchronization to keep the frequency of the horizontal oscillator from being changed from one line to the next by noise. A similar system can be used to keep the frequency of the vertical oscillator from being changed from one field to the next by interference from horizontal sync or deflection signals. There is one receiver available using such a circuit, the *Radio Craftsmen* RC-100 (RADIO & TELEVISION NEWS, February 1950, pages 51-53). The vertical deflection circuit of this receiver is shown in Fig. 2.

Some technicians will notice that this circuit is similar to one used by *Emerson* and others, for horizontal a.f.c. Positive and negative sync pulses are obtained from the inverter and applied to the sync discriminator, along with a signal from the vertical amplifier. The output voltage from the sync discriminator, which depends upon the phase relation between the sync pulses and the receiver deflection signal, is amplified and applied to the vertical oscillator as bias, to control its frequency. The synchronizing pulses are not applied directly to the oscillator and the control voltage is prevented from changing rapidly by C_{95}. One novel feature of this circuit is that the deflection signal for comparison with the sync pulses is obtained from the screen of the 6AQ5 vertical output tube. This electrode has no d.c. voltage applied to it, but the vertical signal is coupled from the plate to the screen by interelectrode capacity. The vertical oscillator plate voltage is not obtained from the damper in this receiver, so that possible source of horizontal interference is removed.

A theoretical disadvantage of a.f.c. for the vertical circuit is that it is *too* stable. When the video signal source is changed, at a station break or when switching channels, the picture at the receiver generally rolls through part of a frame before becoming stationary again. The reason, of course, is that the new vertical signals are not in-phase with the previous ones and the receiver phase must be changed to correspond. If the time constant of an a.f.c. system is made short so that the speed of the receiver's phase change can be very rapid, its immunity to interference will be reduced.

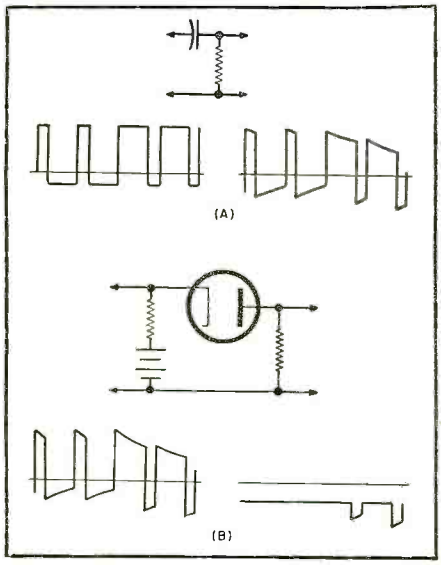
Vertical Separators

Several other circuits have been developed, some of which offer advantages over both the integrator and a.f.c. Apparently none of these has been used in a regular production model American television receiver, possibly because few complaints have

been received by the manufacturers about the performance of the integrator circuit and because these circuits are more expensive than the integrator, although less expensive than a.g.c.

A method of vertical sync separation which makes it possible to obtain a sharper output pulse than that of the integrator and faster action and less cost than a.f.c. uses a differentiator followed by a clipper. A simple circuit of this type was outlined by P. Mandel, *Radio-Industrie,* Paris, France, in "An Experimental Large-Screen Television Projector," *Proceedings of the I. R. E.,* December 1949, page 1464. (See Fig. 3.) A positive composite synchronizing signal is applied to a differentiator having a time constant comparable to a line interval. The output of the differentiator consists of positive pips at the beginning and negative pips at the end of each horizontal sync pulse, equalizing pulse, and section of the serrated vertical pulse. The negative output pip in each case begins at the level reached by the trailing edge of the positive pip. During the short horizontal sync and equalizing pulses the condenser cannot assume much of a charge and the output voltage across the resistor cannot fall very far. Therefore the pips which come at the end of the horizontal and equalizing pulses begin at a large positive value and do not reach a very large negative value. In the case of the much longer vertical sync pulses the condenser has a longer time to charge and the voltage across it reaches a higher value, while the voltage across the resistor falls to a lower value. Hence the pips which appear in the output at the end of each vertical pulse begin at a less positive value and extend to a more negative value than the pips following the horizontal and equalizing pulses. A clipper can, therefore, be used to pass only the pulses corresponding to the notches in the vertical synchronizing pulse. Short noise pulses will be rejected in the same manner as horizontal and equalizing pulses.

Fig. 3. Vertical sync separation by means of differentiator (A) and diode clipper (B).



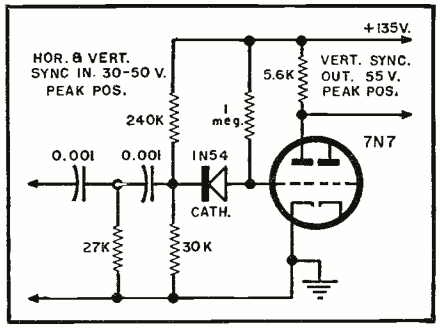


Fig. 4. Vertical sync separator and limiter.

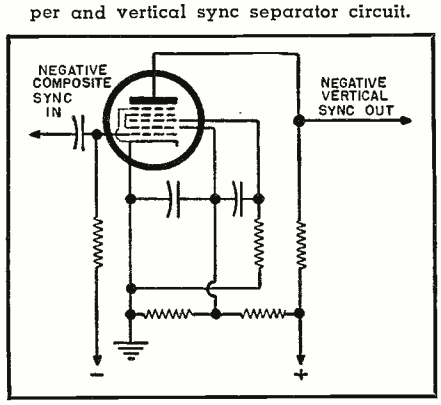
A circuit based upon the same principle was presented by Robert C. Moses, *Sylvania Electric Products Inc.*, in "Improved Vertical Synchronizing System," *Electronics*, January 1951, pages 114-118. (See Fig. 4.) Here the output of the differentiator is applied to a crystal diode biased so as to pass only the negative pips corresponding to the vertical notches. These pulses are then amplified, inverted, and limited by the triode circuit.

This type of vertical separator circuit can be added to most existing television receivers without much trouble. The parts other than the tube would not occupy much more space than the integrator; for the extra triode one of several provisions could be made. Some receivers have unused socket holes on their chassis. In those which have a single triode vertical oscillator, a twin triode in the same socket can be used as oscillator and vertical sync clipper. In other cases, separate oscillator and amplifier tubes can be replaced by a twin triode to free one socket for the sync clipper. In almost any case, a vector socket turret could be used to add another socket.

Differentiator-Heptode Clipper Vertical Separator

An earlier circuit, in which the same principle is applied in a different and slightly more effective manner, was described by J. Hanntjes and F. Kerkhof, of *N. V. Philips' Gloeilampenfabriken,* Eindhoven, The Netherlands, in "Home Projection Television, Part III, Deflection Circuits," *Proceedings of the I. R. E.,* March 1948, pages 408-409. (See Fig. 5.) In this circuit the negative composite synchronizing signal is applied to a differentiator having a

Fig. 5. The differentiator-heptode clipper and vertical sync separator circuit.



time constant of approximately one-half line interval. In the output of the differentiator larger positive pips occur at the time of the vertical notches than after the horizontal and equalizing pulses. These pips are applied to the first grid of a heptode, which is biased so that current flows only during the vertical notches. During the first notch plate and screen current flow and both voltages fall. The screen bypass condenser has a relatively small capacity, so that the screen voltage can fall appreciably during this time. Since the third grid is connected to the screen through another condenser, the decrease in positive screen voltage makes the third grid go negative until the condenser has time to charge. The third grid is driven sufficiently negative to cut off plate current even while the bias on the first grid allows screen current to flow. The time constant in the circuit of the third grid is long enough to keep plate current cut off until the remaining notches in the vertical pulse have passed. The result is that the only signal at the plate of the tube is a short negative pulse of voltage at the time of the first notch in the vertical sync pulse.

In the original *Philips* circuit, the heptode vertical separator was one section of a dual-section tube, the other section being a triode used as the vertical oscillator. No available American tube is equivalent. All of our triode-heptodes have the grid of the triode section connected internally to one of the grids of the heptode. Several alternate courses are open to the American experimenter desiring to try the circuit:

First, to use a European triode-heptode. The ECH4, which has a 6.3 volt, .35 ampere, heater, is available from *North American Philips*. It has a European type base, however.

Second, to use an American triode-pentode, connecting the three grids of the pentode as the first three grids of the heptode are connected in the circuit of Fig. 5. Only one American type is usable. Most of our triode-pentodes have the third grid of the pentode connected to the cathode internally. The recently announced type 6X8 nine-pin miniature has separate connections for the plates and all of the grids of both sections, although there is a common cathode connection.

Third, to use a separate heptode for the vertical separator tube. Several pentagrid mixers and pentagrid converters are available which could be used.

Fourth, to use a separate pentode, connecting it as described under the triode-pentode. In this case, it would be preferable to use a pentode in which the suppressor is constructed to be an effective second control grid, such as the 6AS6 or 7AK7, although other sharp cut-off pentodes would probably work.

Fifth, to use a gated-beam tube, type 6BN6. The limiter grid of this tube produces an unusually sharp cut-off.

—30—

NEW TV PRODUCTS on the Market

ROTATOR ADAPTER KIT

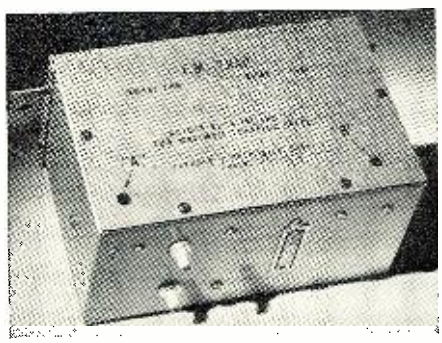
A new rotator adapter kit, designed to permit the installation of any commercial antenna rotator on its antenna towers, has been announced by *Alprodco Inc.*, Kempton, Indiana.

The adapter, which can be installed easily and quickly without special tools, consists of four matched components. These components include an adapter mounting plate, pre-drilled to accommodate any well-known rotator, upon which the rotator is mounted. This is placed within the framework of the tower itself. A ten-foot mast pole is provided to connect the antenna to the rotator, the pole being held securely within a 24 inch bearing, the third component in the kit. Finally, a three-piece mast kit is included which affords the necessary rigid support to keep the mast pole bearing in place.

Literature on this new kit is currently available from the company.

HIGH "Q" TRAPS

A new line of high "*Q*" traps, designed for use between the television receiver and its associated antenna to eliminate adjacent channel and FM interference, has been introduced by *Jerrold Electronics Corporation*, 26th and Dickinson Street, Philadelphia 46, Pa.



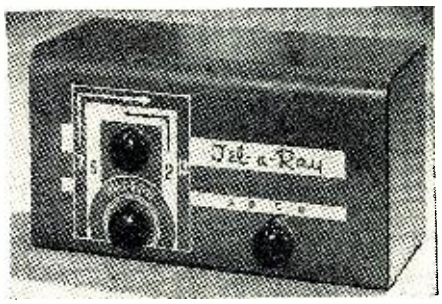
The traps are available in four models. The TLB covers Channels 2 through 6. The Model THB is designed to trap out adjacent channel interference on Channels 7 through 13. Interference from FM stations is trapped by using Model TFM, covering the range from 88 to 108 mc. The fourth unit has been designated as the Model "T Special" and is available on special order. It can be designed so as to eliminate interfering frequencies in any bands other than v.h.f. television and FM.

Full technical details are available on request.

SWITCHING BOOSTER

Tel-A-Ray Enterprises, Inc. of Henderson, Ky. has perfected an antenna switching booster which is capable of receiving signals from four antennas and can be switched from one to another.

Designed for fringe area reception where single-channel antennas perform better than multi-channel units, the new switching booster is equipped with four input terminals for four separate antennas, any one of which may be switched from the front. Four sets of terminals, supplying 6-7 volts a.c. for operation of up to four antenna-mounted preamplifiers, are mounted adjacent to the four input terminals and automatically switched as the antennas are switched.



A 6J6 preamplifier is an integral part of the switching booster and increases the strength of the signal as it arrives from the antenna. On occasions when the signal strength is naturally high, the preamplifier may be bypassed. The booster features an automatic switch which turns the booster on and off with the receiver.

ANTENNA ROTATOR

Viking Tool and Machine Corporation of Belleville, New Jersey has developed a new antenna rotator which is currently being delivered to the trade.

Powered by a simply designed impulse motor, the rotator assures full starting torque of 50 inch-pounds to give it maximum advantage in icy and adverse weather conditions.

Corrosion resistant materials are used throughout. The unit comes complete with a remote control box. An antenna direction indicator is available if desired.

CORONA INHIBITOR

The Receiving Tube Division of *Raytheon Manufacturing Company* has developed a line of picture tubes treated with the company's new "corona inhibitor."

Under certain atmospheric conditions, technicians have experienced difficulty with loss of picture brightness due to leakage, and arc-over from the second anode connector on the bulb of a television picture tube. This leakage from the second anode connection reduces the second anode volt-

age and, consequently, the brilliance of the picture. In addition, there may be audible effects from the corona. This difficulty has been experienced in varying degrees of intensity and in those cases where the leakage or corona has been slight, many valuable manhours have been lost tracking down the source of trouble.

According to the company, the new tubes treated with the "corona inhibitor" have this problem solved at the source. The company will supply additional details on these new tubes to those making their requests direct to the Receiving Tube Division at Newton, Massachusetts.

27" METAL TUBE

Rauland Corporation, 4245 North Knox Avenue, Chicago 41, Illinois is in production on a new 27" rectangular picture tube with an extremely short metal-coned envelope.

The new tube, known as the Type 27QP4, is a rectangular electrostatic focus, magnetic deflection, direct view tube. It is shorter from face to back than a standard 20" tube because of its 90 degree deflection design.

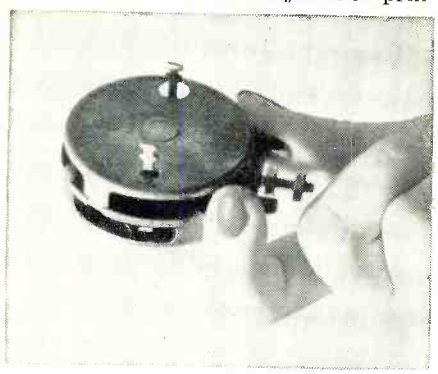
The screen of this new tube provides a picture area of approximately 390 square inches, about 40 square inches bigger than the center spread of a tabloid newspaper.

This tube can be used as a zero-voltage focus or can be focused to maximum sharpness with low voltage from the set's regular power supply. A single external magnetic field must be used in conjunction with the indicator ion trap to prevent ion spot blemish.

POWER RECTIFIER

General Electric Company, Syracuse, New York has developed a new power rectifier for television receivers, radios, and military electronic equipment.

The new rectifier has been designated the G-10 germanium rectifier. The unit operates on the junction prin-



ciple and is designed to supply 350 ma. at normal television receiver plate voltages in a 55 degree centigrade ambient. It has a peak inverse voltage rating of 400 volts, with rectification efficiencies up to 98 per-cent.

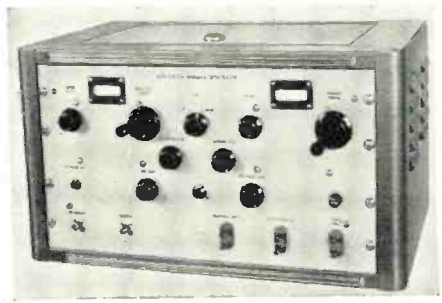
The unit's small size and higher "B+" voltages are due to the extremely low internal losses. Its forward resistance at rated current is approximately 3 ohms and back resistance is about 1 megohm at —350 volts.

Complete engineering details on the G-10 are available from the company together with information on other smaller units with lower voltage and power ratings.

U.H.F. SWEEP GENERATORS

The Tube Department of *Radio Corporation of America,* Harrison, N. J. has recently introduced two new u.h.f. sweep generators, the WR-40A and the WR-41A.

Both instruments feature continuous tuning from 470 to 890 mc. and operation is entirely on fundamental frequencies—no beat notes or harmonics



are used. They have a continuously variable sweep width from 0 to 45 mc. with an amplitude variation of .1 db per mc. or less throughout the swept range. The maximum output level of the sweep oscillator is .5 volt across a 50 ohm load. Facilities are also provided for matching to either a 72 or 300 ohm load.

The WR-40A is a laboratory-type instrument while the WR-41A is suitable for factory operations. Data sheets providing complete details on both of these units are available from the company.

TWO-SET COUPLER

A television coupler which permits the operation of two receivers from a single antenna is now being marketed by *Radio Merchandise Sales, Inc.,* 1165 Southern Blvd., New York 59, New York.

The unit has been designed to meet the requirements of two-set families or those living in apartment buildings or multi-family houses. Through this coupler, simultaneous reception on both sets is possible without interference from either set. Equal signals are provided to each set from the coupler which the company claims will reduce local oscillator radiation from the receiver and minimize incoming interference.

The coupler can be simply and quickly installed on the wall baseboard or other convenient location, at distances permitting the shortest leads to the receivers.

Literature on the coupler is available from the company on request.

FRINGE AREA ANTENNA

The latest addition to its line of fringe area TV antennas, the "Radar-ray" Model C, has been announced by the *Gonset Company,* 72 E. Tujunga Ave., Burbank, California.

This array is designed to give a clean

directivity pattern with high front-to-back ratio, a good impedance match, and high gain on all channels. The gain and front-to-back ratio are greatest on the high channels although it is good on the low channels too.

Through the use of large diameter dipoles and an 8 foot non-resonant reflector screen, it is possible to obtain broadband characteristics greatly superior to those obtainable with conventional dipoles and resonant reflector elements.

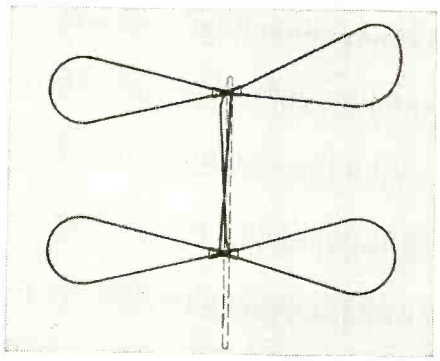
On the high band the array functions as four half-wave dipoles in phase, spaced ¾ wave ahead of the reflector screen. On the low band, shorted stubs across the dipole elements lower the fundamental resonant frequency and at the same time provide a good impedance match on the low channel. These stubs are quarter-wave resonant on the high band and thus have negligible effect on high-band operation.

"CLOVER-V-BEAM"

Telrex, Inc. of Asbury Park, New Jersey is currently making deliveries on its new and improved "Clover-V-Beam" antenna.

The new array is compactly folded, completely preassembled, and can be speedily rigged by tightening two nuts. Performance of this new unit is attributed to the company's unique application of transposed co-linear elements in conjunction with stacked closed loop "Conical-V-Beam" dipoles. In operation the interconnecting rods load the dipoles for low frequency channels and serve as transposed half-wave transformers at the high channels. This provides the sensitivity of resonant closed loop conical dipoles at the low frequencies and long wire "V-Beam" operation at the high channels.

The "Clover-V-Beam" weighs less than 24 ounces and has a lateral displacement under 5 feet, thus offering negligible wind resistance, minimum ice loading, and small down thrust.



Application data on this antenna is available upon request to the Engineering Dept. of the company.

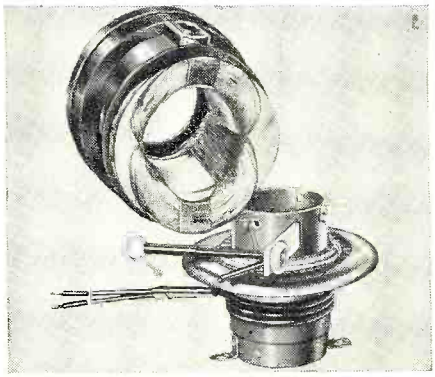
NEW TV COMPONENTS

Standard Transformer Corporation, 3580 Elston Avenue, Chicago, Illinois has announced the availability of two new television components—a high efficiency deflection yoke and a high voltage flyback transformer.

Deflection yoke DY-10 and horizontal output and high voltage trans-

former A-8131 are companion units designed to be used in direct drive circuits. The two new components have extensive applications and are exact replacements in thirty-four *RCA* television models, thirty *Emerson* models, and seven *Capehart* models.

The DY-10 is an anti-astigmatic yoke with cosine windings and nylon



insulation, designed to provide a sharp, well-focused picture over the entire CR tube.

Specifications and a complete list of TV models for which these components are exact replacements are contained in *Stancor* Bulletin 389 which is currently available.

TUBE AND TOOL CASE

Television Engineers, Inc., 1539 W. Harrison Street, Chicago is currently offering a new "Vis-U-All" tube and tool case that meets the requirement for a compact unit to hold all tubes and tools ordinarily required for home TV service work.

The new case will accommodate 45 miniature, 44 GT, and 18 large tubes—a total of 107 tubes or all tubes used in a postwar television receiver. It holds tubes snugly and protects them against breakage.

Made of strong plywood covered with durable leatherette, the new case measures 16 x 13½ x 7½ inches when closed and weighs only 7½ pounds. Fully loaded it weighs only slightly more than 20 pounds. A 15½ x 3 x 2½ inch compartment, with snap lock door, accommodates all tools ordinarily needed for home service work.

TV TOWER LINE

Tele-Ex-Pand Products Sales Corp., Berwick National Bank Bldg., Berwick, Pa., is currently marketing a new line of television towers and accessories designed for home television installations, as probe towers, as community towers, and ham antenna masts.

Deluxe, standard, and economy models are available at the present time in addition to the necessary base plates, mast mounts, and tower tops.

All of the towers are constructed of 1", electrically welded, tubular steel and have 1¼" x ⅛" cross bracing. All of the units have an all-weather aluminum finish.

Data sheets on these towers and the company's line of tower accessories are available on request. —30—

Loudness Control

(*Continued from page 39*)

of the holes is not critical, but should be at least 1/16 inch, and preferably 3/32 inch.

Remove the cover from the potentiometer and, using an ohmmeter, find the 200,000 ohm points. Make a scribe mark at these points, which are to connect to the taps. To make contact with the resistance element at these points, a scribe or fine pen point and a small amount of air drying silver paint are necessary. Apply the paint to the edge of the resistance element at each of the 200,000 ohm marks, and draw a fine line of the paint from each mark to the corresponding hole drilled in the edge of the base. The paint must be applied sparingly to the resistance element so that it will not interfere with movement of the rotor brush, and it cannot be allowed to run over the edge of the base except directly opposite the terminal hole, because a contact with the cover will ground the potentiometer and short circuit a portion of the network. Get as much of the paint as possible into each of the holes, and dip the ends of the contact wires in the paint before inserting them into the holes.

If properly done, the paint itself should hold the wires quite firmly in place. However, don't expect the paint to hold until it has completely dried. This may take several hours, but may be speeded up by baking with an infrared heat lamp.

File notches in the edge of the cover at appropriate points to clear the ribbons of silver paint where they cross the edge of the base to the terminal wires. It is necessary that this be done because the cover must be replaced to provide the stops for the potentiometer.

All the other components of the compensating network as shown in Fig. 3 may be mounted on a small resistor board, or, if the components used are quite small, they may be mounted directly on the terminal wires as was done in the unit shown in the photograph. A shield for the complete unit may be made from a coil shield can or, for that matter, from a small empty tin.

Adjust the variable trimmer condenser only after the complete unit is installed. The effects of wiring capacitance may influence this adjustment greatly, and should be taken into account. The adjustment may be made either by measurements, or simply by listening tests. If the amplifier and speaker system to be used are capable of reasonably uniform response from 40 to 10,000 cycles or better, about 8 db of compensation at 10,000 cycles is adequate when the "Loudness Control" is set for minimum output.

However, if the amplifier or speaker does not have sufficient response below about 50 cycles, the "Loudness Control" may produce an objectionable resonance effect at low levels. In this

case, additional compensation at the high frequencies can be used to advantage by producing a similar resonance effect. The combination of the two will be much more listenable than with either one alone.

Since definite rules cannot be stated which will cover all cases, it may be best to make the final adjustment of the trimmer while listening to a high quality recording at a very low level. Both the high and low frequencies should have a natural sound.

You will be very pleasantly surprised at the results obtainable with the "Loudness Control." If you are one of those people who "just don't like the highs" be prepared to change your mind. Chances are, you just haven't heard a full range system which takes into account the peculiarities of the human ear.

This "Loudness Control" has brought forth many unsolicited compliments from people who are neither electronic nor musical experts. It is no longer necessary to disturb the neighbors with over-loud music, since an appreciation of the full tonal range can now be had at any volume level.

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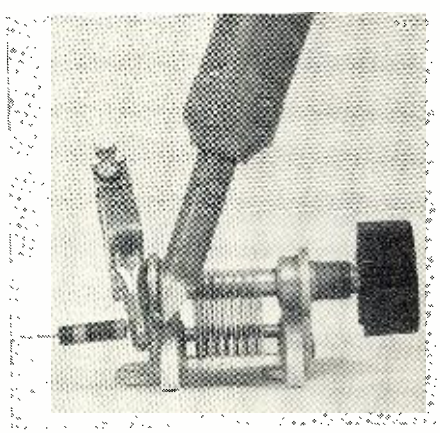
RESISTOR PROTECTION

By MILTON WHITE

A COPPER alligator clip placed on the lead between a composition resistor and the soldering iron as shown in the photograph, will act as a thermal shunt, protecting the resistor against the damage often caused by the heat of the soldering operation. This protection is important where very short resistor lead lengths are required, since under this condition, the heat will not be radiated by the lead quickly enough to prevent the resistor from reaching a temperature where a permanent change in its value may occur. —30—

Method of dissipating heat and protecting resistor when soldering in close quarters.



The "Codetyper"

(*Continued from page 47*)

output, its input grid receives a pulse from the "phantom switch network." This positive-going pulse overcomes the bias which is holding the tube to cut-off because of the large value of the cathode resistance. Plate current starts to flow through a plate resistor and the voltage at the plate drops. This negative-going pulse is coupled to a second section of the tube through a condenser and causes the second half of the tube to become biased to cut-off. When this happens, the rise in plate voltage across the load resistor initiates a positive-going pulse which is then fed to the keyer.

At the same time the square wave which appears across the cathode of the first UIG common bias resistor is taken off and differentiated. This differentiated voltage has two pips on it —a negative-going one which corresponds to the leading edge of the pulse and a positive-going one which corresponds to the trailing edge. The negative pip has no effect on UIG #2 but the positive-going pulse causes UIG #2 to trigger, thereby setting up the same conditions on UIG #2 as previously existed on UIG #1. This pulse follows at the exact moment that UIG #1 has completed its pulse to the keyer tube.

The speed of the interval or the timing thereof is governed by the size of the coupling condenser and resistor and other circuit parameters. In addition, there has to be some method of varying the pulse width depending on the code speed desired. A simple system has been devised whereby all 19 UIG's are controlled by the same potentiometer. This is accomplished by allowing the coupling condensers to discharge up to "B+" rather than down to ground as is usually the case. All grid resistors are, therefore, returned to a common "B+" point. By setting a reference voltage against this common "B+" point, the potential differences across all coupling condensers can be controlled. By varying this voltage, the timing rate of all 19 UIG's can be varied simultaneously.

As the pulse follows down through the chain each UIG is successively triggered and each triggers a keyer in sequence. If UIG #1 is triggered, 19 pulses are formed in the chain, however, the keyers are arranged in such a way that they form the various marking and spacing intervals as will be described.

Keyer Operation

All of the keyers connected to the even-numbered UIG's are, in addition to being biased to cut-off, gated off at the same time. The gating takes the form of a removal of the plate voltage from the keyers. All of the odd-numbered keyer plates are returned directly to "B+" while the even-numbered keyers have their plates re-

turned to one of the "sequence selectors." This means that unless a particular "sequence selector" is turned on, all of the even-numbered keyers will be unable to deliver pulses to the keying relay. Thus any pulse starting at the beginning of the chain and traveling down to the end activates the keying relay on every other pulse only, producing 10 dot marking intervals separated by 9 space intervals.

Since every other keyer is gated to cut-off a string of dots is formed. Should dashes be required in the transmission of the character it becomes necessary to activate one or more of the keyers that were gated off.

It is possible to send any number of units by entering the UIG chain at any point. Every even-numbered UIG has a cathode connection running to the "phantom switch network." This cathode connection on the even-numbered UIG is used to trigger the odd-numbered UIG immediately following. This is done by the simple expedient of putting a positive pulse across the cathode resistor of the UIG preceding the one to be triggered. For example, in sending the letter "S" which would use UIG's #19, #17, and #15 for dots and UIG's #16 and #18 for spaces, it would be necessary to start by triggering UIG #15. To do this the "phantom switch network" would have to deliver a pulse to the cathode of UIG #14 because its keyer is normally gated, which would cause the keyer connected to UIG #15 to be pulsed, operating the relay. This would provide three dots separated by two spaces. If a character consisting of more than three dots was desired, it would be necessary to go down the chain to UIG #12 or back to UIG #10, #8, #6, #4, #2, or #1 or the end of the chain. In this way it is possible to obtain any number of pulses required by a character.

In order to provide dash markers, the keyers, which are capable of supplying the spaces between the dot markers, are made conducting. Thus if a keyer which is between two dot marking intervals is made conducting, the pulses in traveling down the chain of UIG's will activate three keyers in a row instead of one keyer, then miss the next keyer because it is being held gated off, then hit the next keyer which is not gated. This condition results in three keyers, two dot markers, and the space marker being on which together form an interval three times as long on the keying relay, giving a dash interval. These dash marking intervals can be inserted anywhere along the chain by gating the appropriate keyer. The keyers that are required to make the dash marking intervals are always the space marking keyers or the even-numbered keyers.

"Sequence Selectors"

Since the even-numbered keyer plate circuits are under the control of the "sequence selectors," it might be of interest to determine how these "se-

quence selectors" operate to provide the proper number of dashes in the proper place. The "sequence selectors" consist of shielded grid thyratrons of the 2D21 type. Nine of them are used to form the dashes and the tenth one is in the circuit to release the thyratrons that have been activated. For example, consider "sequence selector" #18. This tube is held biased to cut-off and in the standby condition the tube will not draw current. When the tube is given a positive voltage pulse, approximately 12.5 volts, from the "phantom switch network," this triggering will cause the gas to ignite, the tube starts to conduct, the voltage across the plate resistor drops, and the cathode voltage rises to the plate potential, less the drop in the tube. This plate voltage is fairly close to the "B+" supply voltage due to the small value of the plate load resistor and the small current drawn by the circuit. Thus approximately 250 volts is available across the cathode resistor. This cathode voltage is applied to keyer #18 and serves as its plate voltage. Now keyer #18 is able to close the relay when a pulse is applied to its grid. This same process applies to all the other "sequence selectors." The "phantom switch network" will activate any number of these selectors which, in turn, will operate the keyers as required.

The gaseous tubes thus ignited will remain ignited unless some means of erasing them is brought into play. When the letter is completely transmitted, the trailing edge of the pulse from the cathode of the last UIG is used to signify that the character is completed. This trailing edge causes the erase tube, which is biased to cut-off, to trigger. Plate current starts to flow and the erase relay which is in series with the plate circuit opens, breaking a set of normally-closed contacts which are used to supply plate voltage to all of the "sequence selectors" as well as to itself. Therefore, when this erase relay is pulsed, it will automatically extinguish all of the other "sequence selectors" and the erase tube itself and the circuit is now ready to form another character.

—30—

PHOTO CREDITS

Page	Credit
35, 36, 37	Vernon C. MacNabb Co.
40, 62	Radio Corporation of America
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ERRATA

In the diagram of Fig. 3 (page 46 of the November issue) pin numbers 4 and 5 on the 6V6 tube (V_3) should be interchanged.

* * *

In the article, "A Vacuum Tube Keyed Transmitter," appearing in the January issue, the diagram of Fig. 1B has two errors in it which should be corrected. The junction point of R_1 and R_2 should be connected to the top of the key jack instead of ground as shown and the leads to the open and closed contacts of the low current relay should be reversed.

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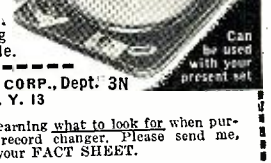

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INDEX OF Advertisers

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NAME	PAGE
Acorn Electronics Corp.	106
Airex Radio Corp.	32
Allied Radio Corporation	27, 140, 152
Almo Radio Company	142
Aluminum Products Corp.	107
Altec Lansing Corp.	104
American Phenolic Corporation	26
American Television & Radio Co.	100
Amperite Company, Inc.	158
Ampex Electric Corporation	123
Amplifier Corporation of America	136
Argos Products Company, Inc.	142
Arkay Radio Kits, Inc.	162
Arrow Sales, Inc.	149
Ashe Radio Co., Walter	25
Atlas Tel Rad Company	168
Audel Publishers	146
Barry Electronics	166
Bell Telephone Laboratories, Inc.	12
Belmont Radio Corporation	7
Bendix Radio	143
Blonder Tongue Labs	135
Bond Equipment Company	114
Brook Electronics, Inc.	102
Brooks Radio and Television, Inc.	144
Burstein-Applebee Company	122
C & H Sales	140
Candler System Co.	140
Capitol Radio Engineering Institute	91
Channel Master Corp.	9
Chicago Transformer Company	111
Cisin, H. G.	126
Circle Sales Co.	148
Cleveland Institute of Radio Electronics	95
Collins Audio Products	14
Columbia Electronic Sales	132
Comet Electronic Sales Co.	143
Communications Equipment Company	105
Cornish Wire Co.	166
Coyne Electrical School	112, 161
Davis Electronics	114
DeForest's Training, Inc.	5
Dow Radio, Inc.	98
DuKane	120
Dull's Electrical Translations	158
Dumont Electric Corp.	166
Eastern Telephone Co.	132
Editors & Engineers, Ltd.	112
Edlie Electronics, Inc.	114
Electronic Expediters, Inc.	112
Electronic Instrument Co., Inc.	3rd Cover, 34, 132, 140, 166
Electronic Specialty Supply	146
Electronicraft, Inc.	166
Electronics Institute, Inc.	166
Electro Products Laboratories	148
Electro Sales	162
Electro Voice Inc.	115
Engineering Associates	162
Esege Sales	145
Espey Manufacturing Company, Inc.	135
Fair Radio Sales	113
Feifer Engineering Co.	154
Fisher Radio	155
Forest Sales	120
Franklin Technical Institute	164
G. L. Electronics	138, 164
Garrard Sales	166
General Apparatus Co.	104
General Electric Company	13, 31
General Test Equipment	166
Gonset Company	141
Goodheart, R. E.	162
Graybarne Corporation	157
Greenlee Tool Co.	157
Greenwich Sales Company	136
Greylock Electronics Supply Co.	151
H & D Products	164
Hallicrafters Company, The	22
Harvey Radio Company, Inc.	108
Heath Company	76 thru 83
Henry Radio Stores	159
Hickok Electrical Instrument Co.	24
Hollywood Technical Ins.	168
Howard Sales	164
Hytron Radio & Electronics Co.	23
Indiana Technical College	162
Instructograph Co.	90
J. F. D. Manufacturing Company	104, 154
J S H Sales Company	158
Jensen Industries, Inc.	90
Jensen Mfg. Co.	102
Jontz Mfg. Co.	116
Joseph Radio Parts Inc., Irving	129
Kaar Engineering Company	146
Ken-Way Products, Inc.	127
Key Electronics Division	165
Lafayette Radio Corporation	149
Lampkin Laboratories	148
LaPointe Plascamold Corporation	16
Leotone Radio Co.	161
Littelfuse Incorporated	21
Lowell Metal Products Corp.	136
Luther, Otto	142
Macmillan Company	164
McConnell's	153, 164
McGee Radio Company	92, 93
McGraw-Hill Book Company	144
McIntosh Laboratory, Inc.	167
Mallory & Co., P. R.	4th Cover, 17
Mark Electronics	147
Midway Company	166

(Continued on page 168)

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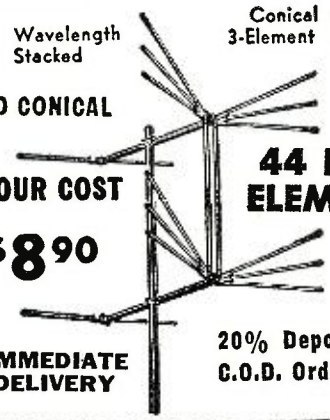

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EAVE MOUNT (18") Heavyweight ..... 2.25 pr.
EAVE MOUNT (24") Heavyweight ..... 3.00 pr.

SPECIAL 300 OHM TV WIRE $15.00 per M ft. in lots of 5 M ft.

1st quality 55 mil web, 22 gauge pure polyethelene and 7 Strand pure copper. 1000 ft. spools ..... Less than 5M ft. ..... $17.50 per M

TERMS: 10% deposit with order. Balance C.O.D. F.O.B., N.Y.C. Include shipping charges with paid-in-full orders.

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	1-11	12 Or More
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DOUBLE V ⅜" Dowel	3.45	2.45
DOUBLE V ½" Dowel	3.95	2.95
10 Element Conical ⅜" Dowel	3.55	2.55
Folded Hi Straight Low Quick Rig ½" elements	4.25	3.25
WINDOW CONICALS	4.95	3.75

MASTS

5 FOOT SWEDGED	.89	.69
10 FOOT PLAIN	1.59	1.29

TV WIRE

42 Mil. 300 OHM	$15.95 M Ft.
55 Mil. 300 OHM	17.95 M Ft.
72 OHM COAXIAL	52.50 M Ft.

CATHODE RAY TUBE SPECIALS

7JP4	$15.00	16RP4/KP4 N.U.	23.00
10BP4	14.95	16RP4A	26.00
10BP4 N.U.	19.95	17BP4A	27.00
10BP4A N.U.	19.95	20CP4	39.95
12LP4	19.95	20CP4 Sheldon	37.00
12LP4A	19.95	19AP4A	47.95
14BP4	19.95	19DP4A	47.95
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OPEN FACE CABINET 39.00

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G.E. type for 16" to 24"
XO45 ..... $3.85
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REGULAR 70° YOKE 3.85

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Lots of 12 or more.. 1.19

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6x9	3.73
5x7	3.43
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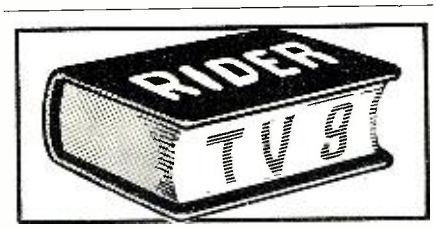
INDEX OF ADVERTISERS

(Continued from page 167)

NAME	PAGE
Midwest Radio & Television Corp.	88
Miles Reproducer Company, Inc.	166
Milwaukee School of Engineering	134
Mosley Electronics	159
Moss Electronics	97
National Electronics	162
National Radio Institute	3
National Schools	11
Newark Surplus Materials	84
Newcomb Audio Products	133
New England Television Corp.	160
Niagara Radio Supply Corporation	101
Offenbach & Reimus Company	122
Ohmite Mfg. Company	6
Olson Radio Warehouse	86, 87
Onan & Sons, D. W.	167
Peak Electronics Company	156
Penn Boiler & Burner Mfg. Corp.	103
Pfanstiehl Chemical Company	126
Photocon Sales	102
Pickering and Company, Inc.	165
Platt Electronics	110
Poly-Tech Company	130
Precise Development Corp.	142
Precision Electronics, Inc.	154
Premax Products	144
Premier Radio Tube Co.	117
Prentice-Hall, Inc.	157
Progressive Electronics Company	129
RCA Institutes, Inc.	85, 132
Radcom Engineering Co.	163
Radio and Television News	139
Radio Corporation of America	Second cover, 75
Radio Craftsmen, Inc., The	160
Radio Ham Shack, Inc.	121
Radio-Music Corp.	145
Radio Receptor Co., Inc.	135
Rad-Tel Tube Co.	153
Ray Mfg. Co.	168
Raytheon Manufacturing Company	15
Refonic Sales Co.	151
Regency	88
Rek-O-Kut Co., Inc.	122
Rider, Publishers, Inc., John F.	119, 147, 168
Rinehart Books	28, 29
Rogers-Phillips Research Labs.	124
Sams & Company, Howard W.	8, 128
Sanett, Robert	88
Sarkes-Tarzian	152
Schott Company, Walter L.	33
Service Management	106
Simpson Electric Co.	126
Snyder Manufacturing Company	30
South River Metal Products	160
Sprague Products Co.	99
Sprayberry Academy of Radio	19
Stan Burn Radio & Electronics	168
Standard Surplus	109
Standard Transformer	141
Star Electronics Distr. Inc.	152
Steve-El Electronics	137
Sun Radio of Washington, D. C.	96
Superior Instruments Co.	161
Sylvania Electric Products	10
Tab	169, 170
Tallen Company	162
Tech-Master Products Co.	158
Tele-Ex-Pand Products Sales Corp.	146
Television Communications Institute	163
Television Supply Company	159
Telex, Inc.	90
Transvision, Inc.	131
Trans World Airlines, Inc.	88, 166
Triad Transformer Mfg. Co.	118
Trio Manufacturing Co.	120
Triplett Electrical Instrument Co.	20
Tri-State College	144
Ungar Electric Tool Company, Inc.	129
University Loudspeakers, Inc.	155
V & H Radio & Electronics	153
Vactron	163
Valparaiso Technical Institute	106
Video Electronics	164
Waldom Electronics, Inc.	167
Weathers Industries	136
Weller Electric Company	18
Wells Sales, Inc.	89
Wholesale Radio Parts, Inc.	150
Workshop Associates, Inc.	98
World Radio Laboratories, Inc.	147
YMCA Trade & Technical School	147



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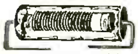

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0.42	289	1350	3509	17977	116667
0.425	299	1355	3600	18000	120000
0.607	300	1400	3700	18300	130000
0.7	310	1488	3730	18380	135000
1.03	311.5	1495	3760	18500	140000
1.3	320	1500	3900	18800	141000
1.75	325	1510	4000	19000	145000
2.5	330	1518	4030	19500	147000
3	340	1600	4200	20000	150000
3.83	350	1640	4220	20441	155000
4	360	1646	4280	20500	160000
4.35	366.6	1650	4300	21000	165000
5	370	1670	4314	21500	166750
5.025	375	1680	4440	22000	167000
6.25	380	1710	4444	22500	169200
6.5	389	1712	4500	22990	175000
7	390	1740	4720	23000	180000
7.8	400	1770	4750	23150	180600
7.9	410	1800	4850	23325	185000
8	414.3	1818	4885	23400	186600
10.38	418.8	1830	4900	23500	190000
11.25	425	1850	5000	24000	198000
13.52	426.9	1865	5100	24600	200000
14.2	427	1892	5210	25000	201000
14.5	430	1894	5235	25200	205000
15	440	1895	5270	25400	210000
16	450	1896	5300	25833	215000
17	452	1897	5500	26000	220000
19.2	460	1898	5600	26500	225000
19.5	470	1899	5730	26600	229000
20	475	1900	5770	27000	230000
22	478	1901	5910	27500	235500
23	480	1902	6000	28000	238000
24	487	1903	6100	28430	240000
25	500	1904	6125	28500	245000
26	510	1905	6140	29000	250000
28	520	1906	6200	29500	265000
30	525	1907	6300	29990	268000
31.5	540	1908	6495	30000	270000
37	550	1909	6500	31000	275000
48	560	1910	6800	31500	294000
50	575	1911	6840	32000	300000
51.78	580	1912	6990	33000	307500
55	588	1913	7000	35000	311000
56.7	600	1914	7320	36000	314000
60	612	1915	7500	37000	316000
63	620	1916	7700	38140	325000
68	625	1917	7717	38500	330000
74	633	1918	7900	39000	333500
75	640	1919	7930	39500	350000
80	641	1922	7950	40000	353500
81.4	645	1924	8000	41400	375000
88	649	1926	8094	42000	380000
95	650	1960	8200	43000	390000
100	657	1980	8250	45000	400000
101	665	2000	8500	47000	402000
103.2	670	2045	8700	47500	420000
105	673	2080	8770	48000	422000
105.7	675	2095	9000	48660	425000
107	680	2141	9100	49000	430000
110	681	2142	9445	50000	450000
120	684	2145	9500	51000	458000
121.2	689	2150	9710	52000	470000
125	697	2160	9800	55000	472000
130	699	2180	9900	56000	478000
135	700	2187	9902	57065	500000
147.5	711	2195	10000	58333	510000
150	733	2200	10430	60000	520000
160	740	2250	10500	61430	521000
165	750	2300	10600	62000	525000
170	800	2400	10900	64000	543000
175	806	2450	10936	65000	550000
179	820	2463	11000	66600	560000
180	850	2485	11400	66650	570000
182	854	2490	11500	67500	575000
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200	900	2525	12000	70000	620000
209.4	910	2600	12500	72000	650000
210	917	2625	12800	73500	654000
216	946	2635	13100	75000	660000
220	978	2700	13500	80000	680000
220.4	1000	2750	13550	82000	690000
225	1030	2850	13600	84000	700000
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271	1200	3300	16500	95000	910000
275	1225	3333	16800	100000	930000
280	1250	3384	17000	110000	950000

Any Size Above, Each 35c; Ten for $3.29

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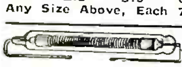
1.	1.579	2.7	4	6.7	10
1.1	1.65	2.75	4.23	7	11.55
1.2	1.75	2.8	4.25	7.5	12
1.25	1.8	2.855	4.5	7.62	12.83
1.3	1.9	3	5	7.74	13
1.35	2	3.3	5.1	8	13.85
1.39	2.11	3.5	5.5	8.02	30
1.4	2.2	3.673	6	8.5	51
1.5	2.25	3.75	6.5	9.05	
1.57	2.5	3.9	6.6	9.5	

Any Size Above, Each 70c; Ten for $6.49



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S. KLYSTRON socket Cinch........ .35
T. LOKTAL Amph 49SSL Steatite... .30
U. OCTAL Amph 7888 mica Bklte.. .09
U. 11-pin 78S11/931 Amph....... .16
V. OCTAL Amph 49S88 steatite..... .25
W. HiV Safety 4-pin Amph 77A4.... .39
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150mmf/300VGap HF $1.39
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HIGH CURRENT MICA CNDSRS.

CYLINDRICAL SIMILAR TYPE G

Mfd.	Kv	Amps	Mc	Each
.09	1.5	35	1	$14.98
2x.003	1.5	7	1	2.98
.0002	6	5	3	5.98
.01	10	30	3	49.50
.0005	35	13	3	39.95
.0025	20	22	3	45.00
.004	20	22	3	45.00
.005	15	30	1	48.00
.0025	12	20	3	28.95
.0015	5	3.3	.3	3.98
.001	30	30	3	110.00

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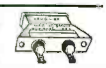
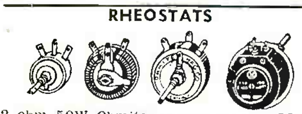
Mfd	Each
50wvdc	
4	$0.49
150wvdc	
1-1-3-5	.69
250wvdc	
2x.25	.35
300wvdc	
1.2	.39
400wvdc	
.1	.49
.5	.59
1	.69
4	1.69
6	2.29
8	2.49
10	2.89
2x.1	.75
2x.5	.94
3x.1	.91
3x.25	.99
600wvdc	
.034	.49
.1	.64
.25	.71
.5	.75
1	.85
2	.99
3	1.08
4	1.89
5	2.29
6	2.69
7	2.89
10	3.29
2x.1	.79
2x.25	.85
2x.5	.90
2x1	1.19
2x2	1.39
2x8	3.49
3x.05	.89
3x.22	.98
3x.25	1.09
700wvdc	
4	1.98
800wvdc	
.1	.69
1000wvdc	
.45	.79

Mfd	Each
2	1.69
5	2.98
10	3.98
15	4.98
1400wvdc	
.25	1.29
.5	1.39
1500wvdc	
.5	1.59
.75	1.69
1	1.79
2	2.29
5	3.49
6	3.98
.05	.79
2000wvdc	
.1	1.49
2x.1	1.75
1	1.98
2	2.49
3	3.98
8	9.49
2500wvdc	
.25	2.29
3000wvdc	
.1	2.49
.5	2.98
2	4.49
3	5.39
4	6.49
4000wvdc	
2	8.98
5000wvdc	
.2	4.49
2	10.98
4	19.98
7000wvdc	
.002	1.69
.0075	1.98
.1	4.98
7500wvdc	
.03	2.98
.05	3.49
10000 wvdc	
.03	3.49
12000 wvdc	
.02	4.98



Mfd	Each
12500 wvdc	
.65	16.98
2	95.00
15000 wvdc	
.0016	9.98
25000 wvdc	
.00025	7.49
1	95.00
AC RATED	
225vac/630dc	
3.3	.79
230vac 630dc	
5	1.29
330vac/1000dc	
1.25	.79
1.5	.89
1.75	.98
2	1.03
2.5	1.09
2.8	1.15
3	1.19
4	1.29
5	1.49
12	3.49
15	3.98
25	6.49
40	9.98
405vac/1200dc	
.15	1.29
600vac/1800dc	
16	6.98
660vac/2000dc	
5	4.49
6	4.98
10	6.98
16	7.98

RHEOSTATS



2 ohm 50W Ohmite.............. $2.59
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15 ohm 25W Ward L............. 1.98
15 ohm 75W Ohmite............. 3.74
20 ohm 50W Ohmite............. 2.35
60 ohm 50W Ward L............. 2.69
100 ohm 50W Ohmite............ 2.25
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25K ohm Type J ⅛" Slotted Shaft.. 1.25
50K ohm Type J ⅜" Flatted Shaft. 1.45
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UG22/U .... 1.60 CW123U ..... .55
UG24/U .... 1.50 M359A ...... .75
UG27/U .... 1.25 UG30/U 2.45
831R/SO239 Receptacle, 50c; 10 for 3.90
831SPN/PL259A Plug ..65c; 10 for 5.50
831SP/PL259 Plug.....50c; 10 for 4.75
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UHF ANTENNA 12"/30CM AT5/ARR1 Usable Citzn & Ham Band Ins. Coax Term Silv Pl Cont Wpf Gask & H'ware Mobile Mtg. New ....39c; 4 for $1.00
PL259 for above.................. .65
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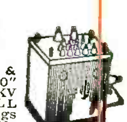
ANT AN131A, 11 ft, 8 sect........ 3.98

Sectional Antennas

MS49-52, 12½ ft. $1.69
BASES; MP22 $3.98; MP48........ 3.98

TRANSFORMERS



115 V 60 Cyc Input TV & CR Pwr Xfmr for 7" to 20" Tubes. Hi VOLTS to 20KV (w/quadrupler ckt). ALL Tubes, PL & FIL wndgs dlvrng: 300 VDC/275Ma Full-Wave, 6.4V/10.3A, 5.4/8A, 2.5V/3A Hypersil Core. Oil impreg..........$7.98
2500V for CRT, 6.3V/.6A, 2.5V/1.75A CSD Kenyon Hvins, 4/BC412 Replmnt....$7.98
1320V & 375VCT/110MA, 5V/3A, 2.5V/3.25A; 6.3V/2.75A HSLD HVINS...$9.98
1100VCT/200MA, 6.3VCT/4A, 5V/3A $5.98
1000VCT/200MA, 18V/.55A, 6.3V/5A, 5V/6A $6.98 ....2 for $12.98
1000VCT/125MA, 500VCT/100MA, 2X5V/3A, 18V/1A, 6.3V/8A U.T.C.......$5.98
1000VCT/45MA, 795VCT/80MA, 360VCT/55MA, 3X5V/3A, 6.3VCT/1A, 6.3VCT/.3A CSD HVINS CAN BE USED 2X RATING RAYTHEON HIPERSIL CORE........$4.98
900V/35MA, 2X2.5/2A, XCLENT 1800V DBLR TWO 2X2 FIL. WNDGS.......$3.49
900V/3MA, 6.3V/2A, 2.5V/3A.......$2.98
840VCT/110MA, & 530VCT/21MA, 2.5V/3A 6.3V/1A, 6.3V/.3A CSD HVINS..$4.98
770VCT/85MA, 5V/2A, 6.3V/3.5A $3.98
770V/2.5MA, 2.5V/3A HVINS HMSLD Includes FILTER PARTS...............$3.69
760VCT/120MA, 2.5VCT/10A, 6.3VCT/2A, 5V/3A, 10V/3.25A $6.98
720V/85MA, 5V/3.5A, 6.3V/3.5A....$2.98
700VCT/120MA, 2x6.3V/3A, 6.3V/1A $3.98
700VCT/85MA, 6.3V/.3A, 6.3V/7.5A, 5V/2A, Jefferson Cased $3.25
650VCT/150MA, 5V/3A, 6.3V/2.1A.$2.98
570V/150MA, 5V/3A, 12V/4A HSLD.$4.49
550VCT/275MA, 5V/4A, 6.3V/6A...$4.49
500VCT/60MA, 6.3V/4A HSLD......$2.98
480VCT/80MA, 6.3VCT/4A, 5V/3A..$2.69
420VCT/90MA, 6.3V/1.9A W/INPUTS 6, 12, 24, 115VDC &115 230VAC @ $1.98
420V/30MA, 6.3V/30MA, 6.3V/.6A 6.3V/1.1A, General Electric...............$2.39
550VCT/150MA, 5V/3A, 6.3V5A.....$3.49
220V/50MA, 6.3V/2A, 6.3V/1A, 5V/6.5A **JEFFERSON H'SLD** $1.89

FILAMENT TRANS.

2.5V/2A @ 79c, 2 for $1.49, 10 for $6.98
2.5VCT/10A 5KVINS 3.98
2.5VCT/20A/12KV INSUL, CSD H5LD 7.98
5VCT/10A4KV INSUL CSD HSLD.. 5.95
5VCT/10A/12KV INSUL G.E...... 6.98
5V/60A CSD KENYON HVINS..... 13.98
5V/115A CSD KENYON HVINS.... 16.95
6.3VCT/.6A 1KV INS CSD HVINS.. 1.98
6.3VCT/.7A NAVY HSLD HVINS... 1.98
6.3V/2A @ $1.39...........2 FOR 2.69
6.3VCT/4A USN USABLE 6.5A CSD 2.69
7.5VCT/12A 15KVINS KENYON... 10.98
12.6VCT/1.25A CSD HMSLD....... 1.98
24V/1.25A CSD @ $1.98, 2 FOR.. 3.49
24V/6A CSD @ $4.98, 2 FOR.. 9.49
42.5V/2A SEL RECT TRANS...... 4.85
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6.3V/.6A, 2X2.5V/1.75A HSLD... 3.49
2X2.5VCT/6A, 2.5VCT/12A/12 KVINS BRDG. RECT 8.49
6.4V/12A, 6.4V/10.6A, 3x5V/3A, 2.5V/1.75A 5.98
2x6.3V/.3A, 5V/3A, 5V/6A, 7V/14A .147KVA GE.......$5.98; 2 For 11.49
115 & 230 V INPT, 16.6V/1.25A, 12.6VCT/3.5A 6.98
Pri. 115V Sec36,24,18V/4ATaps18,12,9,0, 9,12,18 Bridge or Ct............ 7.70

STEP UP OR STEP DOWN

Isolation 115to115V/185Watts....$ 3.98
110V to 220V or 440V/185W...... 4.98
110V to 220V/200W, $5.98; 2 FOR 10.98
220V to 440V/250W, 5.98; 2 FOR 10.98

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2X330VCT/25MA or 660VCT CSD..$ 0.98
750VCT/650MA W/500V TAP...... 11.95
1100VCT/212MA; PRI 115 or 230V 6.50
3000V/10MA CSD WE D161913.... 8.95
5500VCT/650MA USN WSTGHS CSD 69.95
15000V AS V'DBLR WE, SIG 3H5629/7500V/35MA 19.95
550V/3.2KVA HVINS 12.98

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MODUL/240 Watts Peak PP Par 807's to PP807's RF/2000 ohm Load STANCOR/USN H'Sld $6.95
UNIV OUTPUT/12 Watts Any Tube Any Voice Coil UTAH 5999.$1.29; 2 for $1.98
Line Auto Former/30W UTC LVM-11.$3.49
Mike or Line to Grid "ouncer" UTC O 14 50:1/200 ohms to ½ meg $13 List.$1.98
OUTPUT/300 Watts Hi-Fi PP805 to 9 ohm VC, GUD 10KC Weco H'Sld HiVins.$12.98

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36 Volt Willard Mini-BRAND. NEW! 5 oz. Portable Equip Models,.... 98c; 4 for $3
6V/40AH Willard 6.98
2V/20AH Simlr BB54 Willard...... 1.98
6V/6AH Willd NT6/BB214U 1.98
Battery Acid. (R'Exp) 1 pt. 59c; 2 pts. .98
Hydrometer 1.06 to 1.24 Sp Grav... 1.98
Electrolyte Meas Tube, 12" lg..... .25
Spec Grav Ind & Merc. Thermom... .98

DRY BATTERIES

BA43 90/45/1½ Volts 98c
45/30Volt NEW 1949 Batty SimBURGESS XX30E, 1x2⅝x4¼" 79c; 3 for....$2.00

CHOKES

DUAL 30HY/60MA CSD.$0.98
3HY/40MA HI Q CSD 2 for .98
15HY/40MA AC/DC SETS EACH 39c .....3 FOR .98
10HY/60MA/UTC 2 FOR 1.25
12HY/80MA CSD 2.25
10HY 85MA @ 98c;2 FOR 1.79
5HY/100MA HMSLD G.E. 1.39
8HY/100MA/160 ⌒ /2KVINS/CSD.. 1.95
59HY/100MA/CSD 3KVINS/HSLD... 2.49
DUAL 5HY/120MA/2000VTEST..... 2.89
50HY/125MA/CSD/HSLD 2.98
DUAL 12HY/150MA/CSD/2KVINS... 2.98
12HY/300MA/5KVINS/HMSLD 4.95
8HY/225MA THORDASON......... 3.65
DUAL 2HY/300MA HMSLD USN $1.25 each ....2 for 1.98
20HY/300MA or 15HY/400MA/12 Kilovolts Insul 8.95
3 HY 400 MA 15 KVins HMSLD.... 3.49
10HY/135MA 1.35
13.5HY/1A/17KVINS RAYTHEON...49.95

I-F TRANSFORMERS

456 Kc Double Slug Tuned, Shielded....3 for $1; 8 for $2
10 to 14Mc FM&TV Double Slug Tuned, Shld'd.2 for $1; 5 for $2
2.2 to 2.7Mc COLLINS/USN Slug Tuned Coil, 5 prong Mtd. 4 for $1
8.15 to 10Mc Double Slug Tuned, Shielded, Incl 2 Silv P16-25mmf Ceramic Trimmers, 6 Ceramicons & 3-AB Resistors..........99c

END EQUIPMENT BUYS!

US Navy Version BC645 Ideal Citizens Band Conversion, NEW, less tubes, connector & Dyn. $12.95
TG5 Keyer, NEW 5.98
EE8 RingingGenAssy, Like New, Less Handset (TS-9) 7.98
RM-53 TEL CONTROL 4 Xmitter... 5.49
TG10 Code Unit, Less Tubes & Cabinet, as is 19.95
RM29 Control Unit, BRAND NEW.. 12.98
RT34/APS13 30 Mc IF Less Tubes, As Is, Good Condition 7.98
R59/TPS3 Good, As Is, Less Tubes. 29.98
EE65 Telephone Test Set, Fine Cond. 24.98
BE65 Time Interval Signal, Used... 3.98
R74/CRW Revr, Less Tubes, As Is.. 2.49
I-81 Compass Indicator, Like New.. 7.95
I-82 Compass Indicator, Like New.. 4.95
PE97 Plate Supply Unit, Less Tubes 9.98
I-108 Range Calibrator, Metal Case. 29.98
Mackay 168BRadioXmitter, w/Metal Case, Less Vibrapack & Tubes, As Is 2.98
I-198 Sig. Gen.Good Cond.Less Tubes 14.95
ART SPCH AMP, New Less Tubes... 12.98
BC456 Mod, Less Tubes, Dyn, As Is 1.98
SCR595 IFF Unit, Less Tubes, As Is 3.98
BC602 Cont Box for 522, As Is.... 1.29
BC605 Amp, Less Tubes, As Is.... 3.98
BC906 Freq.Mtr.ExcCond.Less Tubes 29.95
BC221AK Freq Mtr, Exc Cond.....125.00
I-122A Sig Gen, Good Cond.......149.50
SCR522A Less Crystals, w/tubes... 69.95
R-1/ARR1 w/conversion data for 220 MC converter. Booster for TV or SCR522/2 MTRS 7.95

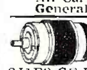
6-VOLT CARTER GENEMOTORS

Brand New! Way Below List Price

Inpt.	Outpt.	Model	Each
6V/29A	400V/375maint	4037AS	$29.95
6V/27.5A	590V/150maint	5915AS	29.95
6V/42A	590V/250maint	5925AS	34.95

All Carter Genemotors Sppplied with General Electric Input Filter Free

SELSYNS



2JIGI GE As Is No Returns 2 for 49c
2JIHI GE Selsyn..2 for $6.98
2J1F3 GE BrandNew115V 400cy.ea. 9.75
C78249 Sync.Diff, 115V/60cy.2 for 25.00
C78248 Sync. Trans 115V/60cy.2 for 29.95
Synchro Repeater 115V/60cy Type 11-4 Brand New @ $13.95.2 for 25.00
Bendix Autosyn AY1 & AY5..2 for 4.95

FRACTIONAL H.P. MOTORS

1/30 HP Motor, 117/234V, 47/63 cyc. 5/.35Amps, 2600-3100 RPM, 1 hp. ¼"dia. x1"Lg Shaft 3 lbs. NEW..........$5.98
1/100 HP Motor, 27.5VDC, 7000RPM Cont. OSTER, NEW $2.49
24VDC Motor, 1⅜" dia.x2¼" lg.. $2.29
Motor&Switch Assy. 28VDC/.6A/2000RPM cont., 6½x2¾x4" overall, Cams drive 14 Silver Pl. Switches, NEW...........$4.98
1/40 HP 1 or 3 Ph 3450 RPM w/Cndsr ⅝" Shaft, Delco-Diehl $3.49
1/40 As Above Slgt Defects in Case..$1.98

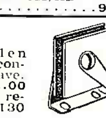
DYNAMOTORS

PE103 in 6&12V out 500V/160MA.$29.95
PE94 28V Plate Supp............. 3.49
DM37C in 28V/9.2A out 625V/225ma 9.98
DM41A in 28V/1.7A out 172V/138ma 2.79
in 12 & 24V out 500V/50ma.... 3.79
DM32 28V/1.1A out 250V/60ma... 3.69
BD77K 14V/40A out 1000V/350ma. 11.95
DM4 12&24V out 225V/100ma. 440V/200ma 11.98
DM53A 28V/1.45A out 220V/80ma. 3.59
DA3A 28V/10.5A out 300VDC/260 ma, 150VDC/10ma, 14.5vdc/5A 6.75

SOUND-POWERED Head & Chest Sets

Complete Navy Unit—Cushioned Headsets, Chest Box, Mike, Cable &Wpf Plug, Adjustable Units. Tested. Used. Exc. Cond. Each Unit..$5.49
Pair $9.98
RCA MI-2454B Head & Chest Set Sound Powered Brand New...........$12.98
P-20 Revrs w/Band & Cord, 24K ⌒...$4.98
HS-18, 2 Revrs/Cord w/PL54 less/HD Band 98c

RECTIFIERS



30Vin/26Vout/150Ma Selen w/mtg flange, 2 units can connect in C. T. for Full Wave. Unit, 36c; 2 for 60c; 4 for $1.00
Full Wave Bridge Selen for relays or Pwr. Inpt 115 to 130 vac; Outpt 115vdc/40Ma. Ea. 49c; 10 for $4.49

Current (Cont)	18/14 volts	26/18 volts	36/28 volts	54/40 volts
1 amp			1.95	
2 amps	2.20		3.50	6.50
4 amps	3.65		6.75	8.75
6 amps	5.40		8.95	14.00
10 amps	6.70	8.10	10.75	24.00
12 amps	7.50		14.00	29.95
20 amps	12.75	16.20	20.25	47.50
24 amps	14.00		26.00	
30 amps	18.50	24.30	29.90	59.50
36 amps	25.00		42.50	
50 amps	39.50	40.50	59.50	105.50
70 amps		63.00	84.00	

CT Rectifiers 100Amp 10-0-10V....$35.00
70Amp 18-0-18V $21.75; 36-0-36V 43.50
Full Wave Selenium Rect & Trans with Ageing-Taps, in Kit Form. At Fraction of Usual Price, All 115V/60Cyc Inpts.
Up to 16VDC at 12 Amps........$29.50
Up to 32VDC at 12 Amps......... 36.50
Up to 32VDC at 48 Amps.........149.50
Up to 20VDC at 6 Amps*......... 12.98
*This 6amp supply has no ageing taps.
We specialize in Rectifiers & Pwr. Supplies to your specifications. Immed. delivery.

NEW TELEVISION COMPONENTS!

HiV Horiz & Def. Output Xformer Sim RCA 211T5 for 15-16" Tubes....$1.98
Width Control Sim 201R4......... .39
UTC 88662 VBOX Xfmr H'Sld...... 1.69
HiV cndsr 500mmf/15KV .... .79
JEFFERS Cndsr 500 mmf/20KV..... .89
Ion Trap Perm Magnet Type....... .98
12 or 12½" Picture Tube Mask..... .59
Twin Line 300⌒ Low Loss..Per Ft. 2½c

KITS FOR THE BENCH

Silver & Mica Cndsrs........30 for $2.50
Controls, 50 ohm to 2 Megs..10 for 2.98
Resistors, ½&1W, to 2 Megs.100 for 3.98
Vitreous WW Resistors.......5 for .69
Sockets, Asstd. 8, 7, 5, 4P...25 for 2.49
Rotary Switches, Asstd.......6 for 1.75
G&P Tube Caps, Asstd.......50 for 1.49
Coil Forms, Th'd Sm HF.....50 for 1.00
Iron Core Slug & Screw.....50 for 1.00
Elastic Stop Nuts, Asstd.....50 for 1.00

THAT'S A BUY "TAB" THAT'S A BUY

DEPT. 3-RN, SIX CHURCH ST. NEW YORK 6, N.Y., U.S.A. - CORNER CHURCH & LIBERTY STS. ROOM 200

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Money Back Guarantee (Cost of Mdse Only) $5 Min. Order FOB NYC. Add Shpg. Charges & 25% Dep. Prices Subject to Change Without Notice.
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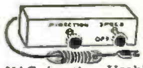
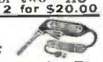
SELENIUM POWER SUPPLY



0-12 VDC/2amps. Variable DC supply, cased & completely built—115 VAC input. Usable for lab. filament DC, Plating, batt charging model railroad. Includes voltage or speed control w/center off reversing switch. Ideal for two "HO" locomotives. Special $10.95; 2 for $20.00

SOLDERING IRON GUN



Sensational value, light weight, heavy dty soldering gun. w/ removable alloy tip will not corrode. Tip is flat, can be used for soldering large and small parts.
"TAB" Special Money Back Gtd. $8.98

PARTS CABINETS

50 Draw Hvy Steel 34¼"H/18"W/9"L/65Lbs. draws3"W/2¼"H/8"L . . . . @$38.00
100Draw as above @$63.00
27Draw Hvy Steel 37"H/30¾" W/14¼" L/120 Lbs. Draws 3"H/9"W/12"L.$39.95
Write for Quantity Price "Extend Do"

LINE FILTERS

10Amp/130vacdc Csd0.1to1000 Mc's.$1.29
30Amp/250vacdc Csd0.1to1000 Mc's. .3.98
50Amp/600vdc/250vac. Fltrs both sides of line. SOLAR "Elim-O-Stat" New $9.98;
100Amp/usable 110 vacdc GE 2 for $1.98

CIRCUIT BREAKERS

Heinmann Magn Brkrs. Amps; 0.22, 2, 3, 5, 7, 9, 12, 15, 20, 30, 35, 40, 80, 180. Each $1.69; 10 for $15.98
Sq.D & CH Toggle Sw Brkrs. Amps; 5, 10, 15, 20, 25. . . . . . .Each 98c; 10 for $8.98
Klixon Thermal Push Button Brkrs. Amps: 5, 10, 15, 20, 25, 30. Ea. 89c; 10 for $7.98

SWITCHES AND MICROSWITCHES

SPNC/10A/WZ-RQ11/Plunger	$0.69
SPNO/10A/YZ-7RTC Pin Plunger	.54
SPNO/10A/G-7RS1/Plunger	.59
SPNC/30A/B-1/HI-ALT/Cased	1.25
NONC/BZ-2RLTC/1¼" LEAF	.98
NONC/MLB373/3¼" LEAF	1.08

6 AMP/125V Removed from Equip. Bklt. CSD CLEAN SPST. .4/$1: DPST. .3/$1

"TAB" THAT'S A BUY

NEW THRIFT-LITE Lifetime Photo-Flash

Not a kit. Incl Pwr pck, Life gtd Lamp, Rflctr & 15' cord 1/1000 Sec flash every 7 sec. True daylite color. Usable all cameras oper 115VAC w/lite Type AC40 . . . . $41.98
Complete Outfit for AC & Battery opr. Incl AC40&BP25 portopak & all accessrs for KODAK&COMPUR Shutters Complete. .$69.95
Write for Complete "THRIFTLITE" Data Boosterpacks, Ext lites, Units for Focal plane shutters & accessories. WE BUY, SELL & SWAP.

TAB "SUN-FLASH" LAMPS

"Tab" No.	Replaces	W-Sec. Max.	Each
U10	GE FT114	100	$ 9.98
No. 1	AMGLO 5804X	100	10.98
23ST	GE FT210	200	10.98
53GT	GE FT403	500	16.98
VA	SYLV. 4330	200	11.98
23MT	FT214	250	10.98
22ST	FT110	200	10.98
353GTQ	FT503	5000	54.98

R4340 FLASH TUBE—Nationally Advtsd @ $57. NEW $36.00
X-400 Air Corps Lamp. 14.98
Booster Packs External Light and Complete Line of Accessories.

MERCURY THERMO REGULATOR

DUAL CKT. 105°F & 32° F. Extremely sensitive & accurate for most exacting requirements—Research, Fire Prev., Freeze, Pt Control, or Max-Min Temp Control. Brand New. Individ. Boxed w/data & ckt. SPECIAL. . . . . . .Ea. 98c; 12 for $10.00
Ball Pens Gtd Red or Blue. . . .5 for $1.00
Ball Pens Draftsman Black. . . . .2 for 1.00

"WILLIAMSON" 10W HI-FI KIT

10 to 20000cycles with Ease! Internationally Famous; For HiFi enthusiasts. Incl Pwr supply, selected parts; Balanced resists. $29.95
W'mson PreAmp Kit & Tone boost Amplifier, chassis, parts, pwr supply. . . .$34.95
SUPER-Wide-Range HiFi TRIODE 10W KIT. 10to20000 cycles, 6B4G's, Max Harmonic Distortion 1¾% at full outpt & only ½% at 5W outpt. Includes Bass & Treble tube boost & Tone ckts 4PreAmp G.E. pickup 5dual & 2outpt (7) tubes. Parts, RCA chassis & info., less outpt xformer. . . .$29.95
UTC Hi-Fi Outpt Xfrm for P.P. 2A3, 6B4, 6A5 & 6L6. Csd cap 30W; Sec 5 taps 2½ to 250 ohms $6.98
GE Reluc Cartridge perm needle. . .$1.98
GE Dual Reluc Cartridge RPX 050. .$7.29
GE Reluc Cartridge RPX040 or 041.$7.29
GE S1201D Hi-Fi 12" PM Spkr. . . .$18.98
Phono Motor 33RPM w/ADJ Speed. .$4.69
Sensational 10" HiFiSpkr Ideal 10 Watt Home Size, Concentric. Separate Driver Woofer & Horn Driver Tweeter—30 to 16000 cps Range English Mfgr. $18.98
Electro Voice EV16H dual twilt Cart.$3.98
"LP" Anti-Static fluid GUD 1000 plays.69c
Extra dual needle for Twilt Cart. . . .$1.20

Hi Gain Dynamic Mike & Xfrm. Buy Comb. Spcl. Dyn Mike & Xfmr. $1.98
XFMR Hmt-sld UTC/SuperElect 3 wdg. 600∼ct & 4000tapped 250 & 150∼can be used Mike to Grid. Line to Grid & Line to Line. Csd & Hmt Sld SPECIAL 49c; Ten for $4.49

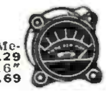
CRYSTALS

Mtd FT243 exacting Sec. Specs 3525Kc, 3700Kc, 3825Kc, 3655Kc, 3735Kc, Ea. $1.25; 4 for $4.75
Write for other Frequencies.
Htr. Oven Xtals—HiAccy. 5010 5025, 5055Kc. . . . . .ea. $14.98
Rochelle Salt Xtals. 69c; 10 for $5.00

SOCKETS FOR CRYSTAL HOLDERS

4-crystal holder ⅛" pins. ¾ & ½" spacing. . . . . .Each 10c; 12/$1
HiFreq Dual Xtal holder. . . . . .10c; 12/$1
HF Holder ½" spacing ⅛" pins 10c; 12/$1
Johnson Mycalex 3 pin BENDIX. 35c

METER SPECIALS



Best Buy—5 Ma DC Tuning Meter. G-E. 2½" dia. $1.29
SPECIAL—0.15 VAC. 2 1/16" Rd., GE. 800 cyc. USN. $1.69

MISC. TYPES

0-800 Volts DC, Weston 3" square built in Mult.	$12.98
0-8 Volt AC, Weston 3¼"	3.49
0-15 Volt AC, Weston 476 3" Sq.	4.95
0-150 Volt AC., Weston Rect. Type	8.98
0-50 Microammeter Weston 3" Sq.	16.98
0-500 Microammeter DeJur 2½"	6.98

DC MILLIAMMETERS

0-1 Ma 3" sq. Weston	7.50
0-10 Ma & 0-5KV (Basic 1 Ma), 3½"	4.98
0-10 Ma & 0-1KW (Basic 1 Ma), 3½"	4.98
0-25 Ma, Weston 3" sq	6.98
0-300 Ma, Weston 3" sq.	5.98

DC AMMETERS

0-1A, 3½" Wstghs	4.98
0-5A, 2½" Triplett	3.49
0-10A, 3" sq. Triplett	3.98
0-15A, 2½" Triplett	3.49
0-30A, 2½" Shunt WECo. Wstghs	2.98
0-60A, 2½" Int. Shunt. WECo	3.49
0-120A, 2½" Ext. Shunt WE/Wstg	3.98
0-240A, 2½", Less Shunt	3.98
0-300A, 3", Less Shunt. WECo	4.49
30-0-30A, 2⅜", Weston 203P&Wstg	4.98
60-0-60A, 2½", W/Shunt, WE/Wstg	4.98
120-0-120A, 2½" Shunt, WE./Wstg.	3.98
240-0-240A, 2½" Less Shunt, GE.	3.69
480-0-480A, 2½" Less Shunt, Wstg.	3.69

RF METERS

0-1A, 2½" G.E. USN—B'Csd	3.95
0-3A, Simpson 2½" Bklt Csd	4.25
0-8A, 3" Triplett Hi-Freq.; Int.Couple	4.98
0-9A, 2½ Wstghs USN	2.49
0-5A, 2½" Rnd Wstghs	3.79
0-120MA, Weston 3½" to 65 Mc	12.95

VOLUME LEVEL INDICATOR

−20 + 3VU, Weston, 3 sq. 16.98

Infrared Snooperscope

Image-Converter Tube Hisensitivity simplified design 2" dia. Willemite. Screen-Resolution up to 350 lines/in. Complete data & tube TAB Special. Each $4.98; 2 for $9.49

TUBES

"TAB" TESTED & GUARANTEED

PRICES SUBJECT TO CHANGE

0A2	$1.29
0A3/VR75	1.42
0A4G	1.45
0B2	1.45
0B3/VR90	1.23
0C3/VR105	1.43
0D3/VR150	.98
0Y4	2.53
0Z4	.79
V5-1	12.49
C1A	9.75
01A	.69
1A3	1.10
1A4P	.79
1A5GT	.79
1A6	1.49
1A7GT	1.32
1AE4	1.80
1B3/8016	.98
1B4P	.89
1B5/25S	.99
1B7GT	.99
1B21/471A	2.85
1B22	3.23
1B23	9.90
1B24	17.49
1B26	2.65
1B27	24.00
1B32/532A	3.90
1B35	11.98
1B37	18.00
1B38	29.95
1B40	4.95
1B41	49.95
1B42	18.00
1B46	1.98
1B53	49.95
1B56	38.50
1B58	350.00
1B60	69.75
ELIC	2.70
1C5GT	.89
1C6	.79
1C7G	.89
1D5GP	.99
1D7G	.89
1D8GT	.89
1E5	.99
1E7G	.99
1F4	.69
1F5G	.79
1F6	.89
1F7G	.89
1G4GT	.89
1G5G	.89
1G6GT	.79
1H4G	.89
1H5GT	.89
1H6GT	.79
1J5G	1.20
1J6GT	.79
1L4	.69
1L6	.98
1LA4	1.19
1LA6	.99
1LB4	1.29
1LC5	.79
1LC6	1.39
1LD5	.99
1LE3	.99
1LH4	.89
1LN5	.79
1N5GT	.99
1P5GT	.79
1P42	4.75
1Q5GT	.89
1Q26	69.00
1R4/1294	1.29
1R5	.79
1S4	1.19
1S5	.79
1S21	6.90
1T4	.79
1T5GT	.99
1U4/5910	.69
1U5	.79
1V	.79
1V2	.70
1X2	.99
1Y2	6.98
1Z2	3.98
2A3	1.78
2A4G	1.19
2A5	.69
2A6	.69
2A7	.69
2AC15	4.98
2AS15	4.98
2B7	.89
2B22	3.90
2C21/1642	.67
2C22/7193	.33
2C26	.19
2C26A	.47
2C33/RX233A	3.49
2C34/RK34	.69
2C39	33.98
2C40	9.98
2C40 JAN	19.90
2C43	26.75
2C43/464A	9.49
2C44	1.20
2C51	7.98
2C52	5.98
2D21	1.49
2E5	1.19
2E22	1.25
2E24	4.85
2E25/HY65	5.15
2E26	3.49
2E30	2.19
2J21	10.69
2J21A	9.25

2J22	7.90
2J31	29.75
2J31A	79.95
2J32	59.95
2J33	39.39
2J34	38.50
2J36	120.00
2J37	12.70
2J38	17.75
2J39	49.50
2J42	250.00
2J48	28.50
2J49	39.45
2J50	27.50
2J52	249.50
2J56	199.50
2J62	49.45
2K25	31.95
2K25/723AB	29.45
2K29	23.95
2V3G	1.29
2W3GT	.98
2X2	.69
2X2A	1.89
3A4	.99
3A5	1.69
3A8GT	1.59
3B4	2.69
3B5	.98
3B7/1291	.69
3B23/RK22	4.95
3B24	5.40
3B25	4.50
3B26	3.70
3B28	8.80
3C6/XX8	1.49
3C22	125.00
3C23	10.98
3C31/C1B	3.45
3C33	14.98
3C34/HK24	5.49
3C45	19.90
3D22	13.95
3D21A	2.39
3D23	4.90
3E29	14.95
3LF4	1.29
3Q4	.79
3Q5GT	1.29
3S4	.79
3V4	.79
4-125A	29.95
4-250A	40.95
4-1000A	108.50
4B27	4.98
4C25/HK54	5.98
4C33	59.00
4C35	28.65
4C36	15.98
4E27/257	14.98
4J22	148.50
4J31	95.00
4J34	194.00
4J42/700	27.00
4J47	260.00
4J47CY	198.00
4J52	350.00
4T4/2	5.95
4X150A	45.00
4X-500F	85.00
5AX4GT	.54
5AZ4	1.35
5C22	53.35
5C30/C5B	3.95
5D21	24.30
5D23	24.95
EL5B HD	16.98
5J29	12.40
5R4GY	2.20
5R4WGY	2.98
5T4	2.49
5U4G	.77
5V4G	1.39
5W4	.89
5X4G	.79
5Y3GT	.49
5Y4G	.79
5Z3	.99
5Z4	1.29
C6A	6.75
6A3	1.59
6A4	1.89
6A5G	2.39
6A6	.89
6A7	1.32
6A8GT	1.09
6AB4	.79
6AB5/6N5	1.33
6AB7/1853	1.39
6AC5GT	1.09
6AC6G	1.49
6AC7	.99
6AD6G	.98
6AD7G	1.49
6AF6G	1.33
6AG5	.89
6AG7	1.99
6AH5G	1.49
6AH6	1.99
6AJ5	2.16
6AK5	1.39
6AK5W	2.98
6AK6	1.49
6AL5	.69
6AL7GT	1.29
6AN5	5.95
6AQ5	.59
6AQ5W	5.98
6AQ6	1.00
6AQ7GT	1.19
6AR5	.79
6AR6	2.98
6AS5	.79

6AS6	2.79
6AS7G	4.50
6AT6	.82
6AU5GT	1.49
6AU6	.69
6AV5GT	1.29
6AV6	.59
6AW6	1.89
6AX5GT	.79
6B4G	1.78
6B5	1.19
6B6G	.89
6B7	1.19
6B8G	1.09
6BA6	.79
6BA7	1.19
6BC5	.69
6BC7	1.23
6BD5GT	1.65
6BD6	.89
6BE6	.79
6BF5	1.06
6BF6	1.49
6BF7	2.55
6BG6G	1.65
6BG7	1.98
6BH6	.89
6BJ6	.99
6BK7	2.15
6BL7GT	1.45
6BN6	1.49
6BN7	1.69
6BQ6GT	1.29
6BQ7	2.15
6BY5G	1.45
6C4	.69
6C5GT	.79
6C6	.79
6C7	1.26
6C8G	.89
6C21	29.45
6CB6	.89
6CD6G	2.49
6D4	2.85
6D6	.89
6D7G	.89
6D8C	.89
6E5	.89
6E7	1.39
6F4	6.35
6F5	.79
6F6	.99
6F6GT	.79
6F7	1.39
6F8G	1.29
6G6G	1.39
6H4GT	.98
6H6	.89
C6J	6.95
6J4	7.65
6J5GT	.59
6J6	1.29
6J7	1.09
6J8G	1.19
6K4A	4.75
6K5GT	1.09
6K6GT	.79
6K7	.85
6K8	.99
6L5G	.79
6L6	2.43
6L6G	1.69
6L6GA	1.69
6L6GAY	2.29
6L7	1.19
6N4	2.39
6N6G	1.69
6N7GT	1.29
6P5GT	.89
6Q7	.89
6R7	.99
6R8	1.39
6S4	.98
6S7G	.89
6S8GT	.99
6SA7GT	.89
6SA7GTY	3.37
6SB7Y	1.19
6SC7	1.39
6SD7GT	.99
6SF5	.89
6SF7	.89
6SG7	1.39
6SH7	.99
6SJ7	.89
6SK7GT	.89
6SL7GT	.89
6SN7GT	.79
6SN7WGT	2.25
6SQ7GT	.79
6SR7	.69
6SS7	1.09
6ST7	1.33
6SU7GTY	3.37
6SZ7	1.05
6T7G	.89
6T8	1.09
6U4/6AX4	.79
6U5/6G5	.99
6U6GT	1.09
6V3	1.89
6V6	2.25
6V6GT	.69
6V8	1.99
6W4GT	.69
6W6GT	.89
6W7G	1.33
6X4	.69
6X5GT	.75
6Y6G	1.27
6Y7G	.89
6Z7G	.89
6ZY5G	.89

7A4/XXL	.89	14A7/12B7	.99	49	.83	262B	3.98	815	2.90
7A5	.99	14AF7/XXD	1.19	50	1.19	274B/5R4	1.90	816/866Jr.	1.09
7A6	.79	14B6	.99	EF50	.98	276A	9.89	826	.95
7A7	.99	14B8	.89	50A5	1.19	T300	26.98	828	11.29
7A8	.89	14C5	1.09	50B5	.79	304TH	9.75	829	11.49
7AD7	1.49	14C7	1.09	50C5	.69	304TL	9.50	829B	13.45
7AF7	.89	14E6	.99	50C6	1.49	307A/RK75	4.85	830B	3.49
7AG7	1.99	14E7	1.09	50L6GT	.69	310A	6.75	832	5.65
7AH7	1.19	14F7	1.09	50X6	.89	311A	7.90	832A	9.75
7B4	.79	14F8	1.29	50Y6GT	.79	311CH	10.95	833A	39.45
7B5	.79	14H7	.99	50Z7G	.98	311CT	10.50	834	5.95
7B6	.79	14J7	1.19	52	.99	311T	10.50	836	4.75
7B7	.89	14N7	1.49	53	.69	313C	2.98	837	1.55
7B8	.89	14Q7	1.09	T55	8.79	316A	1.49	838	3.98
7C4/1203A	.79	14R7	1.19	55	1.06	323A	24.25	843	.39
7C5	.98	14S7	1.09	56	.85	327A	4.95	845	4.90
7C6	.99	14W7	1.09	57	.79	350A	6.50	849	29.45
7C7	1.49	14X7	1.23	58	.79	350B	5.90	852	19.98
7C23	72.00	15E	1.98	RK59	1.45	353A	4.65	860	4.90
7C29	69.95	15R	.89	59	1.78	HK354	24.98	861	23.95
7E5/1201	1.29	FG17/5557	4.75	T60	10.49	355A	14.15	864	.39
		18	.98	HY69	4.98	368AS	7.75		

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7E6	.89	19	.69	70A7	1.59	371B	.90	865	1.29
7E7	.89	19BG6G	1.79	70L7GT	1.59	380A	.79	866A	1.69
7F7	1.25	19T8	1.09	71A	.79	388A	1.49	868/CEIC	3.49
7F8	2.19	19V8	1.62	V70D	4.45	393A	8.90	869	36.95
7G7/1232	1.29	T20/1623	3.79	CRP72	1.37	394A	4.90	872A	3.69
7H7	.89	TUF20	5.19	CRP73	1.49	FP400	15.98	GE-872A	5.49
7J7	1.09	TZ20	3.79	73	1.67	X400	14.98	874	1.39
7K7	1.29	20	1.17	NR74	.29	417A	8.95	878	1.95
7L7	1.19	RK20A	8.95	HY75	4.59	GL434A	29.95	884/6Q5G	1.80
7N7	1.19	RX21	3.75	75	.99	446/2C40	1.19	885	1.45
7Q7	.79	22	.99	75TL	6.89	446B	3.89	893A	250.00
7R7	.99	24	.85	76	.79	450TH	44.00	922	1.75
7S7	1.09	24A	1.10	77	.69	460	15.95	923	1.00
7T7	1.03	24G/3C24	1.90	78	1.05	WL468	13.95	927/CE25	1.45
7V7	1.39	25A6	1.09	79	.89	GL471A	2.69	929	1.33
7W7	1.19	25A7	2.98	80	.69	GL502A	1.79	930	1.25
7X7/XXFM	1.19	25AC5GT	1.59	81	1.69	WL652	65.00	931A	6.90
7Y4	.69	25AV5GT	1.29	FG81A	3.90	GL530	22.00	954	.29
7Z4	.69	25BQ6GT	1.19	82	1.19	531	6.98	955	.40
8DC-15	4.98	25C6	1.18	82V	1.39	WL532	3.89	956	.39
10Y	.45	25L6GT	.69	83	1.45	550P1	19.95	957	.45
UXCV11	5.25	25W4GT	.89	83V	1.79	575A/975	13.75	958A	.67
CV11	5.25	25Y5	.79	84/6Z4	.99	WL579	10.49	967/FG17	4.75
12A	.89	25Z5	.79	85	.79	WL579B	12.98	973	10.75
12A5	1.39	25Z6GT	.99	89	.75	601B	.19	991	.39
12A6	.89	26	.79	VR92	.25	HY615	.25	FM1000	1.50
12A7	1.29	27	.69	FG95/5560	24.85	616	37.00	CK1005	.85
12A8GT	.79	HV27	10.95	FG98	19.95	KU627	18.00	CK1006	3.49
12AC7	1.45	FG27A	8.70	100TH	8.89	WL670A	11.98	CK1007	.89
12AH7GT	1.99	RK28A	4.89	102D	2.98	WL676	39.95	CK1090	2.69
12AK5	1.98	30	.79	102G	2.98	WL677	34.00	R1100	5.00
12AK5W	2.98	31	.59	FG104	37.98	WL686	35.00	R1130	12.00
12AL5	1.11	HY31Z	2.75			701A	5.89	E1148	1.35

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12AT6	.59	32	.49	FG105	18.98	702A	3.29	HY1231Z	5.39
12AT7	1.49	FG32/5558	13.85	VU111	1.45	702B	5.98	1612	1.98
12AU6	.89	32L7GT	1.49	HY114B	.75	703A	5.98	1613/676X	.98
12AU7	.95	33	.59	HY115	.79	704A	.98	1616	.90
12AV6	.69	34	.69	117L/M7GT	1.59	705A/8021	2.79	1619	.25
12AW6	1.79	35/51	.89	117N7GT	1.79	707A	10.49	1620	5.75
12AX4GT	1.20	35A5	.79	117P7GT	1.39	707B	17.49	1622	2.69
12AX7	.99	35B5	.79	117Z3	.59	710A/8011	.95	1624	1.90
12AY7	2.95	35C5	.69	117Z4GT	1.39	713A	1.00	1625	.42
12BA6	.79	35L6GT	.79	117Z6GT	1.19	NL714	5.95	1626	.42
12BA7	.79	35T	4.89	117Z7GT	1.49	714AY	5.90	1629	.35
12BD6	1.75	35TG	3.45	F123A	8.49	715A	6.45	1630	.97
12BE6	.89	35W4	.59	T125	12.49	715B	9.65	1631	1.25
12BF6	.85	35Y4	.69	F127A	19.98	715C	24.25	1632	.77
12BH7	1.29	35Z3	.79	VT127A	3.90	717A	1.49	1633	.73
12BY7	1.35	35Z4GT	.69	CV148	4.98	718BY	48.45	1634	.73
12BZ7	1.25	35Z5GT	.59	150T	14.50	718CY	48.45	1635	1.49
12C8	1.39	REL36/6J4	.49	VT158	14.49	719A	49.95	1636	3.19
12F5GT	.79	36	.65	FG166	49.00	721A	2.49	2000T	149.50
12H6	.89	37	.69	FG172	42.50	722A/287	2.45	2050	1.79
12J5GT	.69	38	.59	182B	1.20	723A	9.75	2051	1.19
12J7GT	.99	RK39	2.89	FG190	12.80	723A/B	14.49	R4340	36.00
12K7GT	.89	39/44	.59	T200	22.98	724A	3.95	5516	5.98
12K8	.99	CRC40	.59	201A	.98	724B	3.45	5517	3.39
12Q7GT	.79	T40	4.29	203A	5.98	725A	7.45	5594	6.65
12S8GT	.98	TZ40	3.98	205B/VT2	1.69	726A	6.90	5608A	5.95
12SA7GT	.89	40	1.09	CE206	3.15	726B	59.95	5637	7.15
12SC7	1.39	HY40Z	3.75	211/VT4C	.45	726C	69.95	5638	4.79
12SF5GT	.79	41	.79	CE215	8.98	801A	.45	5651	3.05
12SF7GT	.59	42	.69	RX21S	9.95	802	3.98	5654	4.79
12SG7	.89	43	.85	WE215A	.18	803	3.89	5656	19.98
12SH7	1.10	45	.69	217C	8.75	804	8.95	5663	1.85
12SJ7GT	.79	45S/VT52	.65	227A	4.98	805	3.90	5670	6.98
12SK7	.89	45Z3	.69	231	1.20	807	1.67	5684	14.98
12SL7GT	.79	45Z5GT	.89	242C	8.49	808	2.98	5686	4.23
12SN7GT	.89	46	.89	244A	4.15	809	2.43	5687	5.75
12SQ7GT	.79	47	.99	247A	9.95	810	10.98	5692	7.69
12SR7	.98	48	1.99	250R	9.90	811	2.90	5693	7.69
12X3	.90	RK48A	14.85	250TH	22.25	812	2.90	5694	3.65
12Z3	.89	RK49	7.50	250TL	18.50	813	8.65	5718	10.15
14A4	1.09			HK254	14.49	814	3.85	5719	12.75

5726	4.39
5749	4.39
5751	5.45
5763	1.70
5812	2.99
5814	5.49
5881	3.29
5840	12.75
X6030	4.49
UX6653	.69
8002R	99.50
8005	5.85
8008	6.49
8012	2.89
8013	2.75
8013A	6.45
8014A	28.95
8020	1.25
8025	5.79
9001	1.65
9002	1.29
9003	1.69
9004	.59
9006	.29

Sub-Miniatures

1AD4	2.95
2E31	1.49
2E36	1.49
2E41	2.39
2E43	1.39
2G21	2.39
CK501X	1.26
CK501AX	1.26
CK502AX	1.79
CK503AX	1.79
CK505AX	1.79
CK506AX	1.79
CK509AX	1.26
CK512AX	1.79
CK522AX	1.79
CK525AX	1.79
CK526AX	2.98
CK528AX	2.39
CK529AX	2.98
CK531DX	.98
CK532DX	.98
CK533AX	1.39
CK534AX	.89
CK536AX	.89
CK537AX	4.98
CK538DX	.89
CK539DX	.98
CK541DK	1.98
CK542DX	.98
CK543DX	.98
CK544DX	.98
CK546DX	1.98
CK547DX	1.98
CK571AX/5886	6.98
CK573AX	2.98
SD828	.98
SD969	.98
CK1027	3.35
CK1028	9.98
CK1089	4.69
CK1090	4.69
CK5672	3.15
CK5676	2.98
CK5678	2.45
CK569[illegible]	5.98
CK5702	7.25
CK5703	1.08
CK5704	5.79
CK5783	6.69
CK5784	7.40
5829	5.98

C'Ray Tubes

CK5851	4.98
CK5875	1.98
2AP1	11.90
3AB1	12.95
3AP1	14.25
3BP1	7.95
3BP1A	14.98
3CP1	2.20
3DP1	4.85
3EP1	4.98
3FP7	1.69
3FP7A	14.98
3GP1	4.70
3HP7	3.85
3HP14	14.98
3JP7	12.50
3JP12	19.95
3JP14	16.95
4AP10	4.69
5AP1	5.98
5BP1	4.49
5BP1A	14.98
5BP4	4.75
5CP1	4.75
5CP7	11.95
5CP7A	9.98
5FP7	1.89
FP14	18.95
5HP1	9.75
5HP4	9.75
5JP2	24.40
5LP1	29.95
5MP1	9.75
5NP1	5.85
7BP1	4.95

7BP7	6.75
7EP4	17.98
7JP4	18.39
9GP7	14.89
9LP7	5.95
10BP4	18.29
12DP7	16.89
12DP7A	49.50
12GP1	49.98
12GP7	16.89
12HP7	16.89
12JP4	27.00
12KP4	47.00
902	10.65
905	3.49
912	89.98
913	11.98
914A	45.00

Vacuum Capacitors

MMF	KV	Each
25	7.5	3.49
50	7.5	1.49
100	7.5	6.95
12	20	9.98
50	20	9.98
55	20	9.98
100	20	12.98
150	20	14.98
12	32	12.98
25	32	14.98
50	32	16.98

Tungar Bulbs

16x897	3.49
199698	4.49
195528	2.49
20x672	2.95
206501	3.59
217283	6.75
289881	2.50
45X674	12.95
859483	2.95

Mazda Pilots

311/28V	.15
313/28V	.15
323/3V	.25

Neon Bulbs

NE16/991	.40
NE20	.10
NE32	.35
NE45/2W	.27
NE51/NE20	.10

Xtal Diodes

1N21	.89
1N21A	1.98
1N21B	3.98
1N21C	27.45
1N22	1.25
1N23	1.49
1N23A	2.98
1N23B	4.98
1N25	7.45
1N26	9.15
1N27	1.65
1N29	3.50
1N32	24.50
1N34	.69
1N34A	.98
1N35	1.95
1N38	1.65
1N39	6.15
1N40	9.98
1N43	1.69
1N44	1.21
1N45	1.39
1N46	.69
1N48	.59
1N51	.45
1N52	1.85
1N54	.89
1N55	2.99
1N56	.89
1N57	.89
1N58	1.19
1N60	.60
1N61	2.10
1N63/K63	2.49
1N64	.69
1N67	1.95
1N69	1.98
CK705	.77
CK707	1.80
CK706	.54

Thermistors

D167019 Vol Limiter	2.95
D168391 Thermal Comp	2.95
D170396 HF Pwr. Meas.	.90
1C Bulb Time Delay	.90

Varistors

CW20259/USN38C	2.95
WEco 40A	1.50
WEco 41A	1.50

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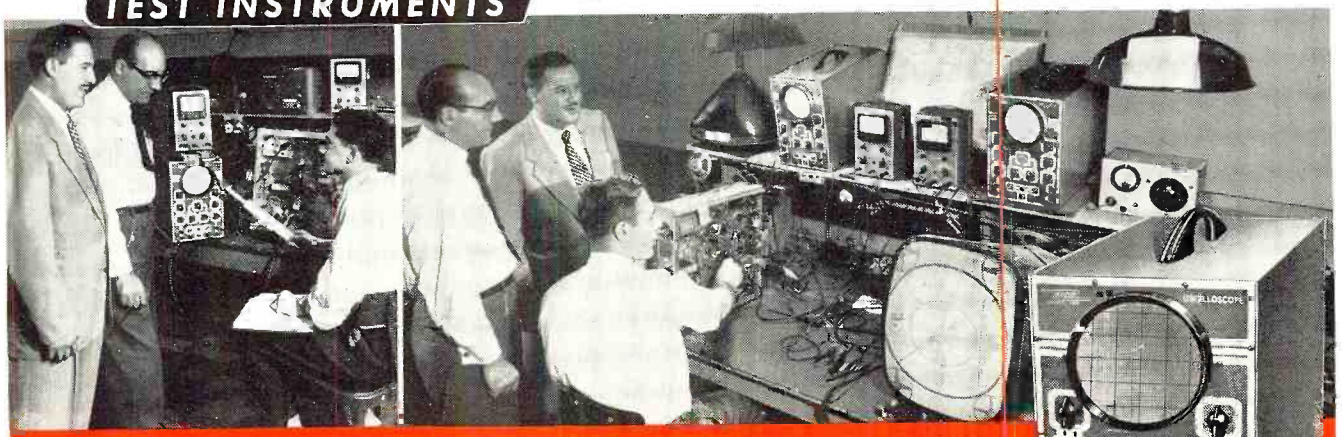

In the Majestic design laboratories, Frank J. Dieli and assistant, Paul Smith, discuss with Harry R. Ashley, some important prototype-circuit measurements just taken with the 425 Oscilloscope, #221 VTVM and #HVP-1 HV Probe.

Frank J. Dieli, Majestic's Chief Engineer, and Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 425 5" Push-Pull Oscilloscope, Model 221 Vacuum Tube Voltmeter and Model HVP-1 High Voltage Probe at the important Final Test Position on the Majestic Television production lines.

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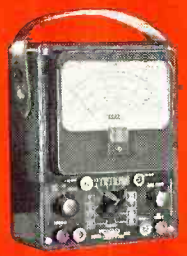

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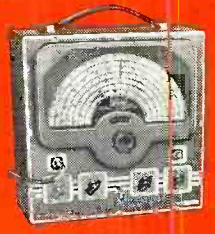

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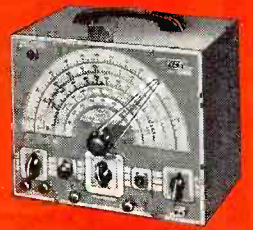

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