RECEIVERS FOR SATELLITES

DECEMBER 1957

Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

HUGO GERNSBACK, Editor

Multi-Way Electronic Crossovers

•

Servicing Auxiliary TV Circuits

•

Maintaining The VTVM

•

Phonograph Pickup Arms

•

Relay Averts a Toyland Tragedy

(See page 102)

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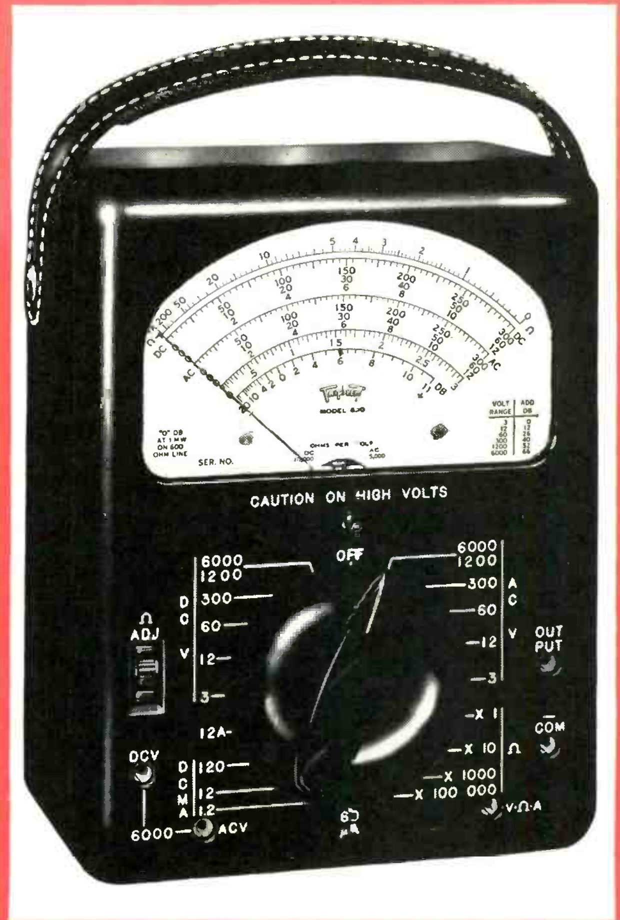

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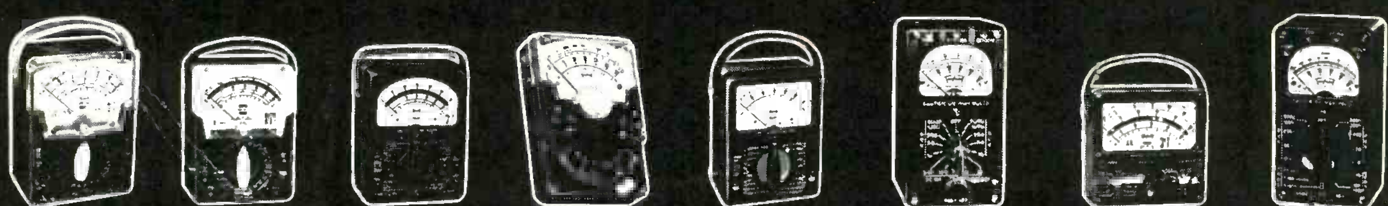

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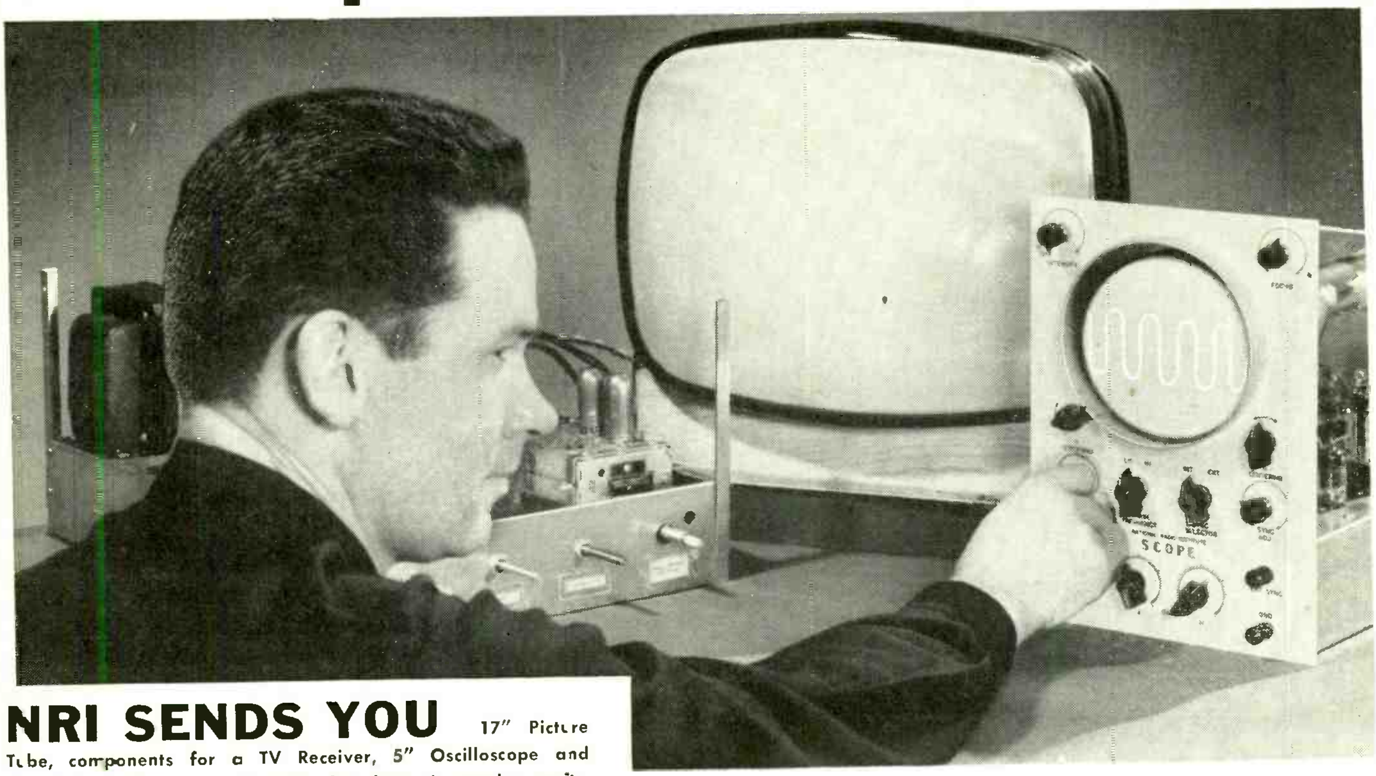

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EDITORIAL

TEST INSTRUMENTS

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ON THE COVER

(Story on page 102)

This is one collision that won't take place. The gadget on the right is an electronic light-triggered relay that stops the train whenever the intersection is blocked.

Color original by James A. McRoberts

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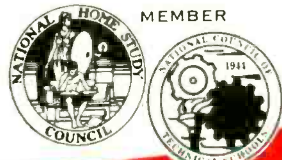

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News Briefs

STEREOPHONY as the dominant trend in the audio–radio field was evidenced at the Annual Audio Engineering Society Convention and High Fidelity Show held in New York City early in October. One complete session of the convention (Friday afternoon, Oct. 11) was devoted to stereophonic sound, highlighted by the demonstration of the Westrex discs. (See page 8.) Part of another session dealt with stereo FM transmission.

At the show, the dominance of stereo was even more pronounced. In addition to the manufacturers exhibiting stereo equipment, the majority of exhibitors demonstrating amplifiers, speakers or other apparatus used a stereophonic setup. Unfortunately the extremely high volume levels traditional at audio shows masked out the stereophonic effect in most cases, but could not conceal the conviction of the manufacturers that stereophony is the next big thing in the audio field. Some expressed the fear that the prospect of stereophonic discs might have a deterring effect on stereo tape similar to that color television is alleged to have had on the sale of black-and-white TV receivers but an equally large group insisted that disc and tape would help each other to promote stereo.

PHONE CABLE TO HAWAII, the worlds longest and deepest, provides 36 circuits between the United States mainland and the island of Oahu, where 80% of Hawaiian telephones are located. The distance between cable terminal points is 2,400 miles. At some places the cable is 3½ miles below the surface of the Pacific Ocean. The cable was built by American Telephone & Telegraph's Long Lines Department and the Hawaiian Telephone Co.

Amplifiers, needed to boost the strength of signals when they reach the fading point along the cable, were developed by Bell Telephone Laboratories. They are built into the cable at 44-mile intervals and are designed to withstand the pressures encountered on the ocean floor. They amplify voice currents 1 million times and are expected to operate without attention for at least 20 years.

It is now possible for operators on both the mainland and the island to dial directly, rapidly completing calls that span the Pacific.

TV SERVICING IN 1966 will be a vastly larger field than today, according to a recent survey made by Frank W. Mansfield, Sylvania's marketing research director. He shows a dollar volume of $447 million in 1948, $2.55 billion in 1957 and an expected $3.97 billion by 1966.

An interesting sidelight is the predicted drop in number and total value of receiving tubes. This is due to the increased use of transistors and the expected reduced price of tubes because of competition from transistors.

Mansfield's survey is based on six service calls a year for color TV sets, three a year for black-and-white sets, one a year for home radios and 0.5 a year for auto radios. Growth in the number of TV sets is also expected. Color sets from 160,000 now to 18,840,000 in 1966, and black-and-white sets from 42,580,000 now to 53,760,000. The number of service technicians for this year is listed as 132,970. Predicted growth at a rate of 5% per year should bring this to 206,640 by the beginning of 1966.

Calendar of Events

1957 Eastern Joint Computer Conference, Dec. 9–13, Sheraton-Park Hotel, Washington, D. C.
EIA Conference on Maintainahility of Electronic Equipment, Dec. 18–19, University of Southern California, Los Angeles, Calif.
Fourth National Symposium on Reliability and Quality Control, Jan. 6–8, Statler Hotel, Washington, D. C.
Second EIA (RETMA) Conference on Automation, Jan. 22–24, Arizona State College, Tempe, Ariz.

THYRISTOR, a new high-frequency switching transistor, can switch substantial currents from one circuit to another in periods as short as 1/50,000,000 second. It is switched from on to off and vice versa by applying low energy pulses of the proper polarity to the base circuit. Announced by Dr. Irving Wolff, vice president of RCA's research department, it is described as a modified alloy-junction transistor. A novel feature is a new form of collector contact which makes the high-speed switching action possible. The Thyristor may be operated as either a bistable switching element or a more conventional high-frequency transistor, either in switching or amplifying circuits. The device is still under development and is not yet commercially available.

Similar units announced by Philco are a new class of field-accelerated transistors made possible by a Micro Alloy Diffused-Base Transistor (MADT) process. MADT's are available in various voltage and frequency specifications for use in transistorized equipment through the entire vhf and part of the uhf spectrum. These transistors feature a maximum frequency of 250 to 1,000 mc. Typical gain is 10 db

at 200 mc, more than 16 db at 100.

A logical outgrowth of MADT is the development of a super-high-speed switch. Engineers now discuss switching time in light feet instead of μsecs. Typically the MADT will switch on or off in 10 light feet. No type number was given for these transistors nor was unit price revealed. The unit is now in production.

STEREO DISC RECORDS were demonstrated by two companies during the recent Audio Engineering Society convention in New York City. Westrex, a subsidiary of Western Electric Co., demonstrated one system at the convention. The other, not shown at the convention itself, was demonstrated by London Records at an outside location. Opinion seemed to favor the London demonstration, though conditions surrounding the Westrex audition caused some to wonder if the records might not be somewhat better than circumstances permitted them to sound.

The London system—originated in England by London's parent company (British) Decca Records—combines vertical (hill-and-dale) and lateral recording. Vertical motion of the stylus produces one of the stereophonic channels, while lateral motion produces the other. The American system records the two channels on opposite sides of a 45° groove. Thus each of the two stereophonic signals is a combination of vertical and lateral movement of the stylus.

It was generally understood that manufacturers were ready to agree on a single standard before beginning to mass-produce records. Once agreement on the system to be used is reached, there need be little delay in putting stereophonic discs and cartridges on the market. The would-be stereophonic listener could use his own pickup arm and turntable, and his amplifier–speaker system would furnish the sound for one channel. It would then be necessary to obtain only one additional preamp, amplifier and speaker system, which many feel need not be of the extreme quality required in a single-channel true high-fidelity system.

5 NEW TV STATIONS since our last listing add to the bumper crop this fall:

KOAC-TV, Corvallis, Ore. 7
WPTA, Roanoke, Ind. 21
WTIC-TV, Hartford, Conn. 3
KETV, Omaha, Neb. 7
WHYY-TV, Philadelphia, Pa. 35

New call letters were chosen by:

WLOF-TV, Orlando, Fla. 9
(formerly WTLO)
KSOO-TV, Sioux Falls, S. D. 13
formerly KSOO)

There are now 513 operating U.S. stations (422 vhf and 91 uhf), 27 of which are noncommercial (6 uhf).

Canada's list of TV stations has grown to 44 with:

CHAT-TV, Medicine Hat, Alta. 6
CHBC-TV, Kelowna, B.C. 3

Viewers should note that CHBC-TV

(*Continued on page 12*)

NEWS BRIEFS *(Continued from page 8)*

has two satellites, CHBC-TV-1 on channel 13 in Penticton, and CHBC-TV-2 on channel 7 in Vernon.

AIEE EDUCATION MEDAL has been awarded to Dr. William L. Everitt, dean of the College of Engineering at the University of Illinois, for outstanding service as a teacher in electrical engineering. He received the medal at the Fall General Meeting of the American Institute of Electrical Engineers in Chicago.

Dr. Everitt has devoted most of his life to education, except for two years as engineer in charge of PBX (Public Board Exchange) development for the North Electric Manufacturing Co. He is noted for inventions in the fields of automatic telephony, radio altimeters for aircraft, directional antenna systems, speech compression and radio tuning systems.

8-RPM RECORD PLAYS 10 HOURS. Speaking before the Audio Engineering Society at its convention at the Hotel New Yorker, New York City, Dr. Peter Goldmark, president of CBS laboratories, announced the new speed. He said that a 7-inch record plays for 4 hours while a 12-inch record would play for 10.

Dr. Golmark pointed out that reducing speed from 33⅓ to 16 rpm reduced the average surface noise by 4 db. The speed reduction from 16 to 8 rpm cuts surface noise by another 3 db.

The 8-rpm record does lose some high-frequency response but, for speech, a 5,000-cycle maximum frequency gives adequate reproduction.

It was noted that research on the 8-rpm speed was performed with the cooperation of the American Foundation for the Blind and the Library of Congress.

RADIO LIBRARY FOR THE BLIND, sponsored by the South East Amateur Radio Club, Inc., 11519 Parkview Ave., Cleveland, Ohio, is now in operation. Among the library's services, mailed free to and from the borrower, are: electronics literature in manuscript form in braille; circulating copies of the *Braille Technical Press;* electronics literature recorded on tape; monthly tape featuring articles from major electronics magazines.

ULTRA-MAGNIFIER quadruples the enlarging power of RCA's model EMU-3 electron microscope. The new device enables the electron microscope to enlarge specimens as much as 200,000 times, compared to its present power of 50,000. This coupled with photographic enlargement permits magnifications as great as 1,000,000 times. The increased enlarging power is made possible primarily by a newly developed intermediate lens polepiece which focuses the microscope's electron beam The ultra-magnifier kit is made up of the new lens polepiece and an electronic control unit which includes a nine-step switch to vary magnification over the new high range. END

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This book, "Your Future in the New World of Electronics," also shows you how CREI Home Study leads the way to greater earnings in the booming electronics world.

However, CREI does not promise you a "snap." With an accredited technical school such as this you must study to convert your ambition into technical knowledge you can sell in the fabulous Electronics market.

Since its founding in 1927, CREI has provided thousands of professional electronics men with technical educations. During World War II, CREI trained thousands for the Armed Services. Leading firms choose CREI courses for group training in electronics, at company expense, among them United Air Lines, Canadian Broadcasting Corporation, Trans-Canada Airlines, Douglas Aircraft Co., Glenn L. Martin Co., Columbia Broadcasting System, All-American Cables and Radio, Inc., Gates Radio Co., Canadair Ltd., Federal Electric Corp., and U. S. Information Agency. CREI courses are prepared by recognized experts, in a practical, easily understood manner. You get the benefit of time-tested study assignments under the personal supervision of a CREI staff instructor. This is accomplished on your own time, during hours selected by you, and controlled by your own will power. This complete training is the reason that graduates find their CREI diplomas keys-to-success in radio, TV and Electronics. CREI alumni hold top positions in America's leading firms. At your service is the CREI Placement Bureau, which finds positions for advanced students and graduates. Although CREI does not guarantee jobs, requests for personnel far exceed current supply. Now is the time of decision for you. Luck will not propel you forward unless it finds you trained. Contacts won't budge you an inch unless you have the skill to back them up. The answer is: Technical Training . . . and willingness to learn. Together they will bring you increased earnings in this new Age of Electronics. Fill out the coupon below and mail it now. We'll promptly send you your free copy of "Your Future in the New World of Electronics." The rest—your future—is up to you!


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- ☐ Television Engineering Technology

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Gyro-like Roto-Drive gives new Thorens TD-124 absolute speed uniformity. Heavier than 16-inch turntables, yet it starts, stops in less than 2/3 turn!

How to get the heaviest possible turntable for smooth, absolutely quiet operation without sacrificing fast starts and stops.

That's the problem Thorens engineers faced when they set out to build the best four-speed, 12-inch, hi-fi turntable money can buy. You'll be amazed at the simplicity of their solution.

The new TD-124 really has two turntables in one: (1) a heavy 10-lb. rim-concentrated, cast-iron flywheel (outweighs 16″ aluminum turntables) (2) a light aluminum cover, or turntable proper. An exclusive, Thorens-originated clutch couples or decouples the light aluminum table to the heavy flywheel for instant starts and stops. What's more, the Thorens double turntable system gives you the weight of a cast-iron table (3 times as heavy as aluminum) without danger of attracting any pickup magnet. And with this unique construction, your pickup gets magnetic shielding from motor or transformer hum fields by the iron turntable.

Ask your hi-fi dealer to show you the Thorens TD-124. Better yet, arrange to hear one of those critical, slow piano records on the TD-124. If you don't know who your dealer is, write Thorens Company, Dept. E12.7, New Hyde Park, N. Y. 7.9

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Correspondence

X-RAYS FROM TV SETS

Dear Editor:

"Hot Words on Boosters" (page 16, October issue) hit a point close to home. Therefore, I am writing this to correct what seems a gross misunderstanding of a rather vague subject.

Since I am a radiation physicist, one of the very first things I found myself doing was measuring the X-rays that emanate from picture tubes and other high-voltage tubes to find out if they would be strong enough to be harmful.

Using a Victoreen R-meter, which is commonly used in X-ray laboratories for measuring X-ray strength, I empirically determined that very little radiation emanated from the face of a TV picture tube. So little, in fact, that the readings were barely indicated on the R-meter. With the TV set in the cabinet, no reading was available, indicating that the strength of X-rays was way below the sensitivity of the meter.

Around the neck of the picture tube, where the glass is rather thin, a definite reading was indicated. However, this reading (at the usual voltages in black-and-white TV sets) was so low that a person would have to spend 6 or 8 months near the neck of the picture tube (or inches from it) to get enough radiation to pass the minimum safe requirements (100 milliroentgens per week) of the Radiological Safety Conference.

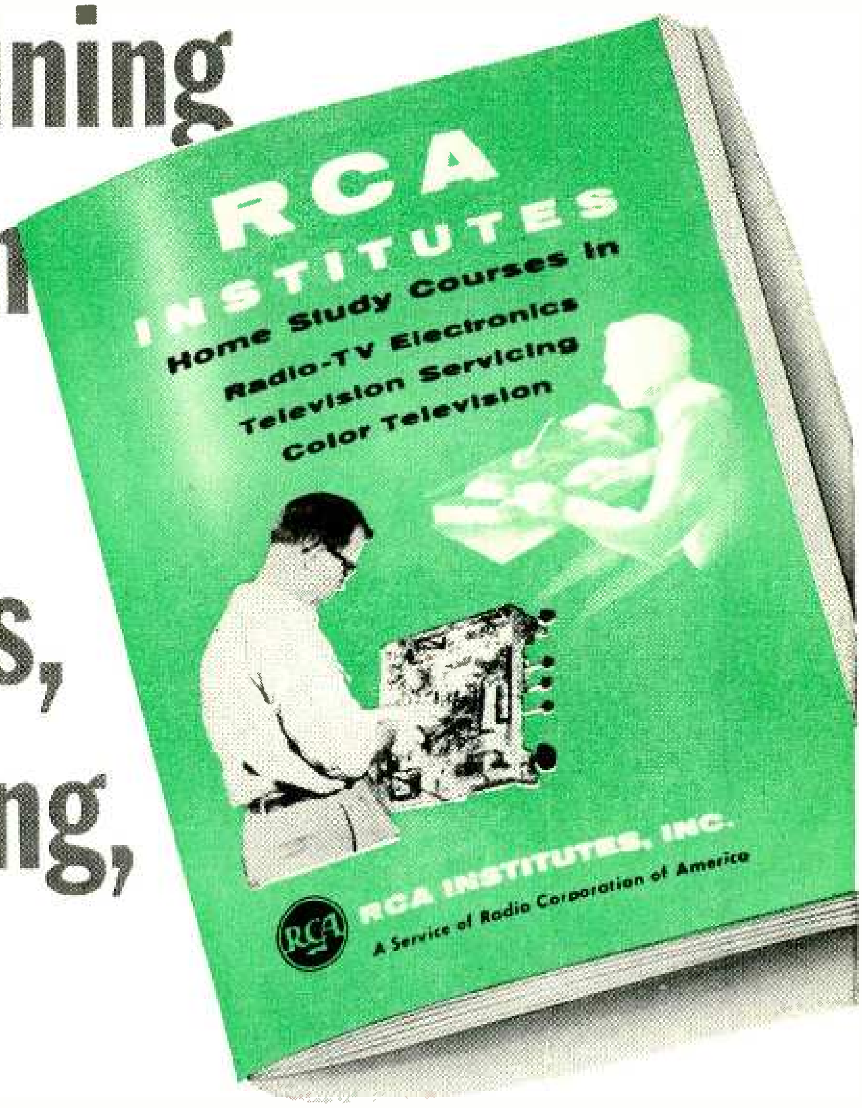
There is, however, a more serious danger point. That is at or near the 1B3, 1X2 and 1V2 tubes used as rectifiers. Here, X-ray dosages were such that a long exposure of perhaps an hour, at 6 inches from these tubes, could cause an overdose of these soft rays. Fortunately, these tubes are usually enclosed in a metal can or placed under the chassis in where the X-rays are heavily absorbed. No reading of any value was available from sets in their cabinet or from sets where all the hardware was in place. My measurements were made within 6 inches since, frankly, I cannot see anyone getting closer than this to a "hot" high-voltage rectifier.

My conclusions from this were very definite:

1. A properly manufactured TV set gives off no appreciable radiation to the user or his family.

2. A properly manufactured TV set has sufficient protection so the service technician need not be worried.

3. A technician who has developed suitable methods of working so that



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he does not allow himself to get close enough to high-voltage components to get sparkover to his body or hands does not have to worry about X-rays since he is usually far enough from their source or well enough protected from their source (by shields, etc.) that he is in no danger.

4. When replacing a TV set in a cabinet, technicians should at all times replace *all* hardware, especially high-voltage cans, and safety glass to insure his customers against *possible* low dosages of X-rays as well as to provide the security these devices offer from shock hazards.

The only tube (picture tube) that seemed a potential X-ray hazard other than the rectifiers was the 3-inch Philips projection tube *when used, and only when used outside its housing.* This tube, remember, has a rather thin glass window, uses some 30,000 volts (which is definitely in the X-ray range), and its cathode is rather close to the screen (it being a short-neck tube). Be careful when using this tube.

Unfortunately, I have not been able to obtain any X-ray measurements on color TV tubes at this time. However, I intend to do this as soon as possible.

CHARLES R. MADUELL, JR.
Consulting Physicist
New Orleans, La.

KLIPSCH VS. VILLCHUR

Dear Editor:

I read with extreme interest the two sides of the speaker-distortion argument presented by Messrs. Klipsch and Villichur in October. But it seems to me that the issue, an extremely important one, has not been joined. Mr. Villchur speaks of harmonic distortion and Mr. Klipsch of intermodulation distortion.

Mr. Villchur shows an oscilloscope trace of a sine wave reproduced by an acoustic suspension system at 30 cycles with a 39-watt input. The waveform is clean to the eye, and this is remarkable. But the eye cannot discern harmonic distortion much below 5%. If harmonic distortion were, say, 3 or 4%, the eye could not tell but this might conceivably imply quite a high order of intermodulation distortion, *perhaps* as high as Mr. Klipsch indicates with a ½-inch cone excursion. *I don't know, I can only guess at what is possible.* The possibilities include that the relationship between harmonic and intermodulation distortion in a speaker resembles that in a tape recorder where, for example, only 3% harmonic distortion may correspond to 20 or 30% intermodulation distortion.

HERMAN BURSTEIN
Wantagh, N. Y.

A HI-FI PROBLEM

Dear Editor

An increasing number of customers are bringing back records with the complaint that they are defective because "they skip" and are "scratched and keep repeating."

When this happens here, we immediately put the record on one of our players and it plays perfectly. Some people then realize that perhaps their own player can be corrected to play the record properly, too.

But the majority remain unconvinced because "the other side plays all right; all my *other* records play all right; it's a new *hi-fi* and I *know* that nothing could be wrong with *it*". The statements are stereotyped; the phrasing, the emphasis, the attitude.

These individuals want one action only. They want "a *fresh* record." We know from experience that giving one to them is no solution. It also repeats in exactly the same places. This exasperates them till they think that we gave them still another "wornout record." Worse, these potential purchasers may lose interest in buying records.

Who is responsible for the state of mind of these customers and the conditions which cause it? Is the record dealer, who sold only the record and not the player? (We do sell record-playing equipment, and we are careful to sell only those we know and can guarantee will not skip or repeat.) Is it the record manufacturer? Is it the cartridge manufacturer? Is it the tone-arm manufacturer? Is it the stylus manufacturer?

This needless situation comes from the sale of certain players and records that are incompatible.

As a retail record dealer, I resent and protest against being the scapegoat and taking the resulting blame, enmity and loss of patronage.

For the benefit of both the public and the industry, I ask that adequate standards of relationship between records and reproducers be established and thoroughly publicized.

The following statement is printed on our carry bags: *Farrington's Record Store guarantees that every record is fresh and undamaged when it leaves our store. Records are not allowed out for home trial.*

We are not responsible for records damaged by record-playing equipment which "keeps repeating," "sticks in the grooves," etc., regardless of whether "it's a new player," or "the other side plays all right."

The responsibility lies with those who sell such equipment.

We guarantee that any record player bought from us will not damage records by "sticking" or "repeating."

For the benefit of the public and industry, I ask that adequate standards or relationships between records and reproducers be established and publicized. The prevalent passive acceptance of normal merchandise as "defective" is not a solution. Thousands of customers are *still* sore.

CHARLES W. FARRINGTON
Farrington Record Store
Arlington, Mass.

$169.95 Net

INDUCED WAVEFORM

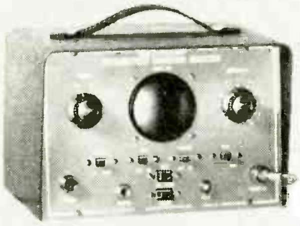
ANALYZER

MODEL 850

Top-O'-Chassis Troubleshooting...greatest servicing advance in years!

Perfect for Portable TV

Localizes defective stage in entire TV receiver in less than 5 minutes—*without a direct circuit connection.* Adopts any 'scope for spotting defects quickly by the modern, easy-to-use Induced Waveform Method. Unique, *Phantom Detector Probe* makes any tube a convenient test point. Just slip probe successively over each tube, then view and trace waveforms on scope from antenna thru RF, IF, audio, video & sync. Speeds servicing of TV, radios, amplifiers, instruments, industrial and laboratory equipment tool Compatible for color. Phone jack for audio monitoring.



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INTERMITTENT CONDITION

ANALYZER

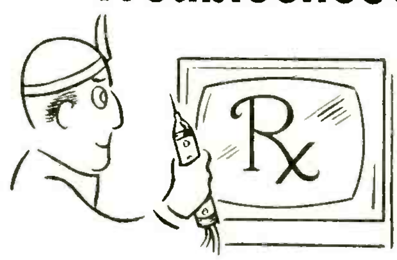
MODEL 828

Pinpoints Intermittents without waiting...cooking...or freezing.

Exclusive new principle makes any TV or radio super-sensitive to intermittents and noisy components . . . without waiting for breakdowns. Saves time and bench space. Cuts callbacks by detecting borderline components before they fail. Special Wintronix Probe and capacity pickup attachments let you *hear* intermittents thru built-in speaker.

WintroniX ANALYZERS

Electronic "Wonder Drugs" for Troubleshooting Pains



Here are the instruments you need to diagnose ailments fast and profitably in today's complicated–often inaccessible–TV, radio & hi-fi sets.

These four Wintronix *Analyzers* swiftly turn wasted trouble-shooting time into profitable parts replacement time on more and more jobs. Obscure radio and TV faults get tracked down fast by Winston's specialized reference signals and measurements. Like X-rays, they quickly give a complete picture of circuit operation—at far lower cost, with fewer circuit connections, and with less set-up time than with separate conventional instruments.

Today, issue a prescription to yourself for a healthier servicing business—see and try these new Wintronix *Analyzers* at your local parts distributor or write for detailed literature.

$79.95 Net

AGC CIRCUIT

ANALYZER

MODEL 825

AGC Troubles Won't Fool You Any More!

Saves hours by detecting hard-to-find AGC faults that may look like sync trouble, etc. Furnishes standard, adjustable r-f signal to antenna; monitors AGC action; checks AGC buss for opens and shorts; measures action of gated pulse systems; supplies AGC bias to restore operation by substitution.

SWEEP CIRCUIT

ANALYZER

MODEL 820

Rapid, Dynamic Sweep Testing

$69.95 Net

Completely troubleshoots entire sweep circuits and restores raster by substituting for defective stage. Tests all flybacks and yokes for continuity and shorts. Self-calibrating. Compatible for color.

Model 915/960 Adapter converts Model 820 to a *Sync Circuit* Analyzer for signal substitution of vertical and horizontal sync pulses. **$14.95 Net**

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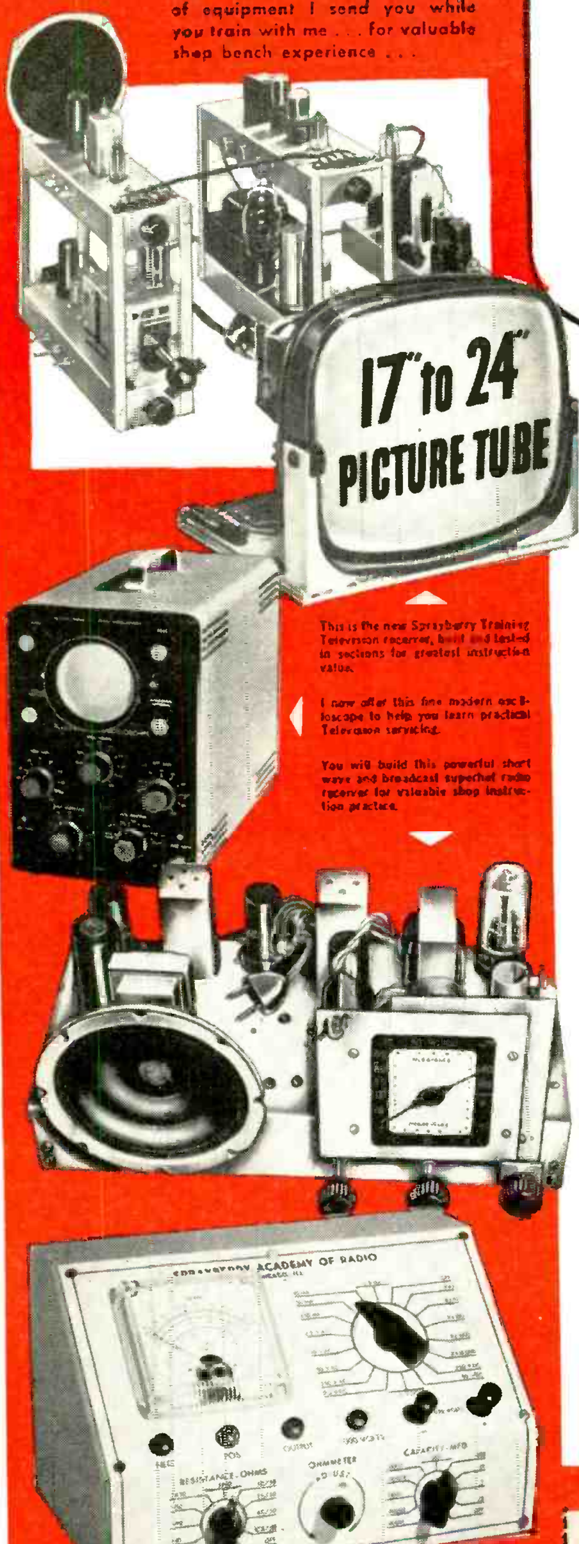
of equipment I send you while you train with me . . . for valuable shop bench experience . . .



This is the new Sprayberry Training Television receiver, built and tested in sections for greatest instruction value.

I now offer this fine modern oscilloscope to help you learn practical Television servicing.

You will build this powerful short wave and broadcast superhet radio receiver for valuable shop instruction practice.

You build the new Sprayberry Tester . . . 18-range Volt-Ohm-Milliammeter readings plus output meter and condenser and resistor substitution selector.

Average cost per lesson
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Why wait—get into Radio-Television fast! I will train you in as little as 10 months to step into the top paying Radio-Television field as a much-needed Service Technician! You will train entirely at home in your spare time . . . which means you can train as fast or as slowly as you like. You have a choice of THREE Sprayberry Training Plans . . . one *exactly* suited to your needs. My easier-than-ever payment terms make it possible for you to get set for the good jobs in Radio-Television without the slightest strain on your budget! Get the true facts . . . just mail the coupon for my big new 56 page fact-filled catalog plus actual sample lesson—both FREE.

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My students do better because I train both the mind and the hands. Sprayberry Training is offered in 25 individual training units, each includes a practice giving kit of parts and equipment . . . all yours to keep. You will gain priceless practical experience building the specially engineered Sprayberry Television Training Receiver, Two-Band Radio Set, Signal Generator, Audio Tester and the new Sprayberry 18 range Multi-Tester, plus other test units. You will have a complete set of Radio-TV test equipment to start your own shop. My lessons are regularly revised and every important new development is covered. My graduates are completely trained Radio-Television Service Technicians.

NEWEST DEVELOPMENTS

Your training covers U H F, Color Television, F M, Oscilloscope Servicing, High Fidelity Sound and Transistors.

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The coupon below brings you my big new catalog plus an actual sample Sprayberry Lesson. I invite you to read the facts . . . to see that I actually illustrate every item in my training. With the facts in your hands, you will be able to decide. No salesman will call on you. The coupon places you under no obligation. Mail it now, today, and get ready for your place in Radio-Television.

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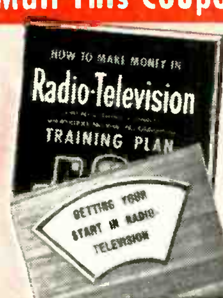

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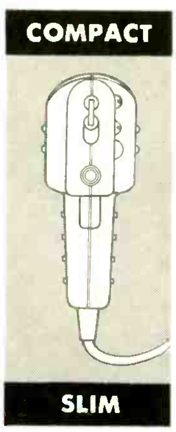
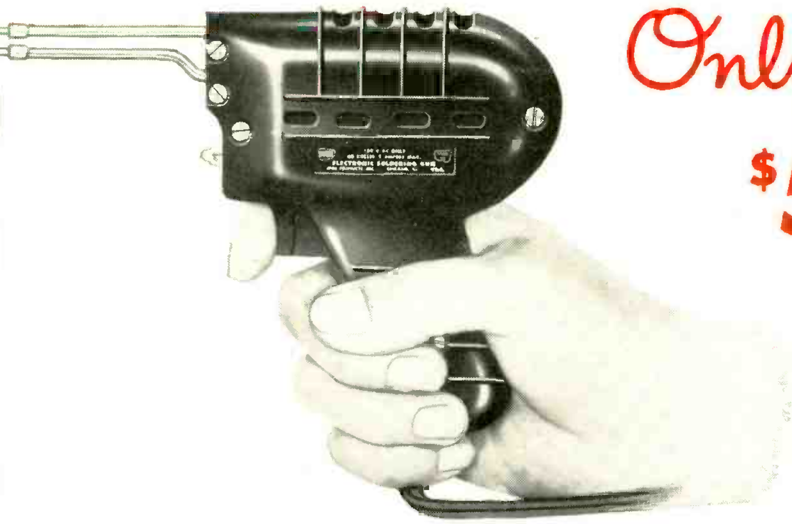
new feather-light 100 WATT ELECTRONIC SOLDERING GUN





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IT'S SMALLER, LIGHTER, HANDY AS YOUR HAND, IDEAL FOR THE WORK YOU DO

Weighs only 19 oz. . . . Heats in 3 seconds on ordinary 110-120 V. A.C. 60 cycle . . . Cools quickly too . . . Automatic spotlight . . . Long reach, long life tips . . . Soldering tips interchangable with hot-cutting or flat iron finish-repair tips . . . Ebony black plastic handle and housing are heat and impact resistant . . . Beautifully balanced — easy to use . . . Ideal for service calls, bench repairs, home work shops. *Lowest priced soldering gun on record.*

3/8″
120 V. — AC/DC

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2 SPEED POWER DRILL

1000 - 3000 RPM as needed. Speed change quick, positive. Provides just the right speeds for different jobs. Geared Jacobs chuck. All you need in an electric drill in this 1 tool. With attachments — it is a whole work shop.

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ALL PURPOSE POWER SAW

Has no equal. Cuts *anything* smoothly, swiftly — 2 x 4's in seconds, ½″ steel, plastics, conduits. Cuts circles, scrolls, dovetails, straight lines or angles. Makes own starting holes. Blows off sawdust. 3 blades — coarse, medium, fine.

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Also ask about other WEN "Quick-Hot" Soldering Guns & Kits from $7.95 to $12.95. Also fine finish and heavy duty Sander-Polishers and Kits from $13.95 to $19.95. They'd help in your work.

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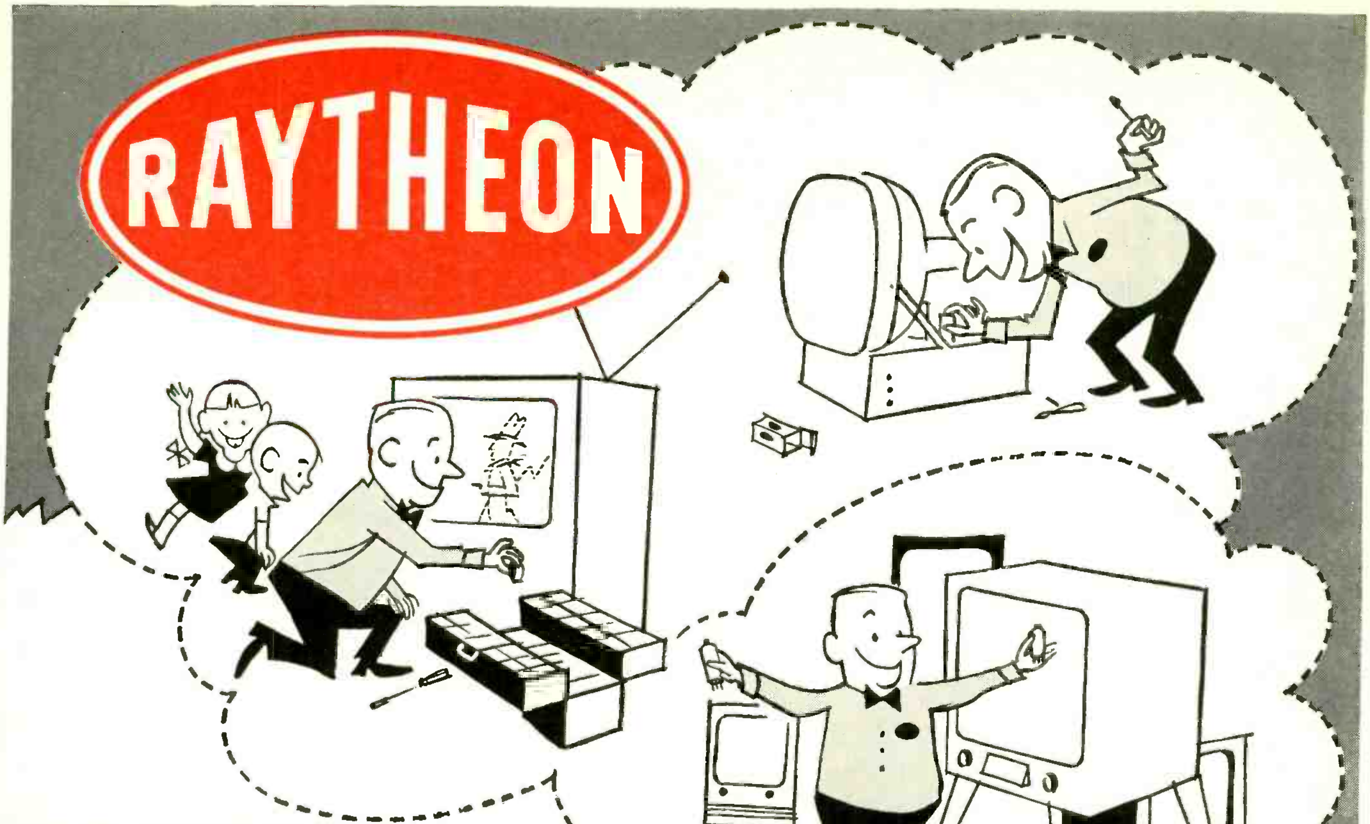
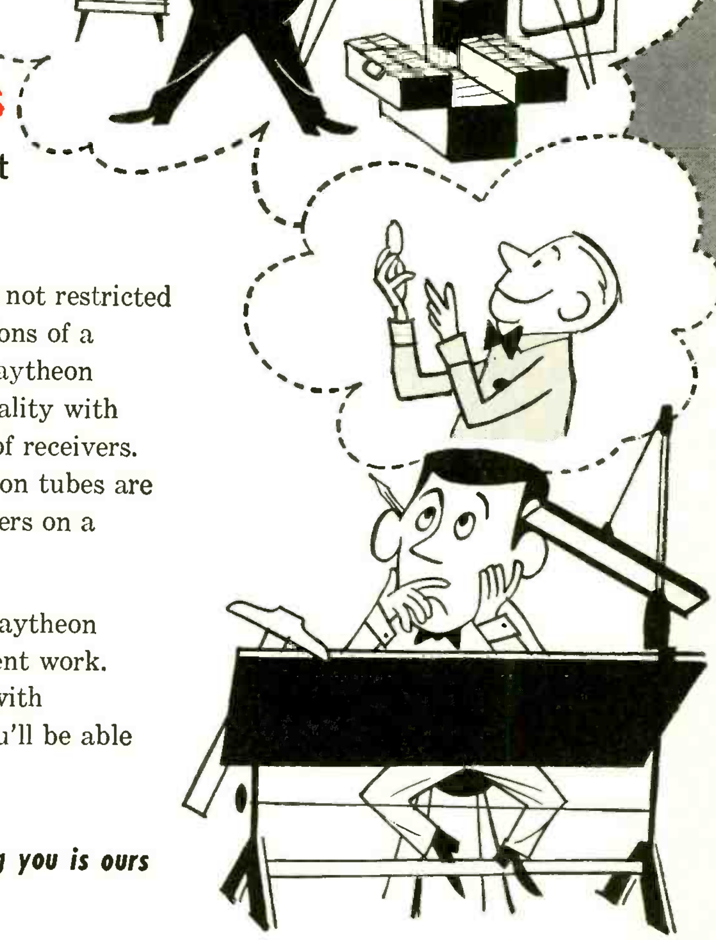
ALL WEN PRODUCTS ARE SUPERBLY MADE — U. L. APPROVED — FULLY GUARANTEED.



RAYTHEON "ALL-SET" TUBES

designed with Independent Service Dealers in mind



When Raytheon engineers design tubes, they are not restricted to engineering the tubes to the limited specifications of a specific TV or radio receiver. On the contrary, Raytheon engineers must design tubes that combine top quality with all-around performance in all makes and models of receivers. Proof of their success lies in the fact that Raytheon tubes are sold to virtually all TV and radio set manufacturers on a competitive technical basis.

This ability to perform in many circuits makes Raytheon "All-Set" Tubes ideal for service dealer replacement work. Fill your Tube Carrying Cases and tube shelves with Raytheon "All-Set" TV and Radio Tubes and you'll be able to meet tube replacement needs of all sets.

TV-Radio service is your business . . . serving you is ours

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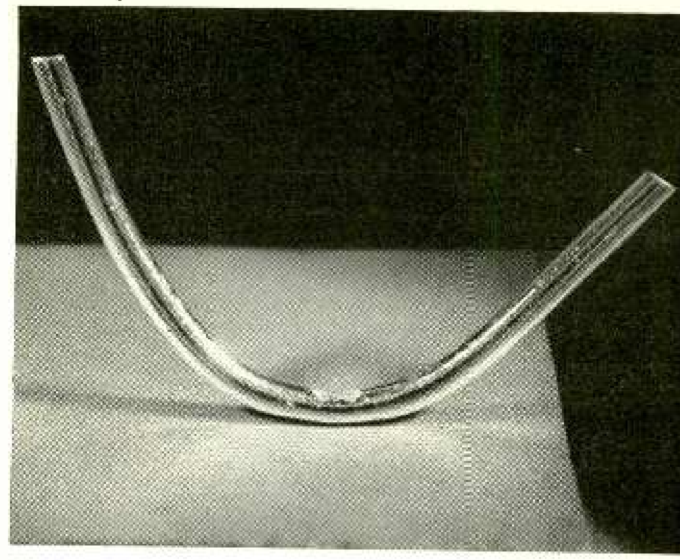
Newton, Mass. • Chicago, Ill. • Atlanta, Ga. • Los Angeles, Calif.

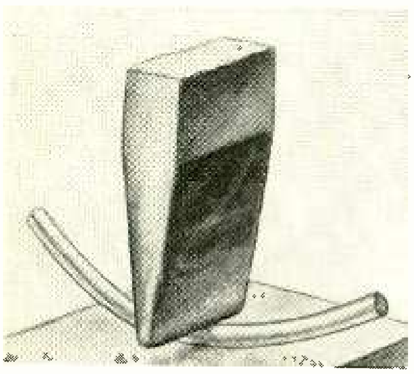
Raytheon makes all these { Receiving and Picture Tubes, Reliable Subminiature and Miniature Tubes, Semiconductor Diodes and Transistors, Nucleonic Tubes, Microwave Tubes.

RAYTHEON®
Excellence in Electronics

Thermo-compression bonding—



Wire bonded to germanium by thermo-compression technique (enlarged). Wires only 1/10 the breadth of a human hair have been successfully anchored to germanium wafers only three hairs thick. The bond may be an ohmic contact or rectifying contact by adding suitable impurities to the wire and the semiconductor.



One method of thermo-compression bonding. A heated wedge presses a wire against a heated semiconductor with enough force to deform the wire. Adhesion occurs in seconds.

new way to join metal to semiconductors

Thermo-compression bonding provides a new way to attach a wire to a semiconductor. It calls for heat and pressure—nothing else. The wire and the semiconductor are moderately heated, then pressed together under moderate pressure. The resulting bond is very strong—stronger actually than the wire. No chemical flux or molten metal is required.

Eliminating molten metal provides an enormous advantage in fixing electrical connections to transistors. That's because molten metal tends to spatter and spread uncontrollably over the surface of a semiconductor. And it may alloy with the semiconductor to alter its all-important crystalline structure and chemical purity. Thermo-compression bonding easily and quickly makes a strong permanent electrical connection without damaging the semiconductor. Furthermore, the lead may be attached to microscopic areas and precisely positioned, a most valuable aid in the construction of high-frequency transistors.

Thermo-compression bonding will speed the production of transistors . . . the transistors needed to fill all the new jobs Bell Laboratories finds for them in the quest to provide still better telephone service to our growing country.

At Bell Labs Howard Christensen and Orson Anderson discuss their discovery of new bonding principle with Peter Andreatch, Jr., who collaborated in the studies.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

NEW! 12-WATT Williamson-type HIGH FIDELITY INTEGRATED AMPLIFIER HF12

with Preamplifier, Equalizer & Control Section

KIT \$34.95 WIRED \$57.95

Compact, beautifully packaged & styled. Provides complete "front-end" facilities and true high fidelity performance. Direct tape head & magnetic phono inputs with NARTB (tape) & RIAA (phono) feedback equalizations. 6-tube circuit, dual triode for variable turnover bass & treble feedback-type tone controls. **Output Power:** 12 w cont., 25 w pk. **IM Dist.** (60 & 6000 cps @ 4:1): 1.5% @ 12 w; 0.55% @ 6 w; 0.3% @ 4 w. **Freq. Resp.:** 1 w: ±0.5 db 12 cps – 50 kc; 12 w: ±0.5 db 25 cps – 20 kc. **Harmonic Dist: 20 cps:** 2% @ 4.5 w; ½% @ 2.5 w; **30 cps:** 2% @ 11 w; ½% @ 5.3 w; **40 cps:** 1% @ 12 w; ½% @ 9.3 w; **2000 cps:** ½% @ 12 w; **10 kc:** 1% @ 10 w; ½% @ 6 w. **Transient Resp:** excellent square wave reproduction (4 usec rise-time); negligible ringing, rapid settling on 10 kc square wave. **Inverse Feedback:** 20 db. **Stability Margin:** 12 db. **Damping Factor:** above 8, 20 cps – 15 kc. **Speaker Connections:** 4, 8, 16 ohms. **Tone Control Range:** @ 10 kc, ±13 db; @ 50 cps, ±16 db. **Tubes:** 2-ECC83/12AX7, 1-ECC82/12AU7, 2-EL84, 1-EZ81. Size: HWD: 3½" x 12" x 8¼". 13 lbs. Mounts in or out of cabinet.

NEW! 50-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER

HF50 KIT \$57.95 WIRED \$87.95

Like the HF60 shown below, the HF50 features **virtually absolute stability, flawless transient response** under either resistive or reactive (speaker) load, & **no bounce or flutter** under pulsed conditions. **Extremely high quality output transformer** with extensively interleaved windings, 4, 8, & 16 ohm speaker connections, grain-oriented steel, & fully potted in seamless steel case. Otherwise identical to HF60. **Output Power:** 50 w cont., 100 w pk. **IM Distortion** (60 & 6000 cps @ 4:1): below 1% at 50 w; 0.5% @ 45 w. **Harmonic Dist.:** below 0.5% between 20 cps & 20 kc within 1 db of rated power. **Freq. Resp.** at 1 w: ±0.5 db 6 cps – 60 kc; ±0.1 db 15 cps – 30 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **All other specs identical to HF60 below.** Matching cover **Model E-2, \$4.50.**

NEW! 50-WATT Ultra-Linear HIGH-FIDELITY INTEGRATED POWER AMPLIFIER HF52

with Preamplifier, Equalizer & Control Section

KIT \$69.95 WIRED \$109.95

Combines a power amplifier section **essentially identical to the HF50 power amplifier with a preamp-equalizer control section similar to HF20** below. Provision for use with electronic crossover network & additional amplifier(s). See HF50 for response & distortion specs; HF60 for square wave response, rise-time, inverse feedback, stability margin, damping factor, speaker connections; HF20 for preamplifier, equalizer & control section description. Hum & noise 60 db below rated output on magnetic phono input (8 mv input for rated output), & 75 db below rated output on high level inputs (0.6 v input for rated output). Matching cover **Model E-1, \$4.50.**

The specs are the proof... 7 NEW BEST BUYS by EICO®

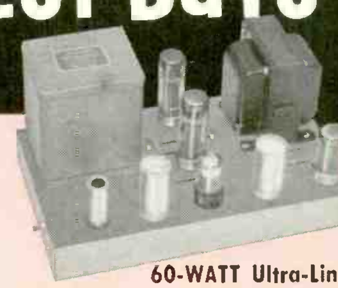
NEW

HIGH FIDELITY PREAMPLIFIER

#HF61A KIT \$24.95, WIRED \$37.95

With Power Supply: #HF61 KIT \$29.95, WIRED \$44.95

Will not add distortion or detract from the wide-band or transient response of the finest power amplifiers at any control settings. High quality feedback circuitry throughout plus the most complete control & switching facilities. Heavy-gauge solid brushed brass panel, concentric controls, one-piece brown enamel steel cabinet for lasting attractive appearance. **Feedback-type, sharp cut-off (12 db/octave) scratch & rumble filters. Low-distortion feedback equalization:** 5 most common recording curves for LPs & 78s including RIAA. **Low-distortion feedback tone controls:** provide large boost or cut in bass or treble with mid-freqs & volume unaffected. **Centralab printed-circuit Senior "Compentrol" loudness control with concentric level control. 4 hi-level switched inputs** (tuner, tv, tape, aux.) **& 3 low-level inputs** (separate **front panel low-level input selector** permits concurrent use of changer & turntable). **Proper pick-up loading & attenuation** provided for all quality cartridges. **Hum bal. control.** DC superimposed on filament supply. 4 convenience outlets. **Extremely flat wideband freq. resp.:** ±1 db 8-100,000 cps; ±0.5 db 12-50,000 cps. **Extremely sensitive. Negligible** hum, noise, harmonic or IM distortion. Size: 4-7/8" x 12-5/16" x 4-7/8". 8 lbs.



NEW

60-WATT Ultra-Linear HIGH FIDELITY POWER AMPLIFIER #HF60 with ACRO TO-330 OUTPUT TRANSFORMER

KIT \$72.95 WIRED \$99.95

Superlative performance, obtained through finest components & circuitry. EF86 low-noise voltage amplifier direct-coupled to 6SN7GTB cathode coupled phase inverter driving a pair of Ultra-Linear connected push-pull EL34 output tubes operated with fixed bias. **Rated power output:** 60 w (130 w peak). **IM Distortion** (60 & 6000 cps at 4:1): less than 1% at 60 w; less than 0.5% at 50 w. **Harmonic Distortion:** less than 0.5% at any freq. between 20 cps & 20 kc within 1 db of 60 w. **Sinusoidal Freq. Resp.:** at 1 w: 35 kc at any level from 1 mw to rated power; no peaking or raggedness outside audio range. **Square Wave Resp.:** excellent from 20 cps to 25 kc, 3 usec rise-time. **Sensitivity:** 0.55 v for 60 w. **Damping Factor:** 17. **Inverse Feedback:** 21 db. **Stability Margin:** 16 db. **Hum:** 90 db below rated output. **ACRO TO-330 Output Transformer** (fully potted). **Speaker Taps:** 4, 8, 16 ohms. **GZ34 extra-rugged rectifier** (indirectly-heated cathode eliminates high starting voltage on electrolytics & delays B+ until amplifier tubes warm up). **Input level control.** Panel mount fuse holder. Both **bias** and **DC — balance** adjustments. Std octal socket provided for pre-amplifier power take-off. Size: 7" x 14" x 8". 30 lbs. Matching cover **Model E-2 \$4.50.**

NEW

COMPLETE with Preamplifier, Equalizer & Control Section 20-WATT Ultra-Linear Williamson-Type HIGH FIDELITY AMPLIFIER #HF-20

KIT \$49.95 WIRED \$79.95

A low-cost, complete-facility amplifier of the highest quality that sets a new standard of performance at the price, kit or wired. **Rated Power Output:** 20 w (34 w peak). **IM Distortion (60 & 6000 cps/4:1) at rated power:** 1.3%. **Max. Harmonic Distortion between 20 & 20,000 cps at 1 db under rated power:** approx. 1%. **Mid-band Harmonic Distortion at rated power:** 0.3%. **Power Response (20 w):** ±0.5 db 20-20,000 cps; ±1.5 db 10-40,000 cps. **Freq. Resp.** (¼ w): ±0.5 db 13-35,000 cps; ±1.5 db 7-50,000 cps. **5 feedback equalizations for LPs & 78s. Low-distortion feedback tone controls:** large boosts or cuts in bass or treble with mid-freqs. & volume unaffected. Loudness control & separate level set control on front panel. Low Z output to tape recorder. **4 hi-level switched inputs:** tuner, tv, tape, aux; 2 **low-level inputs** for proper loading with all cartridges. **Hum bal. control.** DC superimposed on filament supply. **Extremely fine** output transformer: interleaved windings, tight coupling, careful balancing, grain-oriented steel. 8½" x 15" x 10". 24 lbs. Matching cover **Model E-1, \$4.50**

NEW COMPLETE with FACTORY-BUILT CABINET — 2-WAY HI-FI SPEAKER SYSTEM #HFS1 \$39.95

Genuine 2-way book-shelf size speaker system. **Jensen** heavy duty 8" woofer (6.8 oz. magnet) & matching **Jensen** compression-driver exponential horn tweeter with level control. Smooth clean bass & crisp extended highs free of coloration or artificial brilliance. **Factory-built** tuned bass reflex birch hardwood cabinet (**not** a kit) constructed to high quality standards. Neutral acoustical grille cloth framed by a smooth-sanded solid birch molding. **Freq. Resp.** measured 2 ft. away on principal axis in anechoic chamber with 1 watt input — **Woofer:** ±4 db 80-1800 cps **Tweeter:** ±2 db 2800-10,000 cps; **Crossover Region:** 1800-2800 cps, shift in level over this region depends on tweeter level control setting. Power-handling capacity: 25 watts. Size: 23"x11"x9". 25 lbs. **Wiring Time:** 15 min.

See the "BEST BUYS" NOW IN STOCK at your nearest distributor. Fill out coupon on other side for FREE CATALOG.

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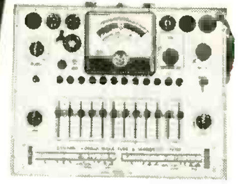


NEW! DYNAMIC CONDUCTANCE TUBE & TRANSISTOR TESTER #666

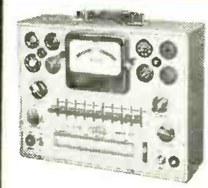
KIT $69^{95} WIRED $109^{95}

COMPLETE with steel cover and handle.

SPEED, ease, unexcelled accuracy & thoroughness. **Tests all receiving tubes** (and picture tubes with adapter). **Composite indication** of Gm, Gp & peak emission. **Simultaneous sel** of any 1 of 4 combinations of 3 plate voltages, 3 screen voltages, 3 ranges of continuously variable grid voltage (with 5% accurate pot). **New series-string voltages:** for 600, 450, 300 ma types. **Sensitive** 200 ua meter. **5 ranges meter sensitivity** (1% shunts & 5% pot). **10 SIX-position lever switches:** freepoint connection of each tube pin. **10 pushbuttons: rapid** insert of any tube element in leakage test circuit & speedy sel. of individual sections of multi-section tubes in merit tests. **Direct-reading** of inter-element leakage **in ohms. New gear-driven rollchart. Checks n-p-n & p-n-p transistors:** separate meter readings of **collector leakage current & Beta** using internal dc power supply. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet. **CRA Adapter $4.50**

5" PUSH-PULL OSCILLOSCOPE #425
KIT $44.95
Wired $79.95

7" PUSH-PULL OSCILLOSCOPE #470
KIT $79.95
Wired $129.50



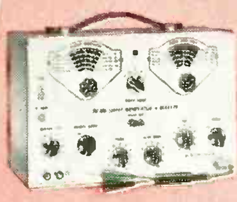
TUBE TESTER #625
KIT $34.95
Wired $49.95
- tests 600 mil series string type tubes
- illuminated roll-chart

Pix Tube Test Adapter $4.50

Sep. voltmeter & ammeter

KIT $29.95
Wired $38.95

6V & 12V BATTERY ELIMINATOR & CHARGER #1050



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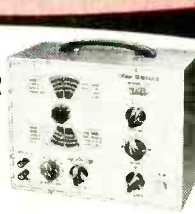

NEW! RF SIGNAL GENERATOR #324

KIT $26^{95} WIRED $39^{95}

150 kc to 435 mc with ONE generator! Better value than generators selling at 2 or 3 times its cost! Ideal for IF-RF alignment, signal tracing & trouble-shooting of TV, FM, AM sets; marker gen.; 400 cps audio testing; lab. work. **6 fund. ranges:** 150-400 kc, 400-1200 kc, 1.2-3.5 mc, 3.5-11 mc, 11-37 mc, 37-145 mc; **1 harmonic band** 111-435 mc. **Freq. accurate to** ±1.5%; 6:1 vernier tuning & excellent spread at most important alignment freqs. **Etched tuning dial,** plexiglass windows, **edge-lit hairlines.** Colpitts RF osc. **directly plate-modulated by K-follower** for improved mod. **Variable depth of int. mod.** 0-50% by 400 cps Colpitts osc. **Variable gain ext. amplifier:** only 3.0 v needed for 30% mod. **Turret-mounted coils slug-tuned** for max. accuracy. Fine & Coarse (3-step) RF attenuators. RF output 100,000 uv; AF sine wave output to 10 v. 50-ohm output Z. 5-way jack-top binding posts for AF in/out; coaxial connector & shielded cable for RF out. 12AU7, 12AV7, selenium rectifier; xmfr-operated. Deep-etched satin aluminum panel; rugged grey wrinkle steel cabinet.

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Reads 0.5 ohms —500 megs, 10 mmfd—5000 mfd, power factor.

KIT $19.95
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VTVM PROBES	KIT	Wired
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Radio-Electronics
Hugo Gernsback, Editor

THE U.S.A. AT BAY

... Teleducation Can Safeguard Your Future ...

THE greatest accomplishment of the Russians was not their famed earth satellite, great as that feat was, but a deadly aroused United States, now awakening to its shocking peril.

For make no mistake, the Russian *Sputnik* is only a moving finger in the sky, writing out plainly Nikita Kruschev's recent threat to us: *"We will bury you!"* That threat is not an idle boast in Russia, a country that glorifies its men of science, technicians and inventors, while in the U. S. many politicians and others delight in ridiculing them. In Soviet Russia, boys with a scientific or technical bent crowd the large number of technical schools to such extent that there is no room for all who wish to attend. Why? In Russia, a scientist is a near-hero. In the United States, there is—and has been—a serious shortage of technical pupils—on which our very future life depends. The result: the United States is now a very bad second runner in a world where science and technology are replacing the soldier, the regiments and the military divisions of former days.

What is the remedy in our perilous dilemma? It is far too late now for a crash program in technical education using our antique teaching methods. There are not enough good teachers to supply such a demand. And good teachers are not made overnight—*it takes many years.* What then is the answer? MASS NATION-WIDE TELEDUCATION.

IF YOU are convinced of the feasibility of *MASS NATION-WIDE TELEDUCATION* and its urgency, in view of the serious danger your country now faces, write or wire your Senators and Congressman calling their attention to this article. They have received copies.

In 1945, we were the first to broach the subject in a short article entitled *"Teleview Teaching."* We said: "Outstanding educators . . . lecture via (closed circuit) teleview from central *Teletoriums.* . . . Thus one teacher can lecture and instruct hundreds of classes."

Since that time we have published a number of articles on this subject.*

A condensed version of this far-reaching plan is summarized thus:

1. The United States government to set up a nation-wide closed circuit educational television network, tying together all schools and colleges. The Government to finance and build the network, but to have no voice in the teaching. Schools, however, would have to agree to a specified amount of *technical* teaching hours per week.

2. We have a sufficient number of *good* teachers right now to teach 50,000 or 5,000,000 pupils or students. These teachers now are wasted, literally.

3. *To be effective, science and technology must start with the 6-year-old child, in easy stages, to awaken his interest.* Television has shown that simple science things fascinate youngsters and, *if presented right, hold his interest.* The marvels of science and the wonders still to come would always have to be emphasized, with the result that a large percentage of youngsters 10 years hence would be well on the way to fill our sadly lagging ranks of scientists and technologists.

4. So as not to confuse, we repeat that the proposed *Nation-Wide Teleducation Network* is to be strictly CLOSED-CIRCUIT—not broadcast. We have all the necessary technical means now to build it. On a crash basis, it could be working in a year or less.

5. Who will do the science teaching? This will be left to a National Science Instruction Board. For details, see "*The Elements of Teleducation,*" in our May, 1956, issue.

Since we first broached the idea of teleducation in 1945, teaching via television has become a rather well established method of teaching. Old-fashioned orthodox pedagogues, skeptic at first, have now become enthusiastic supporters of the idea. Many schools and colleges now have become *TV-integrated,* and wherever funds are available, more schools are coming into the fold.

One of the most recent successful experiments was inaugurated in September, 1956, in Hagerstown, Md., where 6,000 children, in 6 elementary and 2 high schools, are now being educated experimentally via a local *TV school closed-circuit network.* The pupils receive televised lessons in English, geometry, art, music, history and social studies. It has been termed by a very prominent educator, Dr. Alexander Stoddard, who for 10 years was chairman of the Educational Policies Commission of the National Education Association, as *"the most significant thing going on in America today."*

The schoolrooms in Hagerstown today have an average of four 21- or 24-inch regulation TV receivers spotted around the class in strategic positions, so most of the students can get a good view of the proceedings.

We can foresee the day when a single large theater type wall-projection televisor will prevail instead of the box type receiver. The wall-projection type, when mass produced and consequently much cheaper than the comparatively few in use today, will give a better view for the entire class, particularly when the picture is in color, as it surely will be. Much later, it will also be a three-dimensional picture, rather than a flat one. This is most important for science teaching when during televised experiments instruments, apparatus and machines must be viewed from several angles by the student for better understanding.

In the meanwhile, it is understood that the many schools and colleges that are TV-equipped now can readily be integrated into a nation-wide closed-circuit network without difficulty.

Yes, as in all revolutionary new undertakings, there will be many squabbles by the various boards of education in cities and states as to methodology in teaching, procedure, curriculum and many other details. These we feel certain will and must be resolved speedily.

They are not serious *vis-à-vis* the life of our nation, which depends on a successful outcome of this plan.—*H. G.*

* *Tame,* December, 1945; *Newspeek,* December, 1950; RADIO-ELECTRONICS, September, 1951. Also Tec-Teleducation, *Forecast,* December, 1954, RADIO-ELECTRONICS, February, 1955, and May, 1956.
Send for free reprints of all RADIO-ELECTRONICS articles on Teleducation.

The VTVM...its care and repair

By RHYS SAMUEL*

How to keep your vtvm at top efficiency

THE vtvm is such a reliable device that the technician gives it little thought until that inopportune moment when it breaks down.

A defective vtvm should offer no special problems because it is basically a simple instrument. It uses two or three tubes, conventional parts and straightforward circuitry. For the experienced tech especially, troubleshooting should be a snap.

The best way to minimize vtvm down time is to prevent trouble in the first place by following the simple precautions and periodically making the brief checks described in this article. Although many of these points may seem academic, they are often overlooked by techs who should know better. Hundreds of defective vtvm's are returned to manufacturers and instrument repair shops yearly because of user carelessness or neglect.

Preventive maintenance

Probes and cables are a frequent source of trouble because they are subject to constant handling. Internal connections break or become intermittent. Detachable probes are often dropped. Check the condition of ohms probes and cables by shorting them together and flexing the leads while watching the meter pointer. Erratic changes of the meter reading indicate loose or broken connections. Voltage leads should be checked in a similar manner while connected to a test-voltage source.

When a vtvm is used in the shop, mount it securely so that an accidental tug on the test leads will not pull it off the bench or shelf and break the meter movement. Keep detachable probes in an out-of-the-way place or clamp them in fuse type clips on the vtvm case.

To check the condition of the ohms battery:

1. Set the FUNCTION SELECTOR to ohms.

2. Set the RANGE CONTROL to R × 1.

3. Rotate the OHMS ADJUST control to bring the pointer to full-scale deflection. If it is impossible to adjust the pointer to full scale, replace the battery.

4. If OK as checked for full-scale deflection, short the ohms cable to ground for about 10 seconds.

5. Open the short circuit and observe the scale indication. Any appreciable deviation of the pointer from full-scale deflection indicates a weak battery.

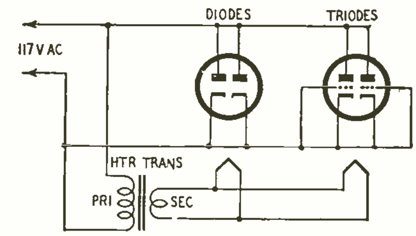


Fig. 1—Recommended test setup for aging tubes for vtvm's.

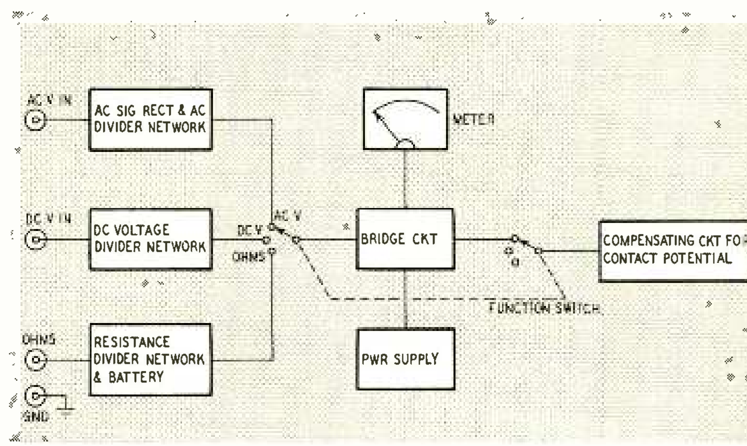


Fig. 2—Block diagram of typical vtvm.

If it is impossible at any time for the meter pointer to deflect to the full-scale point on ohms, it is advisable to replace the battery. *Never leave exhausted batteries in the instrument.* If any inspection reveals a battery that is leaking or corroded, replace it immediately and thoroughly clean out all chemical deposits inside the case and on the battery contacts. Before a new battery is installed in a holder with spring contacts, clean the contacts thoroughly and adjust the springs to insure a solid contact with low contact resistance. Be sure to observe correct polarity during battery installation.

Like the switches in TV tuners, vtvm switches should be checked and attended to periodically. Keep panel nuts tightened to prevent movement of the switch assembly, broken leads and shorted components. Take care during soldering to prevent overheating or scraping the resistors mounted on the switches. Excessive heat can permanently change the value of precision resistors and result in inaccurate meter readings. Avoid twisting or loosening the switch contacts.

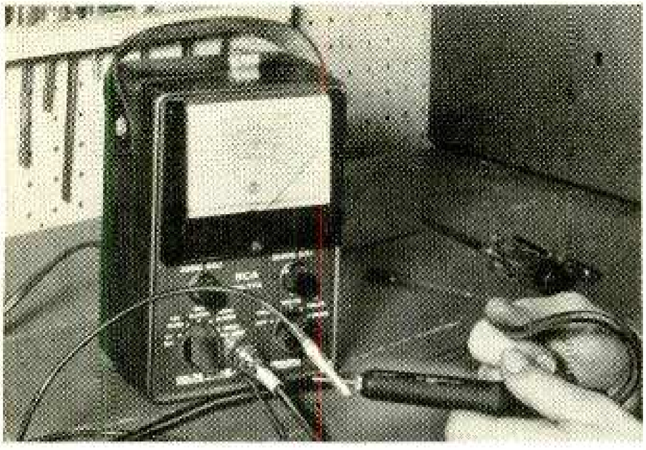
Improper use of a vtvm is a major cause of failure and expensive repairs. While its design makes it almost impossible to burn out the meter movement, excessive and repeated overloads can cause other types of damage. Excessive inputs, which result from improper settings of the FUNCTION and RANGE switches, may change the value of the precision resistors in the divider networks or burn out the low-value resistors. Many vtvm's returned to manufacturers have damaged resistors in the ohms-divider network because the operator attempted to measure voltage with the FUNCTION selector set to ohms.

Replacement parts

Whenever possible, exact replacement parts should be used. Most divider-network resistors have a ±1% tolerance, and many have special values obtainable only from the instrument manufacturer.

Individual replacement parts for meter movements generally are not stocked by the manufacturer. Defective meters are best returned to a repair shop which specializes in this work. Never attempt to check the continuity of a meter movement with an ohmmeter or general-purpose continuity checker. The battery voltage in the ohmmeter may be high enough to burn

*RCA Commercial Engineering Electron-Tube Division, Harrison, N. J. Author, *The VTVM—How It Works, How To Use It*, Gernsback Library, Inc. Some of the information in this article has been abstracted from the book.



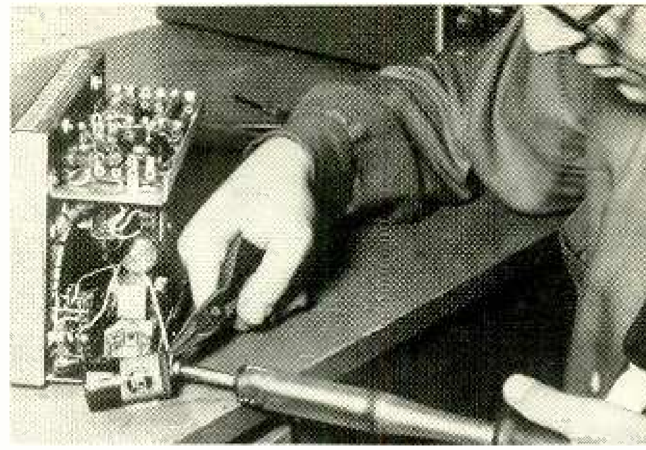


Photo at left shows condition of probe and cables being checked by setting vtvm to ohms, connecting cables together and flexing. Action of meter pointer indicates possible defects. At right, replacing an exhausted ohms battery.

out the meter movement under test.

Tube replacement

Most vtvm's use tubes specially aged or selected to insure a low amount of gas and contact-potential current. Although tube-replacement requirements differ among instrument models, it is usually desirable to age replacement tubes intended for installation in bridge circuits and ac signal rectifiers.

Unless a bridge-circuit tube has suitable operating characteristics and a low value of gas current, it may cause off-zero deflection of the meter pointer when the RANGE switch is changed from the lowest dc-voltage range to the higher ones. This condition requires that the operator re-zero the meter pointer whenever ranges are changed. Often a tube will prove unsuitable for installation, even after a lengthly aging period.

The acceptability of a tube for bridge-circuit use will depend upon the vtvm's design and the manufacturer's recommendations. Usually, a change of one or more divisions in the meter-zero setting as the RANGE switch is changed indicates that the tube requires more aging or is unacceptable for use in a vtvm. If several tubes are available, install them in the instrument one at a time, before aging, to determine which has the lowest value of gas. The tube which produces the least amount of off-zero deflection as the range is changed is the best tube to select for aging.

Single or twin diodes used in the ac signal-rectifying section may or may not require selection or aging, depending upon manufacturer's recommendations. The diode selected should provide a minimum amount of off-zero deflection of the meter pointer when the FUNCTION switch is changed from dc volts or ohms to ac volts, as well as the minimum amount of deflection when the RANGE switch is rotated. Many vtvm's have internal adjustments for differences between signal-rectifier tubes. Hence, tube selection and aging may not be critical.

A new tube may be aged by installing it in the vtvm and running the instrument for a number of hours or days. An alternate and sometimes quicker method of aging diodes or triodes is to use the simple setup shown in Fig. 1. The grids and cathodes of triodes are tied to one side of the ac line and the plates to the other side. Heaters are operated at a normal voltage supplied by a transformer. Diodes are aged in the same manner except that no grid connections are required.

The aging period is from 24 to 100 hours. Aging by this method usually requires less time than aging in the instrument. Whenever a new tube is installed, the vtvm should be checked for calibration and accuracy. Recalibration may be needed to insure accurate ac and dc voltage measurements.

Zero setting, accuracy

When the vtvm is switched off, the meter pointer should rest at the left-hand zero mark. If the pointer comes to rest above or below this mark, the mechanical zero requires adjustment. This adjustment is accessible from the front of the meter case and may be a small setscrew or lever. On some vtvm's the adjustment screw is accessible through a hole in the front of the meter case. The hole may be covered with a small cap or screw plug.

With the power off, remove the cap or plug and adjust the setscrew to bring the pointer into line. On vtvm's with a lever adjustment, insert a small scriber or similar tool into the hole and move the lever right or left, as required. Take extreme care to avoid inserting the scriber into the movement. Always replace the screw plug or cap to seal the movement against dust and moisture.

The inside of plastic meter faceplates of vtvm's is often coated with a special antistatic solution to eliminate effects of static charges on the meter pointer. If this coating is removed, the meter pointer action may be erratic.

On plastic meter cases, therefore, do not rub the inside of the faceplate. If the antistatic coating is ineffective, apply additional antistatic solution to eliminate the trouble. A detergent soap, such as Gleem, is a substitute for the solution. Use a medium amount in water, fill the inside of the case and pour out. Shake off any remaining solution and allow the meter case to dry.

When you suspect that changed-value divider resistors are responsible for faulty readings, check the resistor values on a resistance bridge, if possible. Because many resistors used in commercial vtvm's are accurate to 1%, conventional ohmmeters cannot be used to measure their values accurately.

Factory-fresh flashlight cells are a fair substitute for a dc voltage standard. When new, one of these cells should provide 1.55 volts under the high-resistance load of a vtvm.

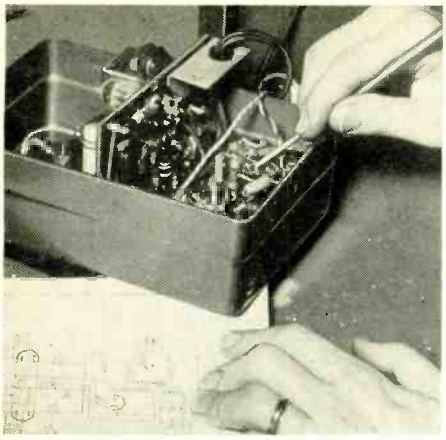
Analyzing the trouble

Like a television receiver, a vtvm has a number of individual sections and circuits which perform specific functions. In a vtvm, some circuits, such as the ac signal rectifier and the ohms-divider network, are inoperative (disconnected) for all other functions. Others, like the power supply, bridge circuit and meter movement, are used for all operations of the vtvm.

A block diagram of a typical vtvm is shown in Fig. 2.

The vtvm is built around a vacuum-tube bridge circuit and indicating meter. The function of the ac signal rectifier and the divider networks for ac and dc volts and ohms is to supply a fixed proportion of the input test voltage to the bridge circuit. During operation, a dc voltage is fed to the bridge from one of these three sections.

On resistance measurements, a resistance-divider network in series with an internal battery furnishes a value of dc voltage in proportion to the value of the unknown resistance placed across the ohms network through the ohms probe and ground cable. On dc voltage checks, the voltage being measured is applied across the dc voltage-divider network which, in turn, applies a pro-



Intermittent troubles can often be found by probing parts and wiring with an insulated tool.

portionate part of the test voltage to the bridge circuit.

In ac voltage tests, the signal is rectified and the resultant dc voltage is applied to the bridge circuit. The input-divider networks for all three measurement functions are designed so that only a small part of the input voltage (1.5 to 3 volts) reaches the bridge circuit.

Voltage for ohms measurements is obtained from an internal battery; all other voltages are obtained from a built-in power supply. The compensating circuit for contact potential is used when the vtvm is switched to ac.

The first step to be taken in localizing trouble consists of inspecting the instrument's performance on all ranges and functions. Set the FUNCTION switch to the first position (—DC VOLTS, for example), and rotate the RANGE switch through each of its range settings. Turn the FUNCTION switch to its next position and again rotate the RANGE switch through all its positions. Repeat this procedure for all remaining settings of the FUNCTION and RANGE switches and note the vtvm's performance at each new step.

Check probes and cables in some routine application while these checks are made. When a complete check has been made, you should have a complete picture of over-all performance. If the vtvm is inoperative on all functions, look for trouble in sections or circuits common to all functions. If the defect occurs only on one or two functions or ranges, look for trouble in the corresponding sections of the instrument.

With some vtvm's, a single probe and cable are used for all voltage and resistance measurements. On other instruments, separate probes and cables are provided. Some common troubles and probable causes are given below.

General troubles

Instrument fails to operate on all functions; pilot light does not light.

Check the line cord and switch wafer section of the FUNCTION switch for defects. Fuse may be open (if used) or perhaps primary winding of power transformer has opened. Check continuity with another ohmmeter.

Instrument fails to operate on all functions; tubes light.

Lead may be broken in ground cable or at ground connection inside case. There may be faulty tube in the bridge circuit, open or short circuit in bridge circuit, or faulty tube or component in the power supply. There may be an open or short in probe or cable, if the vtvm uses multipurpose probe and cable. Meter movement may be defective.

Meter pointer sticks.

Jewel bearing in meter may be cracked or broken. Return meter to meter manufacturer or meter repair shop. Scale plate of meter may be loose and striking meter pointer. Remove meter from case and tighten faceplate screws.

Meter pointer bangs hard left or right, depending upon setting of FUNCTION *switch.*

There may be open or short circuit in bridge network. Check parts mounted on switch wafers. Take continuity readings with another ohmmeter. Bridge tube may be defective.

Intermittent operation on all functions.

Connection may be loose or broken in ground cable or in probe if multipurpose probe is used. Check as described under preventive maintenance. There may be a faulty wiper or contact in the switching section, or loose or broken connection in bridge-circuit wiring. With power applied, check wiring, connections and components with an insulated probe. There may be a defective tube or component in bridge circuit or power supply.

Ohms-function troubles

Instrument fails to operate on OHMS; *works normally on ac and dc voltage measurements.*

Battery may be dead or not making contact. There may be a loose or broken connection in ohms cable if separate cable is used. Contact on FUNCTION switch may be defective. There may be open circuit in resistance-divider network. (NOTE: In some vtvm's this network is made up of series-added resistors. An open circuit can affect operation on two or more ranges. On other vtvm's, separate resistors are switched in when the RANGE is changed. In these instruments, a defective resistor will cause inaccurate readings on only one range.)

OHMS ADJUST *control fails to give infinity setting on resistance scale.*

Ohms battery may be dead. OHMS ADJUST potentiometer may be defective. Bridge tube may be defective.

Ohms readings inaccurate on some or all resistance ranges.

(NOTE: Manufacturers usually do not publish accuracy figures for ohms measurements. Generally, the vtvm should provide readings within 10% of the actual value. If readings of greater precision are required, use a calibrated resistance bridge.) One or more resistors in the ohms-divider network may have changed value. Excessive leakage in this network can also cause trouble. Check OHMS RANGE switch for dirt or damage. High humidity may cause leakage and inaccurate readings on high ohms scales. Bake inside of instrument with low-wattage light bulb. Check ground jack and cable for poor connection. Check for shorted wiring in ohms-divider network.

Meter pointer moves off infinity mark when RANGE SWITCH *is changed.*

Replace bridge tube with new tube having a low value of gas current. (NOTE: A small deviation should be considered acceptable.) There may be excessive leakage in ohms circuit. Check by baking for several hours with light bulb. Do not overheat and damage components.

Ac voltage measurement troubles

Instrument fails to operate on any ac voltage range; works normally on ohms and dc voltage measurements.

Ac signal-rectifier tube may be defective. Ac volts contacts on FUNCTION switch may be defective. There may be open or short circuit in ac signal-rectifier circuitry. Check wiring and components with another ohmmeter.

Meter pointer moves off zero when ranges are changed.

Ac zero potentiometer may be out of adjustment. Adjust according to manufacturer's instructions. If this adjustment fails to correct trouble, replace the ac signal rectifier or bridge tube or both. Check resistance values in network around contact-potential bucking tube, if one is used.

Ac voltage inaccurate on some or all ac ranges; performance on ohms and dc voltage ranges normal.

Resistor network around ac voltage divider may be defective. There may be defective contacts or excessive leakage in switches. Ac signal-rectifier tube may be defective. Check for leaky capacitors or changed-value resistors in ac signal-rectifier circuits or in ac voltage-divider network.

Dc voltage measurement troubles

Instrument fails to operate on any range of +volts or —volts; works normally on ohms and ac volts.

Dc (isolating) probe may be defective. Check isolating resistor. Check all switch contacts used on dc voltage function.

Instrument fails to operate on any range of +volts but normal on —volts, or vice versa; works normally on ohms and ac volts.

Check calibrating potentiometer in series with meter movement. Check for defective switch contacts or wipers in polarity-reversing circuit.

Voltage readings inaccurate on +volts, —volts, or both; ac voltage and resistance readings correct.

Dc calibrating potentiometers may be out of adjustment. Isolating resistor in dc probe may have changed value. Check cable and connectors. Check out resistors in the dc voltage divider network for changed values. END

Modification permits if injection into television receivers

add a tuner test to your field-strength meter

By R. M. CENTERVILLE

EVER wonder how you could double the usefulness of your field-strength meter? It's easy. Add a tuner test, as shown in the diagram, and your field-strength meter becomes as useful on the bench as it is in the field.

In making this modification an output is taken from the unbypassed cathode resistor of the first if stage in the instrument. At this point the if signal first becomes available at low impedance. A 72-ohm coax cable is used to bring the low-impedance if signal from the cathode resistor to a connector on the front panel of the field-strength meter. Some technicians may prefer to mount the tuner-test connector on the back of the instrument.

An output cable with a pair of alligator clips at the terminal end is made up for the tuner-test application. The output from the tuner-test cable is applied directly to the grid of the first if tube in the receiver under test. No disconnections are necessary in the TV receiver.

When the field-strength meter is tuned to a TV station, the output from the instrument is applied to the if amplifier in the receiver under test. A picture and sound output are obtained from the TV receiver, just as if the receiver were operating from its own tuner.

In this manner, a quick and decisive answer is obtained to the question: *Is it the tuner or some other section which is causing the trouble?* If it is the tuner, a normal picture and sound are obtained from the tuner test.

Of course, consideration must be given to the intermediate frequency used in the field-strength meter. If it is one of the older instruments, using a 21-mc if strip, the tuner test can not be used on the newer 41-mc TV receivers. But the newer field-strength meters are operated at 45 mc in many cases and these can be modified for a tuner test. Some new field-strength meters have a built-in tuner test.

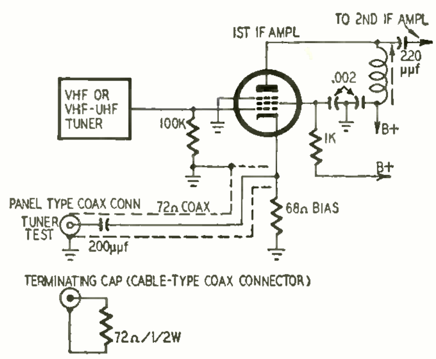


Diagram shows how tuner-test cable is connected in the meter for feeding an if signal into a receiver.

The tuner test is useful to determine not only whether a TV receiver has a dead or a weak tuner but also whether certain types of interference are being generated in the tuner or elsewhere. For example, a set was brought in which had severe herringbone interference in the picture when the fine-tuning control was set for the best picture. It looked like it might be tuner oscillation but it could also have been if instability. The output from the tuner test of the field-strength meter was applied at the grid of the first if stage in the receiver and the tuner in the receiver was switched off channel. Normal reception was then obtained on the receiver, showing that the trouble was in the tuner and not in the if strip. Tuner replacement restored normal operation.

In the field it might be supposed that the presence of the tuner-test cable across the cathode resistor in the instrument might lead to difficulty. It is good practice to provide a terminal cap for the front-panel connector, with a 72-ohm terminating resistor, as shown. However, if this termination is omitted, in most cases there is no discernible change in the performance of the instrument, because the cable inside the instrument is only a few inches in length, a small fraction of one wavelength at the operating frequency. Furthermore, the cathode circuit is a low-impedance network, not as easily disturbed as a grid circuit, for example.

The user may object to the necessity of using two field-strength meters to check out 21- and 41-mc tuners. However, this is the case at the present time. Since the cost of field-strength meters is very modest, in view of their high utility, the average shop does not usually object to acquiring two.

Some field-strength meters have a uhf–vhf front end. Such instruments provide a uhf converter test in a TV receiver also—when the tuner test is applied a uhf antenna can be connected to the field-strength meter and the uhf converter (or receiver uhf tuner) bypassed and tested.

Dead, weak or unstable uhf converters and tuners can thus be quickly pinpointed by the modified field-strength meter. This test is often of great value, inasmuch as uhf test equipment is difficult to manipulate and an in-set performance test is usually preferred for a quick check.

This modification applies directly to the Simpson model 488 TV field-strength meter but it can be used with other units with low-value unbypassed cathode resistors in the first if stage. In the case of the 488, the bias filter capacitor should be changed from 100 to 500 μf to minimize the possibility of hum appearing in the picture. END

EXTENDED-RANGE AUDIO OSCILLATOR

This second of a series on audio testing describes a Wien-bridge oscillator that goes down to 12 cycles and up to 150,000 cycles

By L. B. HEDGE

AUDIO-frequency tests for objective evaluation of characteristics of a hi-fi system and the correlation of these evaluations with characteristics of the system's components require, as a minimum of instruments, an adjustable signal source of high quality and wide frequency range, and a voltmeter capable of measuring the signal voltage at the system's input and output.

After obtaining a suitable voltmeter (described in RADIO-ELECTRONICS, October, 1957), the next instrument to be added to the af test setup should be an af oscillator. Some basic tests can be made with the meter and oscillator alone, and both instruments are essential in more elaborate tests which require additional equipment.[1]

Vfo's for audio use have been the subject of much development, analysis and evaluation during the past 20 years. The Wien-bridge, described by M. Wien in 1891[2] as a frequency-selective network for capacitive impedance measurement, was incorporated in oscillators as a frequency-selective feedback network by H. H. Scott[3] in 1938 and by Terman, Buss, Hewlett and Cahill[4] in 1939. Extensive study and experimental evaluation of these and other oscillator circuits have established the Wien-bridge as one of the simplest and least critical basic circuits for use where broad frequency range, low distortion and high stability of frequency and amplitude are required.[5]

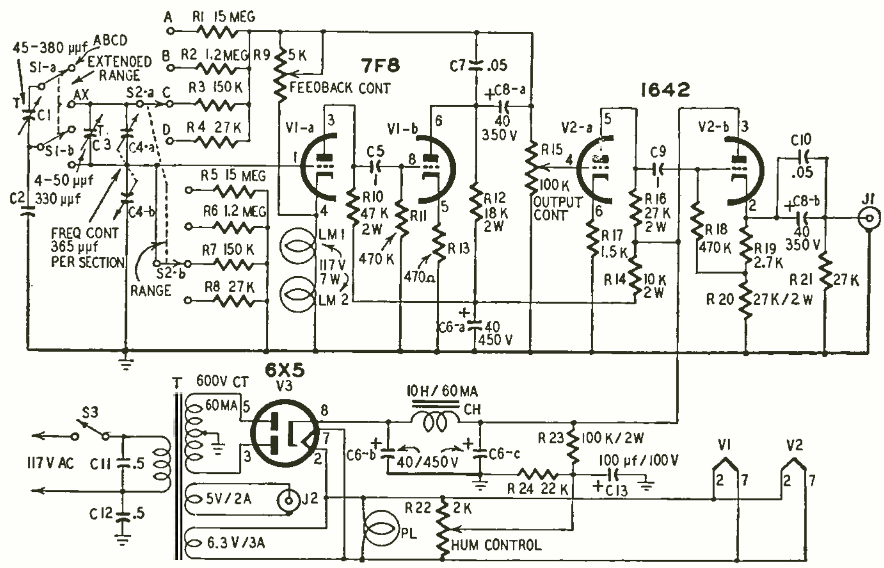
The basic Wien-bridge oscillator circuit (Fig. 1) is named for the feedback network R1-R2-C1-C2-R3-R4, which, when R3 and R4 are adjusted to the correct ratio, provides positive feedback at a frequency determined by:

$$f = \frac{1}{2\pi\sqrt{R1R2C1C2}}$$

with input in phase with the amplifier's output, permitting oscillation at this frequency. Any component of the output which differs in frequency from the value of f determined by the R1-R2-C1-C2 combination is reduced in amplitude and shifted in phase before being applied to the amplifier input. This provides a negative feedback for all spurious components of the amplifier signal (including noise, hum and harmonic distortion). The overall result is a high-quality sine-wave output with an accurately determined frequency.

Several variations of the bridge circuit, including widely differing combinations of values for and relations between R1-R2-C1-C2 and R3 and R4, are possible. The simplest is when R1 = R2 and C1 = C2, with frequency adjusted continuously with a twin variable capacitor for C1 and C2[1], or a dual potentiometer for R1 and R2[3], with switched fixed resistors or capacitors to extend the frequency range.

Amplitude regulation is usually provided by using a self-heating heat-sensitive resistor (incandescent lamp)



*R1, 5—15 megohms
*R2, R6—1.2 megohms
*R3, R7—150,000 ohms
*R4, R8—27,000 ohms
R9—pot, 5,000 ohms, linear taper
R10—47,000 ohms, 2 watts
R11, 18—470,000 ohms
R12—18,000 ohms, 2 watts
R13—470 ohms
R14—10,000 ohms, 2 watts
R15—pot, 100,000 ohms, audio taper
R16, 20—27,000 ohms, 2 watts
R17—1,500 ohms
R19—2,700 ohms
R21—27,000 ohms
R22—pot, 2,000 ohms, wirewound
R23—100,000 ohms, 2 watts
R24—22,000 ohms
All resistors ½ watt unless noted
C1—45-380 µµf, trimmer
C2—330 µµf, ceramic
C3—4-50 µµf, trimmer
C4—365 µµf, dual section, variable
C5, 9—1 µf, 600 volts
C6—40-40-40 µf, 450 volts, electrolytic
C7, 10—.05 µf, 600 volts
C8-a, 8-b—40 µf, 350 volts, electrolytic
C11, C12—0.5 µf, 600 volts
C13—100 µf, 100 volts, electrolytic
LM1, 2—7 watts, 117 volts, lamps
J1, 2—coaxial connectors
CH—choke, 10 henries, 60 ma
S1—dpdt, toggle
S2—2-pole 4-position rotary
S3—spst, toggle
T—power transformer; primary, 117 volts; secondary, 600-volt ct, 60 ma; 6.3 volts, 3 amps; 5 volts, 2 amps (Chicago PCC-60 or equivalent)
V1—7F8
‡V2—1642
V3—6X5
Pilot-lamp assembly
Power plug, polarized
Masonite chassis
Case
Knobs
Miscellaneous hardware
*Matched pairs or 1% precision resistors
‡This tube is obtainable from State Labs, 649 Broadway, New York, N.Y., or as a surplus item from surplus tube dealers.

Fig. 2—Complete circuit of the extended-range oscillator.

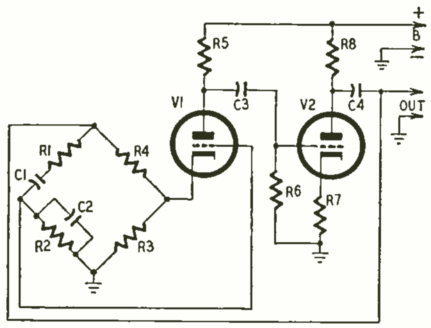


Fig. 1—Basic Wien-bridge oscillator circuit.

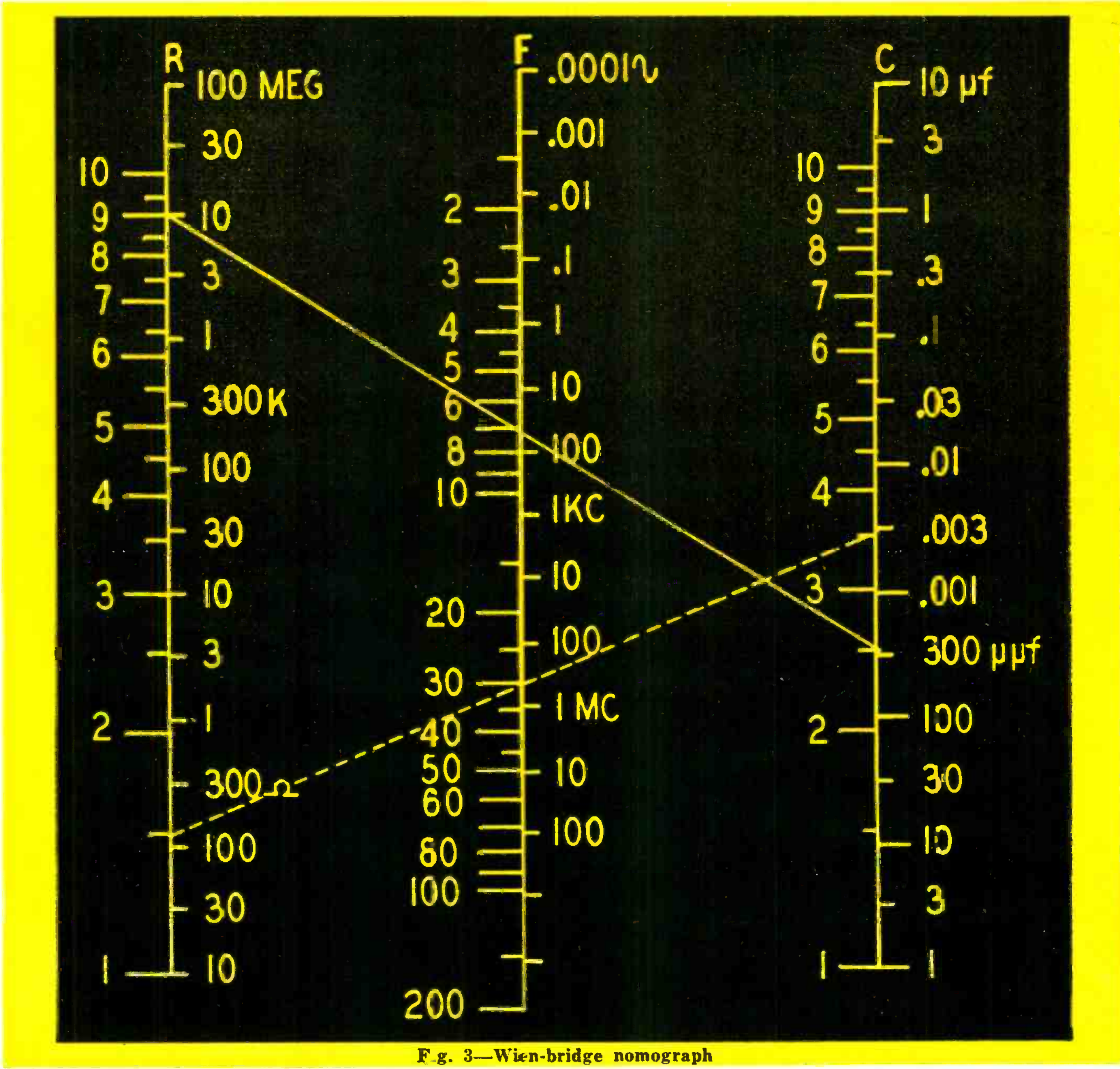


Fig. 3—Wien-bridge nomograph

for R3. With this arrangement, R3's resistance increases as signal current increases, increasing the negative feedback and corrective amplitude stabilization.

Oscillator design

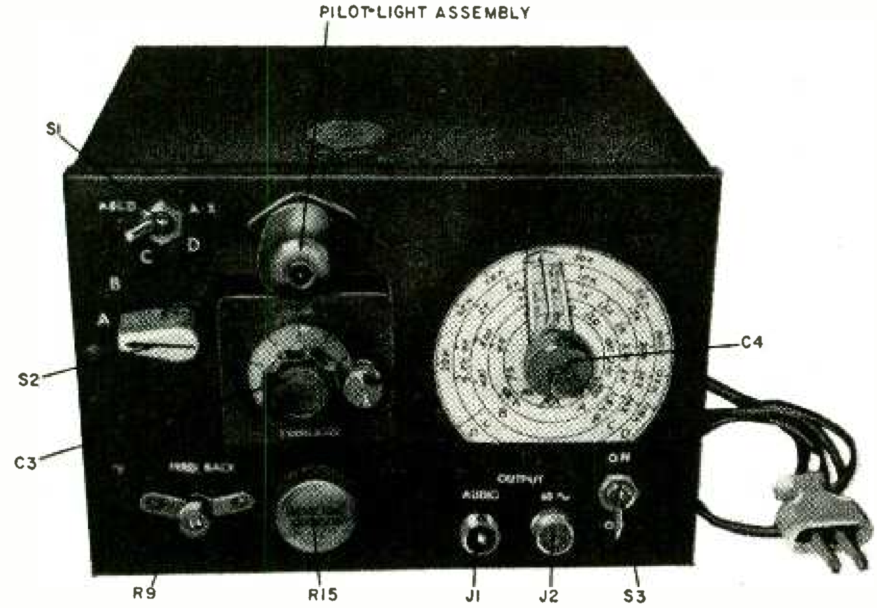
Based on these general considerations, the oscillator shown in Fig. 2 and the photos is designed to provide approximately continuous coverage from 20–150,000 cycles, with an extended low-frequency coverage of 12–20 cycles and a maximum output of about 15 volts. Output impedance is about 600 ohms. Since twin variable capacitors of about 10-to-1 capacitance range (30 to 365 $\mu\mu$f) are readily obtainable, variable-capacitor tuning is used.

The general characteristics of tubes used in the Wien-bridge oscillator are not critical, but certain factors do require attention. High gain is desirable in the oscillator loop (V1-a–V1-b) since it permits a large negative feedback with improved output waveform. Cathode current in V1-a should be large enough to keep the lamp resistors LM1 and LM2 in their stable temperature region, and V1-b's plate-load resistor R12 should be small enough to keep the effective load impedance essentially constant at any position of the RANGE switch S2. A 7F8 was selected for the oscillator triodes (V1-a and V1-b) since it provides high gain without excessively low plate current.

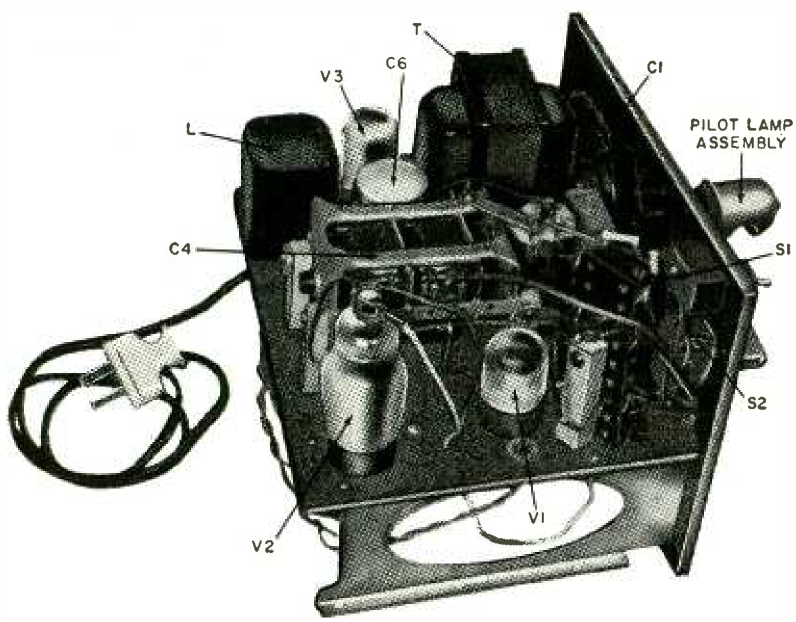
Since the oscillator is very sensitive to hum pickup, particularly from heater–cathode leakage, voltage divider R23–R24 is arranged to maintain the heaters of V1 and V2 at about 50 volts above their cathodes, minimizing the tendency for heater–cathode leakage. Potentiometer R22 permits balancing such leakage, if it does develop, to a negligible value.

A few special construction points must be considered to provide accurate balance and uniform output over the oscillator's entire frequency range. Stray capacitance between the tuning capacitor and the cabinet or chassis is a problem since the common rotor is not grounded. A Masonite sheet was used as a mounting board in the chassis setup, with the capacitor mounted upside down to minimize changing stray capacitance effects as the rotor position changes with respect to chassis and cabinet. If a metal sheet is used for the chassis, it should be cut away under the capacitor to keep stray capacitance effects small. The capacitor's shaft must be well isolated from the panel for the same reasons. A 2-inch-long ¼-inch-diameter plastic rod placed between the capacitor's shaft and the panel dial or drive (a gear-reduction drive in the unit shown) will do the job well.

The trimmer (C3) balances the frequency control network at the high-frequency (low-capacitance) end of the



Audio oscillator in its metal case.



Internal view showing layout of important components.

tuning scale, and it should be so arranged that it can be adjusted with the oscillator enclosed in the cabinet. Potentiometer R22 should also be mounted so it can be adjusted with the oscillator in its cabinet, and R9 is mounted on the front panel to facilitate final adjustment. It is provided with a screwdriver-slotted shaft and a shaft lock to prevent accidental changes in its setting. This is important since too much negative feedback will induce a kind of pulsed oscillation caused by thermal-overshoot time-delay characteristics of cathode lamps LM1 and LM2 and too little negative feedback will increase the harmonic content of the oscillator output.

Resistors R1 and R5, R2 and R6, R3 and R7, and R4 and R8 must be accurately matched pairs—the exact value of each resistance pair is not of great importance since small gaps between or overlaps in successive ranges will have little if any effect on the usefulness of the oscillator. Uniform output and low harmonic content will depend, however, on the precise matching of each pair. If a good resistance bridge is available, these pairs can be made up from ordinary 20% resistors connected in series-parallel combinations. If no resistance bridge is available, use precision resistors for these elements. Approximate values for the resistances used for each frequency range in the Wien-bridge network can be determined from the nomograph of Fig. 3. The low-frequency limit, using the maximum capacitance value for the variable capacitor elements, should be quite accurate, but the high-frequency limit will be somewhat lower than that shown in Fig. 3 or the equation because of stray-capacitance effects and the added capacitance of capacitor C2.

In addition to these details of design and assembly, the oscillator's general layout should be arranged to keep the fields of the power supply transformer and choke as far from the elements of the V1 circuit as possible to minimize further the possibility of stray hum pickup. The 60-cycle output terminal, connected to the second filament winding of the power transformer, is provided as a source for use in intermodulation distortion measurements. A polarized power plug (see my articles in January, 1953; October, 1955) is necessary, or reversal of the plug will cause hum and other complications. The plug's wide blade attaches to the line lead that goes to the junction of C11 and C12.

Final adjustment

After building the oscillator, adjustment should be started with R9 set at its minimum resistance position during a warmup period of a few minutes. Connect an ac voltmeter, set for at least 30 volts full scale, across the oscillator's output and, if an oscilloscope is available, connect its vertical input across the oscillator output too. Turn the OUTPUT CONTROL R15 to maximum output, set RANGE switch S2 at the low-frequency (A-range) position, the EXTENDED RANGE switch S1 at the ABCD position, and trimmer C3 at minimum-capacitance and the FREQUENCY CONTROL C4 at maximum-capacitance (minimum-frequency) position. After a few minutes' warmup:

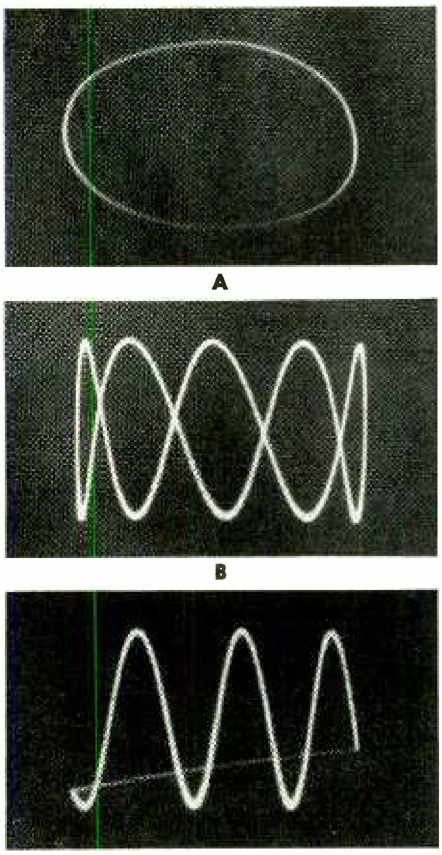
1. Increase the FEEDBACK CONTROL slowly until oscillation starts. Adjust to the minimum value that will maintain oscillation.

2. Increase the FREQUENCY CONTROL gradually to maximum-frequency (minimum-capacitance) position, increasing the capacitance of the trimmer (C3). if necessary, to maintain oscillation as frequency increases.

3. Decrease the FREQUENCY CONTROL gradually, observing closely the ac voltmeter reading. If a position is reached where the voltage varies noticeably and *regularly*, leave the frequency control at this position and adjust hum potentiometer R22 to the position that reduces the output voltage variation to a minimum. (This effect will occur at a frequency near to the 60-cycle line frequency if hum is being picked up in the oscillator.) The mixture of oscillator output and hum will produce a beat in the output at a frequency equal to the difference between the oscillator and hum frequencies and, if this difference is small, the meter will indicate the beat-frequency voltage with changes in voltage reading. If a scope is used. the hum voltage can be observed as a distortion of the oscillator output waveshape at low frequencies, and adjustment of R22 can be made to minimize this distortion. After the hum adjustment is complete, return the frequency control to minimum frequency position.

4. Set S2 to range B position.

5. If oscillation does not start immediately, allow a minute for it to start.



C

Fig. 4—Calibration, scope patterns: a—60 cycles; b—300 cycles; c—300 cycles at 100-cycle sweep.

If oscillation has not started after a minute, or if it starts and stops in pulses, increase FEEDBACK CONTROL gradually until stable oscillation is established.

6. Repeat step 2 at this range position.
7. Set S2 to range-C position.
8. Repeat step 5 at this range position.
9. Repeat step 2 at this range position.
10. Set S2 to range-D position.
11. Repeat step 5 at this range position.
12. Repeat step 2 at this range position.

At the conclusion of this procedure, oscillation should occur over the entire basic range (ABCD) with a variation in output voltage of not more than ±5%. If the output voltage shows more variation than ±5%, determine by repeating steps 1 and 5, at each range position, which range requires the highest setting of the FEEDBACK CONTROL to maintain oscillation. Resistors for this range are not accurately balanced—balance can usually be established by connection of a small resistor (approximately 1% of the nominal value) in series with one of the range resistors or a large resistor (approximately 10 times the nominal value) in parallel with one of the range resistors. If the change made in one resistor requires increasing the FEEDBACK CONTROL to maintain oscillation, apply the correction to the other resistor of the pair. If more than one range requires increasing R9 to maintain oscillation, apply this corrective resistor-matching procedure to each.

The extended low-frequency range can now be adjusted. Set the EXTENDED RANGE switch at the AX (closed) position, with the FREQUENCY CONTROL somewhere in mid-range, and adjust trimmer C1 to give the same output voltage as that produced with the FREQUENCY CONTROL in the same position and the EXTENDED RANGE switch in ABCD (open) position.

Scale calibration

With the oscillator adjusted, calibration of the frequency scale is the next and final job. If a scope is available, calibration is easily and accurately accomplished. With a 60-cycle input to the horizontal amplifier, the 60-cycle point on the scale is located by adjusting the oscillator frequency to produce a circular or elliptical stationary pattern (Fig. 4-a), and multiples up to 300 cycles and submultiples down to 15 cycles are easily identified by Lissajous figures (Fig. 4-b).

By switching the horizontal amplifier to internal sweep with the sync control at 0 and the oscillator at 300 cycles, the sweep frequency can be set at 100 cycles and the oscillator frequency checked at 100-cycle intervals up to 1,000 cycles (Fig. 4-c). By alternately stepping up the frequency of the scope sweep and the oscillator frequency, calibration can be extended to the top of the oscillator's range. As the scope's sweep frequency approaches its maximum, the flyback time of the sweep will take a larger portion of the sweep cycle time, and the resulting pattern will approach the Lissajous figure—at least to the extent that one or two cycles of the oscillator output may appear in the flyback trace and must be counted to determine the ratio between oscillator and sweep frequencies.

If a scope is not available, a speaker or headphone connected across the output of the oscillator may be used to give an audible tone which can be tuned to the pitch of a note from a piano or other musical instrument in the mid-frequency range of the oscillator, and a series of such calibrations covering one range of switch S2 can be extended to the lower and higher ranges by use of the Wien-bridge nomograph (Fig. 3). Frequencies of standard musical scale tones are given in the table. Calibration by comparison with musical tones should be quite accurate over the range of available reference tones, and extended calibration based on the Fig. 3 nomograph should be more than adequately accurate for audio test purposes since precise frequency values are seldom significant in these tests.

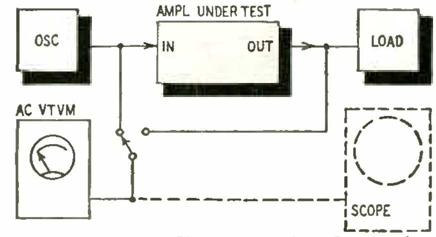


Fig. 5—Block diagram of a basic frequency response and output power test setup.

With calibration completed, the oscillator is ready for use, and with an ac vtvm it comprises the basic af test setup. Frequency response curves for an amplifier are made with the oscillator and voltmeter connected as shown in Fig. 5. If a scope is available, it should be connected across the vtvm and used to observe the input and output waveforms at frequencies and signal levels at which measurements are made. If the amplifier contains a volume control, it should be kept at its maximum output setting during tests, with the input signal level adjusted by the oscillator's output level control. Response measurements should be made with the input voltage constant at all frequencies at a level sufficiently below the amplifier overload level to avoid overload distortion errors.[6] Serious distortions can be detected on a scope as changes in the shape of the signal wave image. Measurements of distortion require the use of an analyzer which will be described in the next article of this series. The output of an amplifier under test should be connected to a resistance load of the value for which the amplifier is designed and of a power rating at least twice that of the power output of the amplifier. Output power of an amplifier under test may be computed from the formula

$$\text{Power (watts)} = \frac{E^2}{R}$$

where E is the rms ac voltage measured across the load resistor of R ohms. END

Table of Musical-Note Frequencies*

	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
	33	35	37	39	41	44	46	49	52	55	58	62
	65	69	73	78	82	87	93	98	104	110	117	123
	131	139	147	156	165	175	185	196	208	220	233	247
Middle C	262	277	294	311	330	349	370	392	415	440	466	494
	523	554	587	622	659	698	740	784	831	880	932	988
	1,047	1,109	1,175	1,245	1,319	1,397	1,480	1,568	1,661	1,760	1,865	1,976
	2,093	2,217	2,349	2,489	2,637	2,794	2,960	3,136	3,322	3,520	3,729	3,951
	4,186											

*To the nearest integral number of cycles. Based on A above middle C 440.

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MONITORING "Sputnik"

By ROBERT F. SCOTT
Technical Editor

WHEN announcements of the Russian satellite (Sputnik) burst upon us not so long ago I immediately cranked up the old Super-Dooper receiver and began listening on the 20-mc channel. While considering the possibilities of monitoring Sputnik's second channel, I suddenly realized that while the shack was literally full of "all-wave" receivers of various vintages, not one could be tuned to 40 mc. Something had to be done. Technical magazines and handbooks did not come up with the circuit of a single converter operating around 40 mc that I thought would do this job satisfactorily.

Reports stressed the importance of using a receiving system with high sensitivity, good selectivity and a good noise factor, so I decided to "engineer" a fixed-tuned crystal-controlled converter based on a cascode type front-end design like that used in many TV and FM sets. This should insure an acceptable noise factor and good sensitivity. Selectivity would be supplied by the receiver's antenna, mixer and if circuits.

The old Super-Dooper was a little noisy; its image rejection was not good enough on 20 mc to prevent Voice of America and Mackay Radio transmitters (92 miles away) from breaking through and swamping weak signals. I decided that a hot low-noise converter would give me a better signal-to-noise ratio on 20 mc and began thinking in terms of a converter to cover Sputnik's 20- and 40-mc channels. Since at the time of writing, reports were that the Russians were planning to release other satellites, such a converter may be also useful to you in tracking Sputnik No. 2.

Fig. 1 shows the block diagram of the converter, The 20–40 mc cascode rf amplifier will provide good sensitivity with low noise. A crystal oscillator was selected to provide good stability and to minimize calibration difficulties. The 32-mc oscillator is 12 mc above the 20-mc channel and 8 mc below 40 mc. The 20- and 40-mc signals will be received at 8 and 12 mc, respectively.

Thus the receiving system is comparable to a double superhet with the receiver acting as a tunable 8–12 mc first if and a 456-kc second if, detector and audio system. (The high first if provides adequate image rejection and the second if supplies the selectivity.)

Some converters do not provide enough signal output for good weak-signal performance and some receivers are relatively insensitive around 10 mc—my receivers are peaked on the centers of the ham bands—so I've incorporated a wide-band if amplifier with gain control to boost the overall sensitivity. The circuit of the converter is shown in Fig. 2.

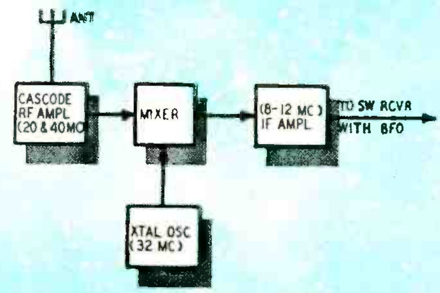

Fig. 1—Block diagram of the 20—40-mc crystal-controlled converter.

The cascode rf amplifier is based on the FM front-end of the Bogen R750 AM–FM tuner. The inductors in the antenna and mixer grid circuits were selected to tune to 40 mc with a small capacitor or stray and distributed capacitances alone. Small trimmers are then switched in and adjusted so the circuits tune to 20 mc.

The mixer is the pentode half of a 6U8 in a circuit similar to that in some TV tuners. The oscillator, the triode half of the 6U8, is recommended by the crystal manufacturer (International Crystal Manufacturing Co., 18 N. Lee St., Oklahoma City, Okla.) for 10–60-mc operation of his third-overtone (FA-5 and FA-9) crystals. International assured me that the circuit will surely supply enough signal injection in this circuit for good mixer conversion.

(FA-5 and FA-9 crystals differ only in the design of the holders. They are not generally available on the open market, but can be obtained from

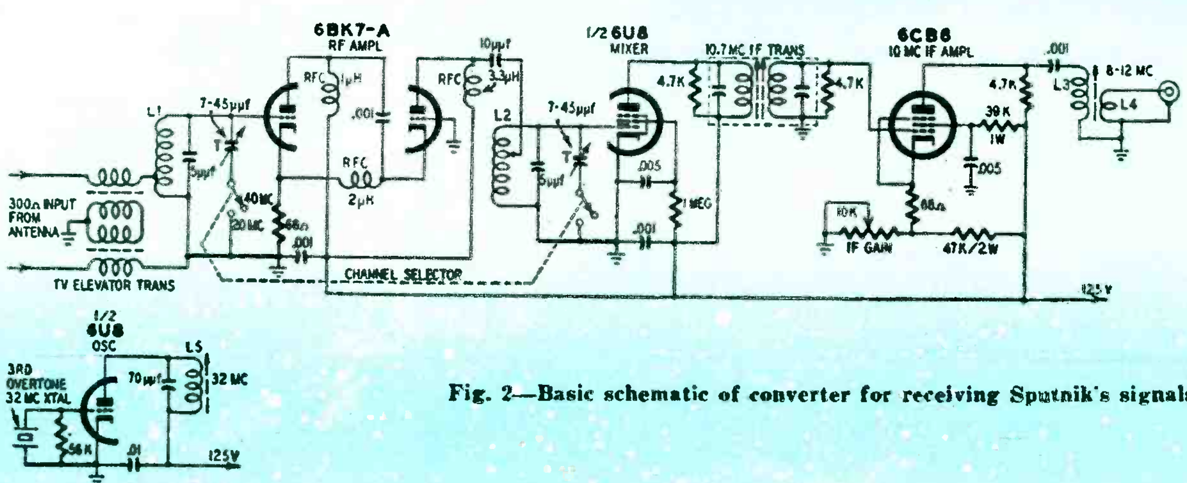

Fig. 2—Basic schematic of converter for receiving Sputnik's signals.

the manufacturer for $4. Orders are usually shipped within 24 hours of receipt.)

The grid resistor in the oscillator may be any value between 22,000 and 220,000 ohms. I'll start with around 56,000 ohms and experiment to find the optimum value. If the oscillator provides too much signal, I'll lower it by inserting a dropping resistor between the B-plus line and the bottom of L4. The oscillator coil (L5) may be a CTC (Cambridge Thermionic Corp.) type LS-3 30-mc type or any coil and capacitor combination that will tune to 32 mc.

The antenna coil L1 and mixer coil L2 may be approximately 15 turns of No. 20 wire, ¾ inch in diameter and 1 inch long. This may be cut from B & W type 3011 Miniductors. The tap on L1 is made at the fourth turn from the ground end. The mixer plate coil L3 may consist of a 1-inch-long closewound coil of No. 28 enameled wire on the upper part of a National XR-91 form. L4 is a 10-turn coil of No. 28 wire over the cold end of L3.

Other frequencies between 20 and 40 mc can be used for the oscillator. The point where either channel comes in on the receiver will be the difference between the oscillator and signal frequencies.

Circuit alignment is comparatively simple. Pretune L1, L2, L3 and L5 with a grid-dip meter. Then, use a signal generator to align the if amplifier, mixer and rf circuits in that order. If you don't have a signal generator, you may be able to align the circuits on WWV transmissions on 20 mc. Vary the values of resistance across the if transformer for relatively even response between 8 and 12 mc. Rig up a simple noise generator and use it to set the taps on L1 and L2 for minimum noise.

In bringing you details of this converter we could not wait until the crystal arrived, and therefore had no opportunity to try it, before press deadline. So minor modifications may be needed when the converter is put on the air. For example, you may have to keep all leads as short as practical and use good vhf wiring and layout techniques.

Gonna try 108 mc?

The selection of a 32-mc crystal is a good idea if you plan a 108-mc converter for monitoring our satellite. You will probably be able to use the same oscillator circuit and components as in the 20–40-mc converter. The third-harmonic (96-mc) output of the 32-mc oscillator will probably be strong enough for good conversion to 12 mc.

If the 96-mc signal is too weak, try a small coupling capacitor between mixer grid and oscillator plate. If this fails, insert a 35–40-mc tuned circuit in the oscillator's cathode return and connect the crystal directly between the grid and cathode. Tune the plate circuit to 96 mc. END

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Radio-Electronics

TRANSISTOR & HYBRID AUTO RADIOS

By JACK DARR

Part II—Printed-circuit boards, and some special circuitry found in auto radios today

LAST month we had a rundown of the new look in auto radios. These transistorized (in places) receivers have some interesting special features we will now examine.

As in many other types of electronic equipment, printed circuits have appeared in auto radios. Motorola uses Pla-Cir plated-wiring boards in several of the new sets, as does Philco. Delco is also using printed-wiring boards in quite a few sets. In the signal-seeking tuners, switch panels and station-selector tab boards are small plated circuits. Quite a bit of printed wiring is used in the Chevrolet, especially in the rf, oscillator and if stages (see Fig. 6).

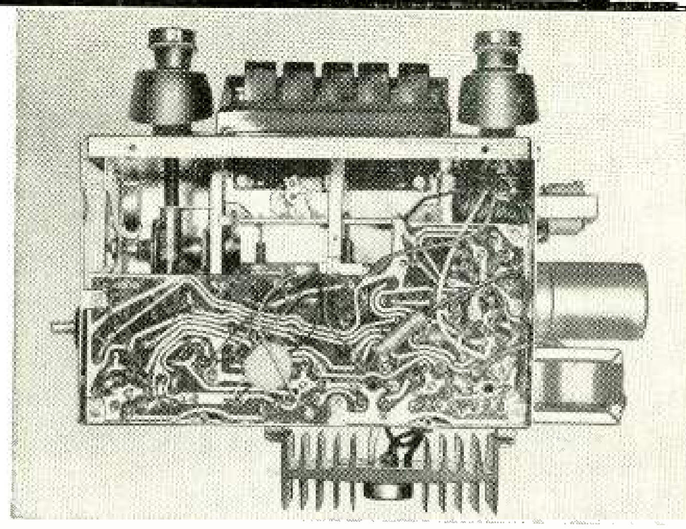


Fig. 6 — Printed-circuitry used in the Chevrolet 987575.

Motorola's Res-Caps are actually small printed-circuit combinations of resistors and capacitors, similar to the Couplates and vertical integrators familiar to the TV technician. They are used, in various combinations of capacitance and resistance, in many parts of the sets. If one of the parts fails, it may be replaced individually, or the whole unit may be replaced.

Special circuits

A novel circuit is found in the Motorola 79MS, the set designed for Ford Thunderbirds. Fundamentally, the purpose of the circuit is to increase the radio's volume as the speed of the engine increases. With an increase in speed, wind and road noises get louder and the volume of the radio is automatically increased to compensate for this.

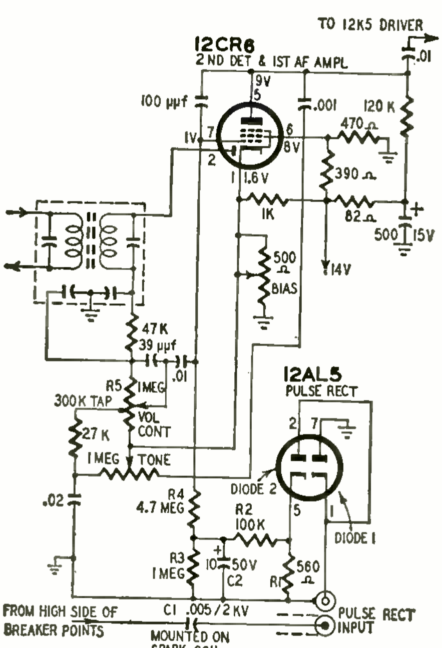


Fig. 7—Circuit increases radio's volume as car speeds up.

Specifically, volume is increased as the car's engine is speeded up. This is done by the circuit shown in Fig. 7. A special cable connected to the high side of the breaker points feeds noise pulses from the distributor to a 12AL5 dual-diode, through a .005-μf blocking capacitor C1. Negative pulses are shunted to ground by diode 1, as is any charge that may be built up in the blocking capacitor. Positive pulses are rectified and cause a voltage drop across cathode resistor R1. This positive voltage is coupled to the grid of the 12CR6 audio amplifier, through a filter consisting of R2, R3, R4 and C2. The amount of this voltage determines the gain of the pentode section of the 12CR6, directly controlling the receiver's volume.

The time constants of the circuit are such that the action will not be affected by normal rapid increases and decreases in engine rpm, which might occur when shifting gears, but will follow a gradual increase in speed. As the pulses become more frequent, the charge on C2 builds up and the added positive voltage on the grid causes an increase in the stage's gain. As the engine gradually slows down, the voltage across C2 discharges, allowing the volume to drop. These variations, of course, take place around the operating point of the tube, as selected by the position of the manual volume control R5.

Motorola also is continuing the use of their Volumatic agc control circuit in their present line of auto radios. Replacing the conventional avc circuit, which is actually an agc circuit as it has no effect on the audio section of the set, this circuit not only controls rf gain but directly controls the audio volume as well. The circuit uses a 6CR6 or 12CR6 diode-pentode tube and is shown in Fig. 8. Grid resistor R1 returns to the agc bus instead of ground. This provides a variable bias that is in direct proportion to the amplitude of the signal picked up by the set. The bias controls the gain of the pentode section of the tube, the audio stage. Conventional agc is also used, in a standard circuit, from the diode section. This added degree of control has proved successful in eliminating fading from changes in signal levels, due to movement of the car, that is so prevalent in auto radios. It also aids in the operation of automatic tuning devices. The output level variations between the various stations are smoothed out to the point where it is not necessary to adjust the manual volume control

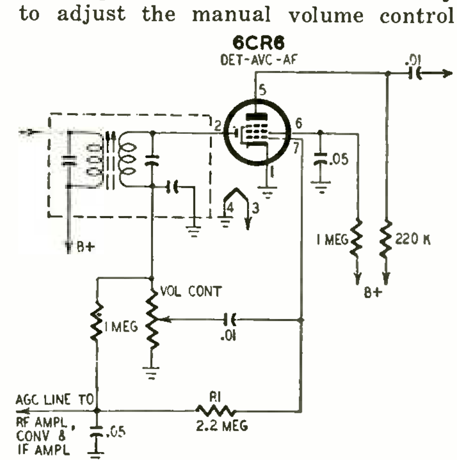


Fig. 8—Volumatic circuit controls rf gain and audio volume.

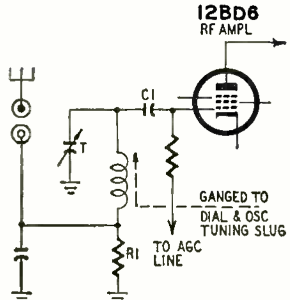


Fig. 9—Differentiating filter, called an *Eliminoise* circuit, is found in new Motorola auto radios.

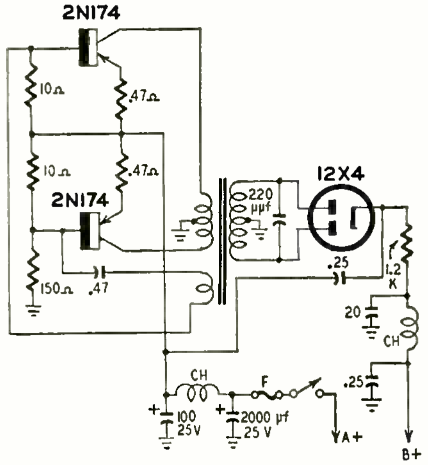


Fig. 10—Transistorized power supply replaces familiar vibrator.

while using the automatic tuner, search tuner or other forms of automatic tuning.

A differentiating filter, of the high-pass variety, is used in the antenna input circuit to help eliminate high-line noise and other electrical interference (see Fig. 9). R1 and C1 values are chosen to eliminate reception of the low or prevalent noise frequencies. This reduces the amplitude of 60-cycle pickup from power lines and helps reduce the ill effects of standing waves on the antenna, resulting in a much cleaner signal.

The transistor power supply

The versatile transistor, not only replaces tubes, but has even been used to replace the vibrator itself. This is found in the Chevrolet Corvette radio, Delco model 3725156. Conventional tubes are used in all but the output stage where a pair of 2N173 transistors supply audio output. Power requirements are about 200 volts. This is supplied by transistors.

A pair of 2N174 p-n-p power transistors are hooked up in an oscillator circuit (see Fig. 10). This is a relaxation or blocking oscillator, very familiar to all TV technicians. A frequency of around 20,000 cycles is used, to eliminate hum and buzz and simplify filtering problems. The frequency of oscillation is determined mainly by the inductance of the power transformer primary. This is a special unit with a primary, high-voltage secondary and a tertiary feedback winding.

As the first transistor conducts, through the center-tapped primary, the other is cut off. When the first transistor reaches saturation, the field collapses, inducing a voltage in the opposite direction in the tertiary winding. This voltage drives the second transistor into conduction, then into saturation, and the first transistor into cutoff. Since the second transistor conducts in the opposite direction, a square wave is produced. Through the stepup action of the secondary winding, the voltage is raised to 200–250 ac. This is rectified by the 12X4, filtered and applied to the set. Filter components are not nearly as large as in the older sets. The input filter is a 20-μf unit, while the output filter is only 0.25 μf!

The ac voltage may be measured across the secondary; if it is not present the transistor may not be oscillating. This could be caused by a defective transistor, power transformer or by excessive loading of the B-plus line to the receiver. Tests for oscillation may easily be made with a scope or by pulling the 12X4 from the socket, removing the load and measuring the ac voltage.

The heat sink

Another new feature will be the heat sink necessary for proper operation of the power transistors. The technician will be able to spot transistor sets by the appearance of a set of fins on the end of the set, on either side of the small round object which is the power transistor. Power type transistors, such as the 2N173, 2N278, Philco's AR-5 and AR-6, etc., are all basically alike in structure, although their individual characteristics differ somewhat. All require some means of radiating the heat generated during normal operation (see Fig. 11).

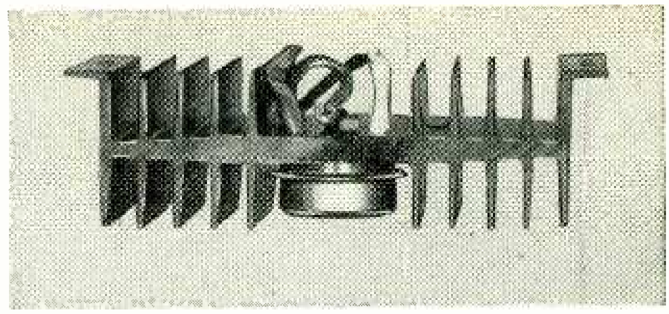


Fig. 11—Heavy aluminum fins keep power transistor cool during operation.

Transistors of this type draw up to 900 ma during operation and generate quite a bit of heat. The transistor must not be allowed to get too hot, otherwise a condition known as thermal runaway may occur and the transistor will be ruined. Therefore, the transistors are mounted solidly to the end of the chassis, on a special plate which is insulated from the chassis on many sets. In others, the transistors themselves are insulated with thin mica spacers which allow heat transfer to the chassis but prevent grounding the collector which is connected to the case in most of the common power types. Some use a central stud and two flexible leads or lugs; the stud is the collector connection while base and emitter are connected to the leads. Others use three flexible leads, mounting the transistor by means of small bolts through the ears of the case.

When testing power transistors in actual operation, they must be firmly clamped to their heat sinks. Otherwise, they may get too hot and become defective. Insulation must be perfect to prevent grounding of the collector to the chassis. Almost all circuits up to this time use the common-emitter configuration, which uses the collector as the output element. While the collector returns to ground through the primary of the output transformer, grounding it would cause trouble.

Control of the normal thermal increase in collector current is accomplished in the design of the circuit. Delco uses a small resistor (0.47 ohm) in the emitter circuit. If the transistor overheats, this resistor increases the bias voltage, opposing the current increase. Thermistors are also used in the larger sets with push-pull output (see Fig. 12) for the same purpose. In addition to the 0.3-ohm emitter resistor, a thermistor is connected across the 4.7- and 39-ohm base voltage-divider resistors. It changes the base–emitter voltage to compensate for temperature increases which would otherwise cause much increased collector current and possible thermal runaway.

This completes a full look at the new line of transistor radios and their special features. I'm sure you'll feel as I do—there have been some changes made. Next, we are going to discuss servicing these sets. END

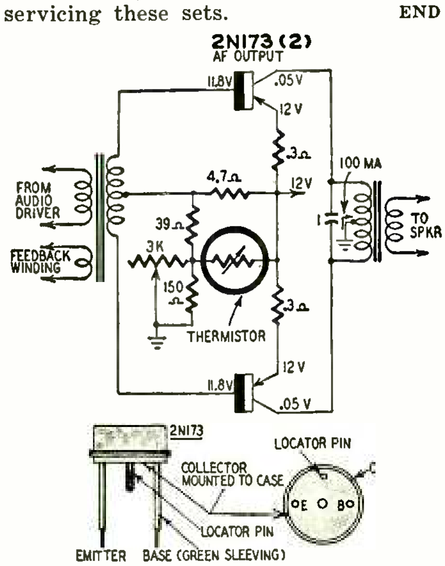


Fig. 12—Delco output stages use thermistor to protect transistors against overheating.

TRACKING U.S. SATELLITES

Want to track our space satellite? Here's how to go about it

By JORDAN McQUAY

DURING the winter and spring of 1957–58, the United States will launch a number of earth satellites into interplanetary space as part of our participation in the International Geophysical Year.

After launching via a multistage rocket, each satellite will circle the earth in an elliptical orbit at altitudes above 500 miles and at speeds of nearly 20,000 miles an hour. Purpose of the space voyage is to collect scientific data about the earth and the upper atmosphere.

In addition to special instruments, the metal sphere of each satellite contains a tiny radio transmitter weighing about 12 ounces. Various atmospheric data collected by the satellite are transmitted on a frequency of 108 mc, but with an extremely low power of less than 50 mw.

With appropriate ground-based receivers, this radio signal permits tracking of the satellite through most of its flight. Large and elaborate installations —known as Minitrack stations—have been installed by the Government to track and receive data from the satellites.

With a receiving system that's sufficiently sensitive, however, anyone can pick up the coded signals from a U.S. satellite. And with slightly more elaborate equipment, you can help directly in locating and tracking the satellites as they pass over or near your area of the country.

If you're a radio ham or dx fan with a yearning to contact stations in outer space, here's your chance!

A receiving system, based on the interferometer principle and similar to that used by the Minitrack stations, has been developed by the Naval Research Laboratory in Washington for tracking U.S. satellites.

In its simplest form (Fig. 1), the system requires (1) a set of two identical Yagi antennas on a single base line from 20 to 500 feet long, (2) a coaxial T junction centrally located on the antenna base line, (3) a frequency converter to shift the incoming 108-mc signal to a lower frequency acceptable to a standard type of communications receiver, and (4) an S-meter or visual recording device connected to the output of the standard receiver. The two Yagi antennas should have the same shape and spacing of elements, and should be mounted parallel to each other. The antenna base line should be as long as possible—preferably running in a somewhat east–west direction. A number of economical, commercial frequency converters will probably be on the market soon. But a conventional overtone crystal oscillator with a buffer amplifier can be used to convert the satellite signal to a *clear* frequency acceptable to the range of your communications receiver. Amateur receivers and converters intended for the 144-mc band may also be modified for the lower frequency. The really ambitious constructor may wish to try the preamp–converter shown in Fig. 2. It was designed especially for the purpose of satellite tracking by the Naval Research Laboratory. The tubes are expensive—the GL-6299 lists at $56—and the layout and construction requires considerable experience with vhf circuitry. (Construction details and design data on the equipment may be found in the article "A Low-Noise Preamplifier for Satellite Tracking" in the December, 1956, issue of *QST* magazine.)

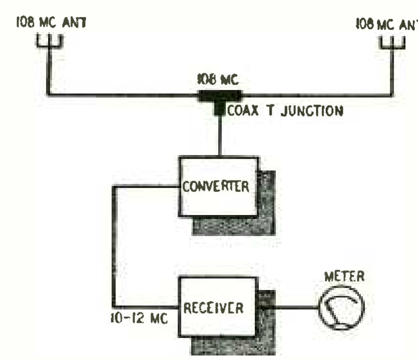


Fig. 1—Simple system for tracking satellite launched by United States.

Experimenters wishing to try a less expensive version of the circuit might substitute a 6Q4/EF80 in place of the expensive 6299. It is a low-noise tube whose characteristics are somewhat similar. The 5842/417A or a triode-connected E180F/6688 could also be tried, although they do not closely approximate the original tube.

Another approach would be to substitute the cascode rf amplifier described in the "Low-Noise TV Booster" (RADIO-ELECTRONICS, November, 1957) for the portion of the circuit between the antenna terminal and the input to the mixer. Coils would have to be adjusted for the spectrum, of course. Further savings might be realized by using a 12AT7 for the 12AT7-WA and a 6AQ5 for the buffer.

When a U.S. satellite is expected over or near your area, you'll know about it from your local newspaper or radio or TV station. Then, at an appropriate time, fire up your converter and receiver, and tune carefully for a weak pulsed signal at or near 108 mc. It may be difficult to detect at first. If you fail

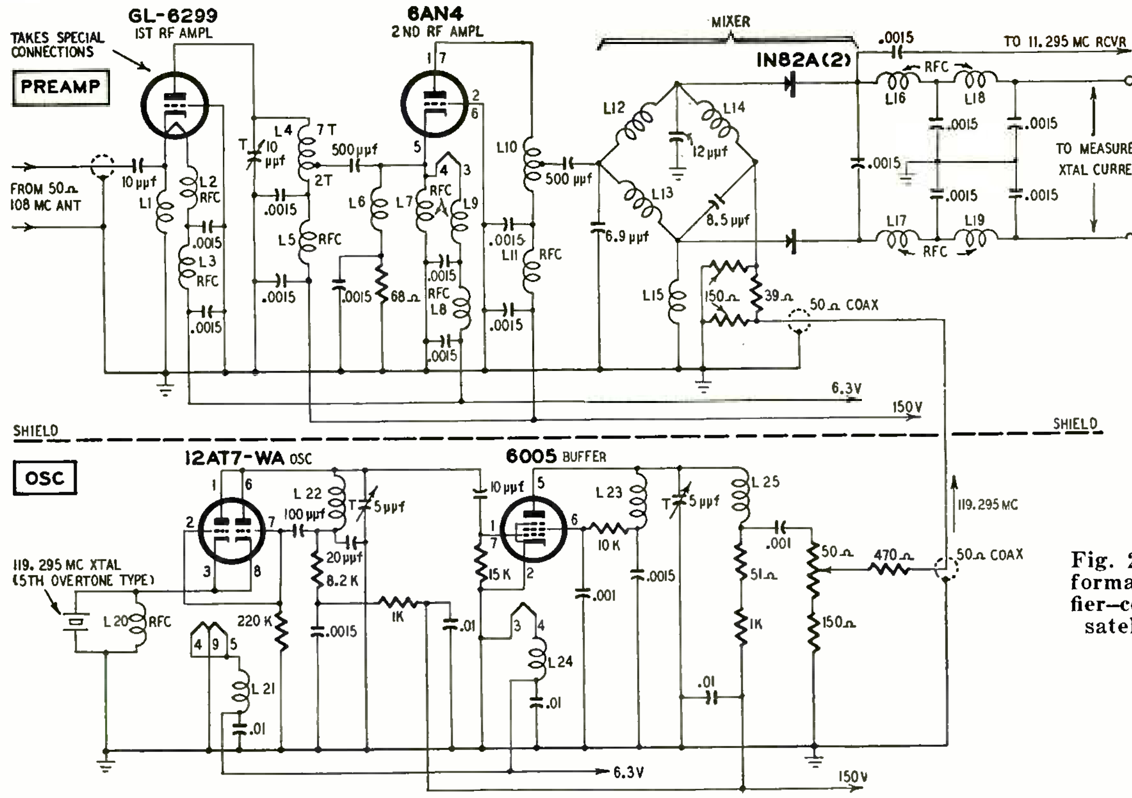


Fig. 2 — High-performance preamplifier–converter for satellite tracking.

L1—0.2 µh; 5 turns No. 16 wire; 5/16-inch diameter; spaced 12 tpi (turns per inch)
L2, 6—3.9-µf rf choke, Jeffers* type 104, self-resonant at 108 mc
L3, 7, 8, 9—5.6-µh rf choke, Jeffers 102
L4—0.6 µh; 19 turns No. 16 wire 7/16-inch diameter; spaced 12 tpi, tapped 2 turns from bottom
L5, 11—4.7-µh rf choke, Jeffers 102
L10—0.5 µh, 7 turns No. 18 wire on CTC (Cambridge Thermionic Corp.) LS-6 form; tapped 2¾ turns from bottom
L12, 13—0.62 µh, Jeffers 102 pruned (turns removed) for required value
L14—0.26 µh, Jeffers 102 pruned for required value
L15—0.43 µh, Jeffers 102 pruned for required value
L16, 17, 18, 19—high-impedance pie-wound rf choke self-resonant at 11.3 mc
L-20—5 turns No. 18 wire; 1/4-inch diameter; spaced 12 tpi. Must resonate with capacitance of crystal holder
L21, 24—5.6-µh rf choke, Jeffers 101
L22, 23—0.15-µh, Jeffers 101 pruned for required value
L25—0.33-µh, Jeffers 101 pruned for required value
*Jeffers Electronics Division of Speer Carbon Co., Dubois, Pa.

to receive signals, carefully recheck the calibration and tuning of your converter as well as the receiver.

With good reception, you should get an indication on your S-meter of the signal from the satellite. This signal may fluctuate slightly, but will gradually rise as the satellite approaches your area. When the satellite passes directly over or relatively near you, the output reading on the S-meter will reach its maximum. Then, as the satellite continues in its orbit, the S-meter reading will gradually decrease until it finally disappears altogether.

If you fail to receive signals at 108 mc or if you want to track and record a more accurate indication of satellite positions with respect to time, you can make any of a number of modifications and improvements in the simple system described above: (1) A longer antenna base line, from 500 to 1,000 feet, can be used for better signal resolution. (2) The coaxical T junction can be replaced by a hybrid junction to feed *two* converter–receiver units. (3) All elements of the rf transmission line can be more accurately matched. (4) A low-noise preamplifier can be included in each of the two frequency converters to increase sensitivity. (5) A source of time, accurate to 10 milliseconds or better, can be included in the tracking system so that exact time is recorded simultaneously with signal intensity of the satellite. (6) The output indicator can be changed from a simple S-meter to a graphical or magnetic tape recording for permanent record.

A diagram of this improved tracking system, also developed by the Naval Research Laboratory, is shown in Fig. 3. A hybrid junction can be constructed to match the impedances of the two antennas with the inputs of the two preamplifier–converters. Suitable types of low-noise preamplifier–converters will soon be available commercially, but can be assembled around two grounded-grid amplifier tubes feeding a balanced mixer with a separate local oscillator. (See Fig. 2.) Outputs from the two standard communication receivers can be connected in parallel to any of several kinds of permanent visual recorders. Most desirable is the direct-writing type with a frequency response up to about 30 cycles. Galvanometer type photographic recorders may also be used. Paper speed for recorders should be at least 3 inches per second.

Improved tracking systems are usually sensitive—sometimes extremely sensitive—to satellite signals. As a result, the output device may often record fluctuations in intensity, at the same time recording gradual increases or decreases in average intensity. Other variations in intensity may occur as the result of polarization effects on the satellite signals. The frequency of *some* types of intensity variation is a measure of ionospheric refraction of radio waves from the satellite.

Further refinements in the above tracking systems will result in improved reception and more accurate recording of satellite signals, and can be made by introducing additional sets of antennas, use of large broadside arrays and more precise recording devices.

By designing and building your own system for receiving and recording radio signals from the U.S. satellites, you'll get personal satisfaction from contacting and tracking stations in interplanetary space and you'll be making a direct contribution to this important phase of the International Geophysical Year. END

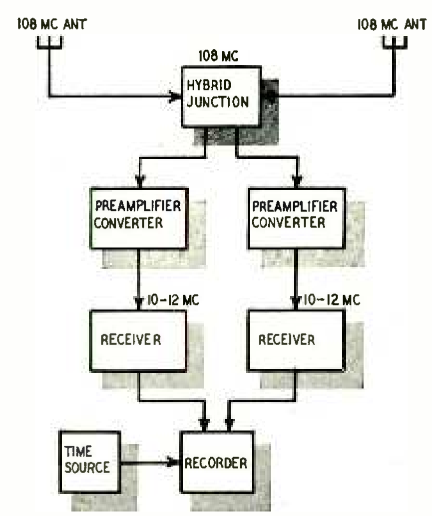


Fig. 3—An improved satellite tracking system.

AC DC POWER SUPPLY

By GEORGE P. PEARCE

IN hobby and experimental work there is frequently a need for a small ac or dc power supply—for example, in electroplating, generation of small quantities of oxygen and hydrogen, running miniature electric motors and models, charging storage batteries, rejuvenating dry cells, operating electromagnets, low-voltage lamps and innumerable experiments and tests where a low voltage is required.

To meet my own needs along this line and to avoid the annoyance of finding that my batteries are dead just when I want to use them, I set to work and built a compact electric power supply that provides trouble-free, reliable dc at 9 or 18 volts and ac at 3.15 or 6.3 volts with current up to 1 ampere.

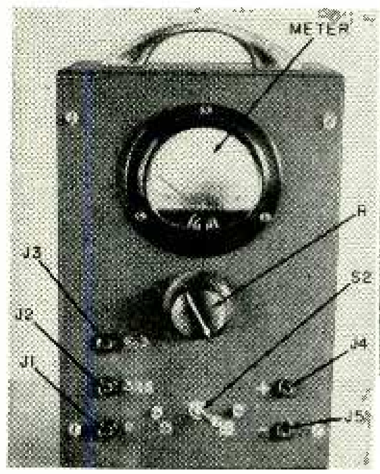
The unit is built around a small filament transformer with 117-volt primary and a 6.3-volt secondary with center tap rated at 1.2 amperes. This transformer is a standard type and can be obtained from most radio supply houses. The outside terminals give 6.3 volts and either outside terminal to the center tap gives 3.15 volts ac. For dc I use a voltage-double circuit which gives me 9 and 18 volts.

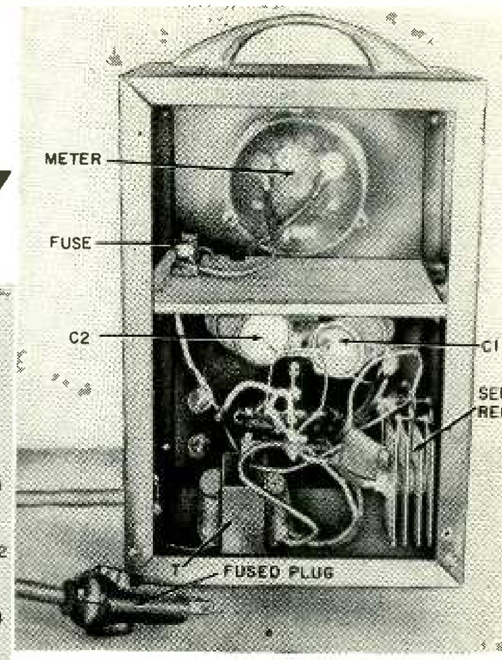
The voltage doubler may be a pair of 1-ampere 26-volt (maximum ac input) half-wave selenium rectifiers or a 26-volt 500-ma full-wave bridge with the normal ac terminals strapped to provide two series-connected 1-amp half-wave rectifiers. Suitable 1-amp half-wave units are not readily available so you can use a full-wave bridge such as the Sarkes Tarzian A-2, Radio Receptor P1B1S1G and International JD507G.

Note that this voltage doubler actually produces 2.82 times the rms voltage on open circuit. The voltage drops as the current demand is increased. The amount of drop or the voltage regulation depends greatly on the size of the capacitors used. The larger the capacitors, the better the voltage regulation.

The circuit shown in the diagram was designed to use odds and ends I had in my junkbox except for the small steel cabinet which I bought for around $1.75. The photos show the completed unit ready to deliver dc or ac power up to 1 ampere.

Before attempting the design of the final assembly, I made a temporary hookup on a breadboard to test all components and be sure they were in proper working order. I then made the final design and arranged everything





Above—Inside view shows simple construction.
Left—Completed power supply in handy carrying case.

to fit into the 9 x 6 x 5-inch steel cabinet so they would be in good balance when carrying the unit.

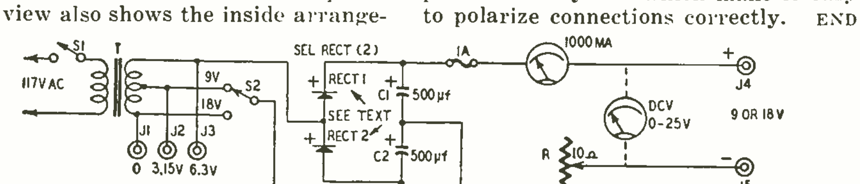
In planning the design, these steps were taken to obtain the highest efficiency out of the materials on hand: The 1-ampere voltage-doubler rectifier was placed in an open space near the bottom of the cabinet where it would be surrounded with the coolest air available. The transformer was also located on the bottom and as far away from the rectifier as possible without getting the cabinet out of balance.

To get everything into the cabinet I had to make a double decker, but I was careful to cut vent slots in the shelf to permit free circulation of air. This has proven very effective and, since the entire steel cabinet acts as a radiating surface of approximately 250 square inches, there was no need to drill a grid of ventilating holes which let in dust and insects to cause trouble. It can be seen from the photos that nothing whatever is attached to the back panel, which is easily removed by taking out four screws. This provides quick access to the works for replacing a blown fuse or for repairs. The view also shows the inside arrangement. The front panel can be removed by taking off one nut on the back of the meter and unclipping four wires.

The fuse is placed in a convenient spot in the assembly and a spare is clipped close by so I need not hunt for a new fuse in an emergency. Since the 1-ampere meter is the most expensive item in the assembly the fuse is placed next to it to protect the meter no matter where an overload or internal short may develop. You may prefer to use a 0–25-volt dc voltmeter. In this case, wire as indicated by the dotted lines in the diagram.

The 3.15-volt ac circuit is taken off one side of the transformer center tap. The other side goes to the dc rectifier so that both supplies can operate at the same time. It was not thought necessary to protect the ac output side of the supply, since there are two fuses in the power-cord plug, which protect the input side of the transformer.

The banana plug receptacles for the output are color-coded—red for positive and black for negative. The banana plugs have similar color-coded bodies as well as the alligator clips at the power delivery end which make it easy to polarize connections correctly. END



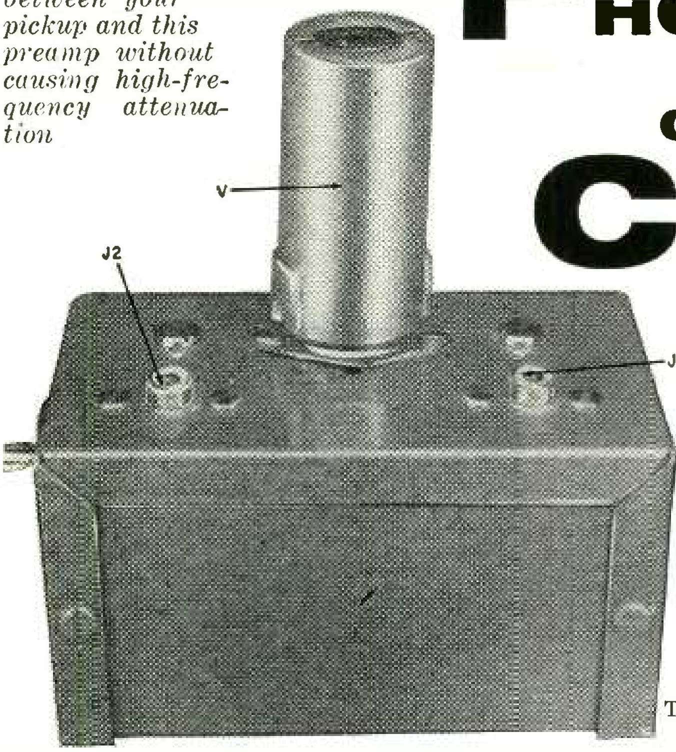
R—10-ohm, 25-watt rheostat (Ohmite 0145 or equivalent)
C1, 2—500 µf, 25 volts
J1, 5—black banana jacks
J2, 3, 4—red banana jacks
RECT 1, 2—see text
S1—spst toggle
S2—spdt toggle
T-117-volt primary, 6.3-volt ct 1.2-amp secondary (Stancor P6134 or equivalent)
Meter—0–1 amp, ammeter (Triplett 66F164 or equivalent) or:
Meter—0–25-volts dc (Triplett 66F155 or equivalent)
Case—9 x 6 x 5 inches
Knob
Fuse, 1 amp
Fused plug, with two 2-amp fuses
Miscellaneous hardware

Circuit of the ac–dc supply.

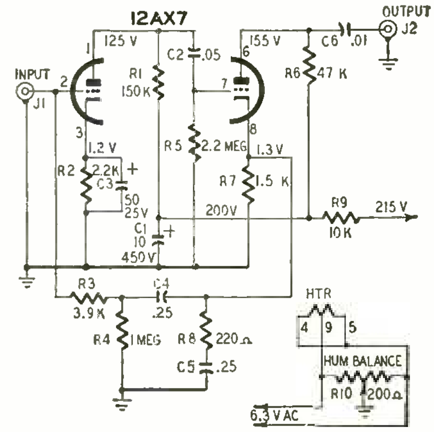
Up to 400 feet of cable can be run between your pickup and this preamp without causing high-frequency attenuation

PHONO-PREAMP COMPENSATES FOR CABLE CAPACITANCE

By G. FRANKLIN MONTGOMERY



The completed preamp.



R1—150,000 ohms	C3—50 µf, 25 volts, electrolytic
R2—2,200 ohms	C4, 5—0.25 µf
R3—3,900 ohms	C6—.01 µf
R4—1 megohm	J1, 2—phono jacks
R5—2.2 megohms	V—12AX7
R6—47,000 ohms	Case, 4 x 2¼ x 2¼ inches
R7—1,500 ohms	Socket, 9-pin miniature, shielded
R8—220 ohms	Shield for 12AX7
R9—10,000 ohms	Miscellaneous hardware
R10—pot, 200 ohms	*All resistors ½ watt*
C1—10 µf, 450 volts, electrolytic	
C2—.05 µf	

Fig. 2—Circuit of one-tube preamp.

THERE are times when you might like to operate a phonograph turntable and pickup at distances of more than a few feet from the nearest electronic equipment. With a high-impedance magnetic pickup, such operation is usually impractical as the pickup's high-frequency output is attenuated by the capacitance of a long connecting cable. The preamp described in this article can be used with over a hundred feet of cable between it and the terminals of a G-E cartridge, without high-frequency loss and without requiring additional equipment.

The reason for phonograph cable loss is apparent from the equivalent circuit of a magnetic pickup (see Fig. 1). The voltage developed by the pickup is represented by E, the inductance of the pickup coil by L and the effective coil resistance by R. If the pickup is terminated in a capacitance C (the cable capacitance, for instance), L and C form a low-pass filter section. With practical values of L and C, the cutoff frequency of this filter can easily fall within the audio-frequency range and the pickup's output will become negligible at frequencies above this point.[1, 2]

One solution to the problem is to provide a cathode-follower amplifier between the pickup and the cable.[2] The drawback of this arrangement is the extra equipment and the need to supply power for it. The unit described here simply replaces the usual phonograph preamp so that no extra equipment is necessary and permits using a long cable. It has been designed particularly for the G-E series of magnetic cartridges RPX-050, 052, etc., although the amplifier's circuit constants can be worked out for use with a number of other high-impedance pickups.

Circuit action

The circuit design is based on the following reasoning. Suppose the con-

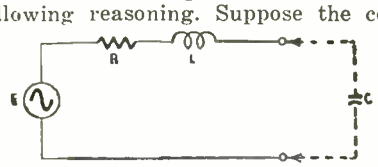


Fig. 1—Equivalent circuit of a magnetic cartridge.

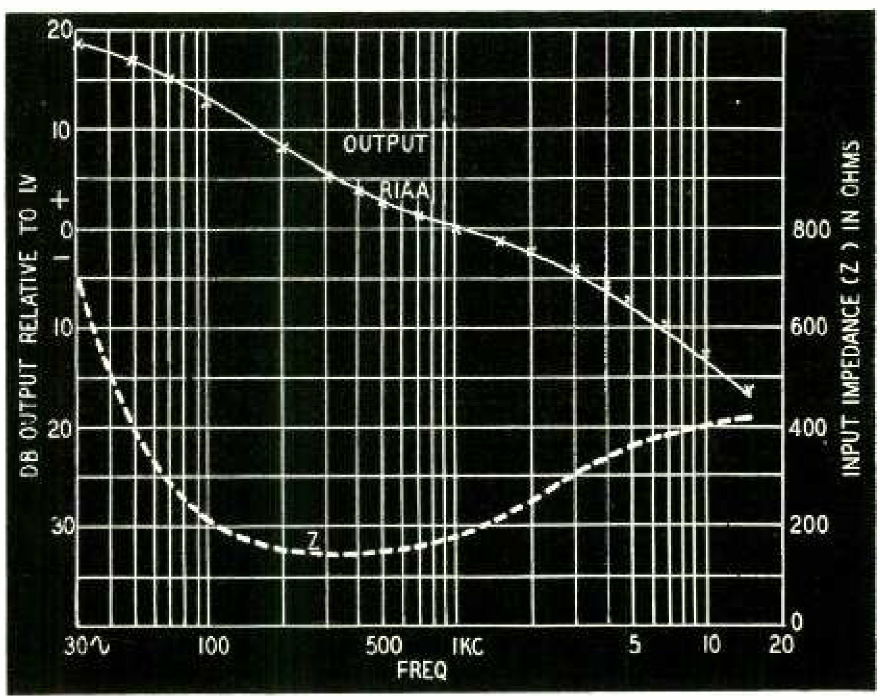


Fig. 3—Solid line: RIAA characteristic, X indicates actual preamp frequency response; dashed line: preamp input impedance.

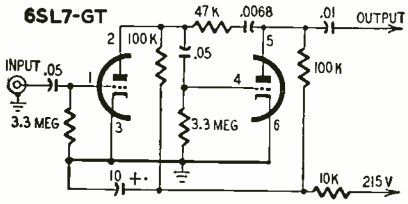
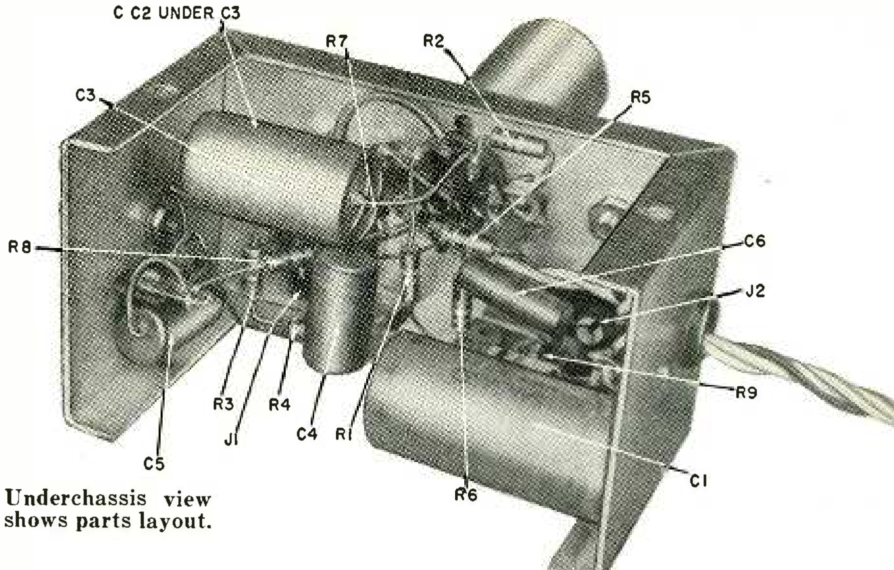


Fig. 4—Standard preamp circuit.



Underchassis view shows parts layout.

necting cable were terminated in a low resistance R_0. If R_0 were equal to the characteristic impedance of the cable, then the pickup would always be terminated in R_0 and its performance would be independent of cable length no matter how long the cable might be. Even if R_0 were made several times the characteristic cable impedance, it would still be possible to use a considerable length of cable before its capacitive reactance became equal to R_0 at the upper limit of the af range.

Terminating the pickup in a low resistance produces high-frequency attenuation by itself, of course, but it is an attenuation that is predictable and controllable. In addition, its slope with frequency is such that with minor modifications it can be used to compensate the pickup response for modern recording characteristics.

A simple resistive termination of this sort is impractical due to the low developed voltage of the usual magnetic pickup. To overcome tube noise and hum in the preamp, the amplifier input must be kept as large as possible and little or no attenuation of the pickup's output can be permitted.

We now recall two facts concerning feedback amplifiers: First, an amplifier's input impedance can be modified by feedback. Second, the application of feedback does not change the signal-to-noise ratio of an amplifier. These facts suggest that a phonograph preamp can be made that will load the cartridge cable with a low impedance and at the same time maintain the signal-to-noise ratio that exists when a short cable and no feedback are used.

Fig. 2 is a circuit for such an amplifier. The two sections of the 12AX7 are connected in cascade. Negative feedback is taken from the cathode of the second section and is applied through the network consisting of C4, C5, R3, R8 and R4 to the amplifier's input. If the network consisted only of R3, the amplifier's input impedance would be a constant resistance throughout the audio range. The purpose of the additional elements is to vary the input impedance with frequency and correct the output of the G-E cartridge in accordance with the RIAA playback characteristic. The RIAA characteristic is plotted in Fig. 3. The crosses on this curve indicate the measured amplifier response, obtained by driving the unit from a signal source of 10 mv in series with a 330-ohm 500-mh impedance, which simulates the G-E cartridge.

Also shown in Fig. 3 is the magnitude of the preamp's input impedance. Note that at the high-frequency limit of the range, the impedance is a resistance of about 400 ohms. If an ordinary preamp were used with the G-E cartridge, a terminating capacitance of 200 $\mu\mu$f would place the cutoff frequency at about 16,000 cycles. With a cable capacitance of 50 $\mu\mu$f per foot, the cable should be no longer than about 4 feet. Using the feedback preamp, a capacitance of .02 μf is permissible for the same cutoff frequency and the cable may be up to 400 feet long.

Reducing input impedance by using negative feedback may seem curious, because we are accustomed to amplifiers in which the input impedance is *raised* by this means. The reduction will be less strange to readers who follow design advances in audio power amplifiers; it is now common practice to modify amplifier output impedance by a combination of positive and negative feedback. The output impedance is reduced by either negative voltage or positive current feedback, and increased by either positive voltage or negative current feedback.

In the preamplifier, the input impedance is similarly affected. The voltage fed back to the input is negative with respect to the source voltage, but it is applied in *shunt* with the source, thereby increasing the source loading, which is the same as reducing the amplifier input impedance. Had the feedback voltage been applied in *series* with the source, the source loading would have been reduced and the effective input impedance increased.

Low distortion level

The negative feedback used in the preamp helps reduce amplifier distortion. The circuit shown in Fig. 4, which corresponds to one used in many installations, was set up with a 1,000-cycle source in series with 3,300 ohms. With an amplifier output of 1 volt, the total harmonic distortion was 0.5%. The same test on the feedback preamp gave 0.1% distortion. Since the audio generator used in the measurements had inherent distortion of the same order, the actual preamp distortion may be less than 0.1%.

Total hum and noise in the preamp's output is over 60 db below 1 volt. This hum level was obtained only with *selected* 12AX7 tubes and with the usual arrangement of a hum-balancing potentiometer connected across the heater supply, as shown in Fig. 2.

The feedback network C4, C5, R3, R8 and R4 has been determined only for the G-E series of cartridges. Other pickups, having different values of resistance and inductance, will require a different set of feedback circuit constants. The easiest way to determine these is by experiment. The procedure is to connect a low-impedance audio signal source (10 ohms or less) of rated pickup output voltage in series with the cartridge and amplifier input. An ac vtvm is connected to the amplifier's output. Curves of output voltage vs. frequency are then run for different feedback circuit values until the set is found that matches the RIAA characteristic or whatever characteristic is desired. Alternatively, a dummy network may be used in series with the generator instead of the pickup itself. The resistance and inductance of the dummy should duplicate the actual pickup constants. The accompanying table lists these constants for most high-impedance cartridges.

TABLE OF PHONOGRAPH CARTRIDGE CHARACTERISTICS

Manufacturer and type	R (ohms)	L (mh)	E (rated mv)
Audax HiQ7	575	700	20
Clarkstan 204	1,300	350	30
G-E RPX-050, 052, etc.	340	520	10
Pickering 120, 140	600	165	30
Pickering 260	750	130	30
Recoton-Goldring 500	1,500	550	30

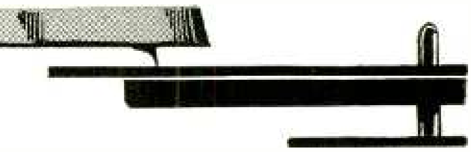
This preamp—with only slight modifications—was used in the "Bookshelf Audio Amplifier" (RADIO-ELECTRONICS, April, 1957, page 32) and has turned in an excellent job. END

References

[1] Norman Pickering, "Effect of Load Impedance on Magnetic Pickup Response," *Audio Engineering*, March, 1953.
[2] W. A. Fitzmaurice and W. Joseph, "Pickup Loading and its Effect on Frequency Response," *Audio*, July, 1954.

HI-FI PICKUP ARMS

Part I—Types of arms; separated vertical and horizontal pivots; Fairchild 280A/281A; Audax KT-12/KT-16; Pickering 190D; Shure Studio Dynetic and General Electric A1-500/A1-501



By JULIAN D. HIRSCH

THE vital role of the pickup arm in audio reproduction is not as widely understood as it should be. The arm bears the same relationship to the cartridge as the speaker enclosure does to the speaker it houses. Most, if not all, of the extreme low-frequency reproduction of a phono system is dependent on the properties of the arm. Because its contributions are largely confined to frequencies below 40 cycles, they are not as audibly striking as those of a speaker enclosure which may influence the response for several octaves higher.

Apart from frequency-response considerations, pickup arms have a considerable effect on playback distortion. A poor arm may introduce large amounts of distortion or may even cause the pickup to fail to stay in the groove. Operating convenience must also be considered since, unlike the speaker enclosure, a phono arm is handled frequently and contains a rather delicate mechanism—the phono cartridge. An arm which is awkward to handle or is easily dropped may prove unsatisfactory even though its acoustical design be excellent.

A surprisingly large number of phono arms are offered for home use. In this series of articles I will describe most of the approximately 20 high-quality types, pointing out their unique features and essential design principles.

The arms may be classified according to several of their design characteristics. For example, some arms do not employ damping means, while others use various forms of viscous damping to eliminate or minimize the major resonance. From the standpoint of the user, perhaps the most obvious difference between various makes is the manner of pivoting the arm in the vertical and horizontal planes. (We will consider the vertical pivot as that which allows the arm to move vertically, although the pivot axis is horizontal. Similarly, the horizontal pivot is the one that allows the arm to traverse the record.)

In some designs, both pivots are located essentially at the same point, usually near the rear of the arm. In handling this type, the entire arm swings upward when it is lifted to or from the record. Other arms have the vertical pivot located well forward of the horizontal pivot. A large portion of the arm does not move vertically when the cartridge is lifted from the record. This type of construction allows a fairly large counterweight to be used. This gives the arm considerable lateral mass and a low resonant frequency, while the vertical mass is kept low for reduced record wear. A third type is actually the ultimate refinement of the second, in which the vertical pivot is at the front of the arm, immediately behind the cartridge. Such arms have little or no up and down movement in handling, and require the user to develop a special technique if he is accustomed to the more conventional designs.

Several unconventional arms have been designed to reduce or eliminate entirely the tracking error which is the inevitable result of playing a record made with a cutter which travels on a radius with an arm that rotates on a single pivot point outside the record diameter.

Other distinctions between arms include the degree of lateral balance, various types of leveling and height adjusting mechanisms, use of springs or counterweights for stylus-force adjustment and others too minor to consider. Obviously, to categorize the large number of arms for comparison purposes, it is necessary to make certain arbitrary decisions as to the basic design differences. Since the relative location of vertical and horizontal pivots directly affects the feel of the arm more than any other factor (except the presence of viscous damping, which is used on only a few types), we will use this as our basis for grouping the arms.

Separated pivots

The first two arms in this category are the Fairchild 280A/281A and the Audax KT-12/KT-16. Each has its vertical pivot located several inches forward of the horizontal one. Apart from this, they have little in common in the way of appearance or handling feel.

The Fairchild 280A (Fig. 1) and 281A are of similar design, and are intended for playing 12- and 16-inch records, respectively. They are laterally balanced by the counterweight at their rear. Because of this, leveling is not critical and they are relatively insensitive to the effects of jarring. The vertical pivots are located about 40% of the way from the rear of the arm to its front.

The arm is constructed of extruded aluminum, of about 1-inch-square cross-section. This provides rigidity and minimizes torsional resonances which can occur in an arm. The weight of the forward portion of the arm and the

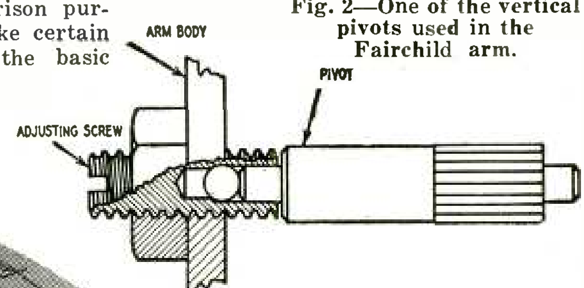


Fig. 2—One of the vertical pivots used in the Fairchild arm.

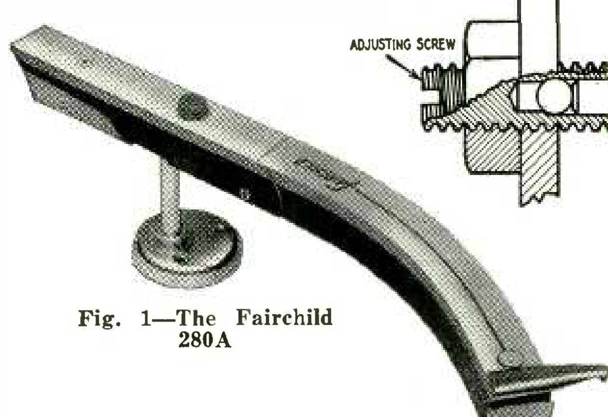


Fig. 1—The Fairchild 280A

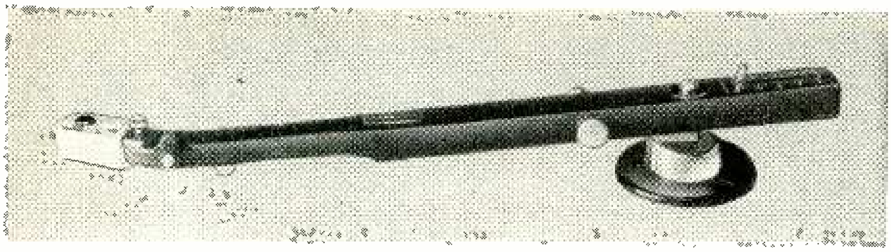
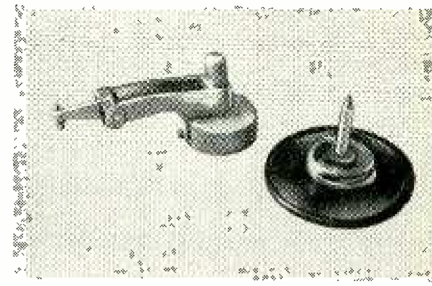


Fig. 3 (Left)—Audax KT-16, sold in kits or fully assembled.

Fig. 4 (Below) — Closeup of Audax pivot assembly.



cartridge is counterbalanced by a long spring which is adjusted with a thumbscrew under the arm.

The pivot bearings are simple yet effective. Fig. 2 shows their construction. They are individually adjusted at the factory for optimum performance. The base of the Fairchild arm is fastened to the motor board by three screws and rests on rubber grommets. The screws may be tightened against these grommets to level the arm relative to the motor board. A single screw may be loosened to permit vertical adjustment of arm height to accommodate any turntable. Another adjusting screw enables the arm to be set so the stylus cannot strike the turntable if no record is on it.

Two unique features of the Fairchild arms are the absence of an arm rest and the plug-in drawers (or heads) for cartridges. A detent built into the base holds the arm in rest position without the need of mounting the usual separate arm rest on the motor board. The cartridge is mounted in a separate metal drawer which slides into the open front of the arm. It will accommodate practically any cartridge which mounts on standard ½-inch centers.

In the arm are a pair of springs which make solderless connections to the cartridge pins, for a wide range of lengths and spacings of these pins. When the drawer is removed, the springs short-circuit, preventing loud hum or noise when changing cartridges (and also safeguarding the speaker cone).

Audax KT-12/KT-16

The basic Audax arm has been on the hi-fi scene for many years and has enjoyed an excellent reputation. In the past, its usefulness has been limited by the fact that it would accept only Audax cartridges. But the new KT series has a removable shell which accommodates any standard magnetic cartridge as well. Fig. 3 shows the Audax KT-16 arm.

Perhaps the most novel feature of these arms is that they are sold in kit form at a saving of nearly 50% over their assembled prices. The arms can be assembled in less than 15 minutes, using only a screwdriver.

Unlike the Fairchild arm, the entire body of the Audax arm moves in the vertical plane. Only a small angular movement is possible vertically since the vertical pivots are 2 inches forward of the horizontal pivots and the rear of the arm strikes the base assembly when the arm is raised more than a few degrees.

The arm is made of light aluminum with a U-shaped cross-section. A heavy brass counterweight in the rear is adjusted by loosening a knurled screw, permitting a wide range of stylus-force adjustment with any cartridge. The vertical pivots are simply screws with conical ends which are threaded through the sides of the arm and fit into small dimples in the pivot casting. The adjustment for low friction and low play is easily made, after which protective caps lock the pivot screws.

The horizontal pivot, described by Audax as "compass-point pivoting," can be seen in Fig. 4. The entire arm mass is supported on a needlepoint, which provides low friction and has no adjustments or wearing parts. The slot, which covers a 90° arc in the base, is engaged by a screw in the pivot casting and prevents the arm from being rotated more than 90°. This is to keep the pickup from being placed on the wrong side of the record, which could damage the record grooves. The screw visible at the front of the pivot casting provides a stop to prevent the stylus from striking the turntable in the absence of a record.

The outstanding feature of the Audax design is its simplicity, since it has a minimum number of moving or adjustable parts. One minor disadvantage of this emphasis on simplicity is the need for shims to adjust arm height. Cardboard shims are supplied with the arm and are placed under the base as needed to fit the turntable height.

Pickering 190D

For many years Pickering 190-series arms have held a unique place in the field. The entire arm is constrained in the vertical plane, and only the cartridge pivots vertically. Fig. 5 is a phantom view of the Pickering arm. The arm body has a rectangular cross section and is extremely rigid. It is counterweighted and is balanced about the horizontal pivots. Leveling the arm is completely noncritical, as it will track records with the motor board inclined 45° or more to the horizontal.

The arm's height is adjusted by loosening a single screw and sliding the entire arm up or down on the upright rotating spindle which forms the horizontal pivot. This spindle contains two precision ball-bearing assemblies and has extremely low friction. The base mounts with a single screw passing through the motor board, and three adjusting screws permit the arm to be set parallel to the turntable surface. This is an important adjustment since the arm cannot move in the vertical plane.

At the extreme forward end of the arm is a small pivoted plate on which the cartridge is mounted. Needle bearings are used for the vertical pivots. A long stretched spring counterbalances the weight of the cartridge and its mounting plate, and a knurled wheel underneath the arm permits the stylus force to be adjusted conveniently.

Although the body of the Pickering 190D arm is straight, the necessary

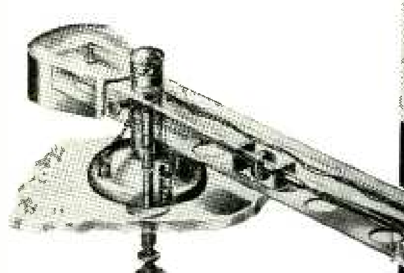


Fig. 5 (Above) — Phantom view of Pickering 190D.

Fig. 6 (Right) — The Pickering arm in use. Notice the magnetic arm rest.

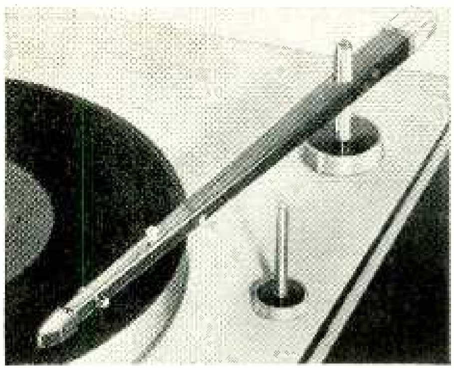


Fig. 7—Shure Studio Dynetic also has a magnetic rest.

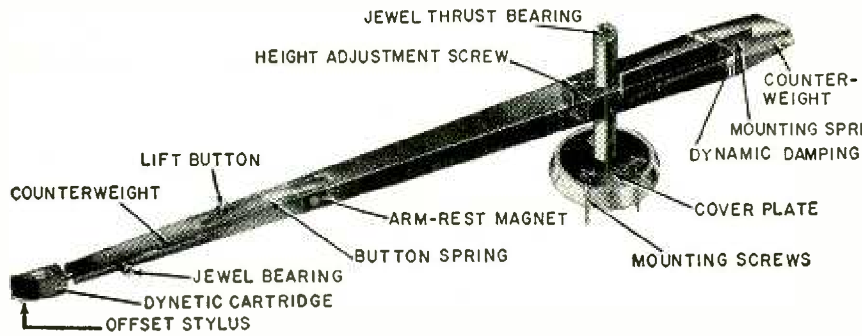


Fig. 8—Phantom look at the Shure arm.

offset angle is provided by the orientation of the cartridge mounting. The arm is supplied with a mounting clip for the Pickering 350 Fluxvalve cartridge, but this can be removed and any cartridges having standard ½-inch centers can be mounted. The finger lift at the end of the arm merely lifts the stylus clear of the groove, and the arm is swung to the desired position without any vertical motion. This requires a somewhat different technique than any other arm does.

This design has the advantage that the cartridge is protected and cannot strike the center spindle of the turntable. The design of the finger lift also prevents the stylus from striking the turntable in the absence of a record, if properly adjusted.

The salient feature of the Pickering design is the reduction of vertical mass to a practical minimum, using conventional cartridges. Not only is the cartridge mounting plate as small and light as possible, but a spring counterbalance is used instead of a counterweight which would add to the vertical mass. The heavy counterweight at the end of the arm serves the dual function of balancing the arm laterally and providing a high lateral mass, resulting in an arm resonance well below the audio range.

Another novel feature of the Pickering 190D is the magnetic arm rest (Fig. 6). The arm is shown installed on a motor board and the magnet can be seen on the side of the arm. The arm rest (not shown) is an upright piece of steel to which the arm is held by the magnet.

The Pickering 190D is available only in a 16-inch model, but the stubby counterweight gives little overhang and it can frequently be installed in locations too cramped for other 16-inch arms.

Shure Studio Dynetic

The basic philosophy behind the design of the Shure Studio Dynetic arm is similar to that of the Pickering 190D, although there does not appear to be any physical resemblance between them.

Fig. 7 shows the Shure arm in playing position. It comes in 12- and 16-inch models. Notice the magnetic arm rest. Fig. 8 is a phantom view of the Shure pickup. The vertical pivot is located just behind the cartridge. Ruby jeweled bearings are used in both vertical and horizontal pivots. The arm is a slim streamlined device and can be adjusted vertically for turntable height by loosening a screw and sliding it up or down on the horizontal pivot spindle.

The cartridge mass is counterbalanced by a threaded weight, which is moved back and forth for stylus-force adjustment. The special Shure cartridge, an integral part of this arm[1], has a very low mass so the total vertical mass is still quite small. The arm itself is straight, with the offset angle built into the stylus assembly of the cartridge.

Like the Pickering 190D, the Shure arm does not move in the vertical plane. A unique system lifts the stylus from the record. A small plastic button on the top of the arm is pressed *down* to lift the cartridge and released to lower it to the record. Since the cartridge itself is never handled by the user, and the maximum downward force it can exert is only 2 grams, it is impossible to damage the record or stylus by accidentally knocking the arm across the record.

The Shure design incorporates a new and novel damping system, termed "dynamic damping." The weight at the rear of the arm balances it about the horizontal pivot's axis. It is connected to the body of the arm by a springlike suspension bar. The space between the weight and arm is filled with a plastic material. The physical and mechanical constants of the system are chosen so that at the arm's resonant frequency the plastic provides mechanical resistance which effectively damps the resonant peak. At other frequencies, the mechanical resistance has no effect so there is no possibility of a viscous drag which might introduce undesirable lateral or vertical forces when playing eccentric or warped records.

[1] J. D. Hirsch, "Modern Phono Cartridges," Part IV, RADIO-ELECTRONICS, July, 1957.

G-E A1-500/A1-501

Like the preceding two, General Electric arms (see Fig. 9) have a wide separation between vertical and horizontal pivots, with most of the arm constrained in the vertical plane.

The main body is a rigid tube, mounted on a very-low-friction, horizontal pivot spindle. Its height is adjusted by sliding the arm up or down the spindle. The cartridge shell is removable for easy cartridge installation, though it is not a plug-in shell. The entire shell is offset for correct tracking.

The cartridge is counterbalanced by a sliding weight on a boom extending to the rear of the shell. This boom has a gram scale which reads the stylus force directly when using G-E cartridges or others of equal weight.

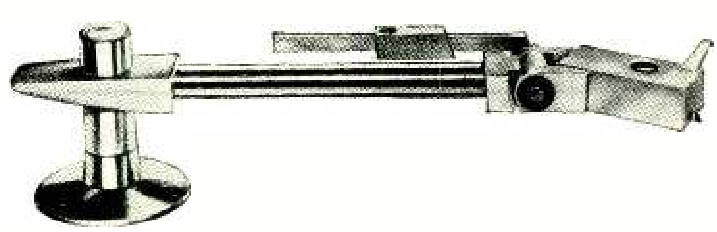
The cartridge shell may be tilted upward 90° to inspect, clean, or replace the stylus.

There is almost no overhang to the rear of the horizontal pivot, so the arm can be installed in limited space, especially in its 12-inch version (A1-500). However, it is not laterally balanced and must be carefully leveled for proper operation.

The next article in this series will describe the large group of arms with vertical and horizontal pivots located close to each other. TO BE CONTINUED

The Rek-O-Kut A-120/A-160, Pickering 194D, Leak Dynamic and Weathers pickup arms will be described in the next installment.

Fig. 9—A tubular arm is used in the G-E A1-500.



Multi-Channel electronic crossovers

Two 3-channel units that can be used to provide any crossover frequencies between 100 and 10,000 cycles

By NORMAN H. CROWHURST

AN increasing number of readers have been writing me to ask about electronic channel separators. Circuits they have tried suffer from excessive noise, hum or distortion. Then, too, some want to adjust the crossover frequencies in different ways. To overcome all these problems I have developed a couple of universal channel-filter circuits, along with a design chart that indicates component values for any desired crossover frequencies.

The two circuits have been carefully designed so the amplification level does not run up into distortion or down into the noise region. Sometimes these problems occur because the channel separator provides extra gain and proper attenuation is not inserted at the right place. The circuits presented here have zero insertion loss—the input and output levels are the same. Also, considerable feedback minimizes distortion.

Both circuits can readily be added to existing equipment, an essential feature for our purpose, because the single tube for each channel filter requires less than 1 ma at 250 volts for its plate-screen supply. If existing equipment does not have reserve heater supply (6.3 volts at 300 ma for each channel), it can be obtained cheaply from an additional filament transformer.

Both circuits use a single 6AU6 for each channel. The difference between them is that the simpler circuit gives a 12-db-per-octave transition rate, while the more complicated one steps up the transition to an ultimate slope of 24 db per octave. As previous articles have pointed out, the shallower transition is usually recommended. But some readers have asked, "How can I make the transition more sudden," so a circuit is included that gives the full 24 db per octave. However, circuit values are much more critical if the correct response is to be obtained. Various values around the circuit may have to be adjusted to get a smooth response, turning over at the correct frequency.

Simpler 12-db circuit

In the simpler circuit (Fig. 1), the effective dynamic range of the 6AU6

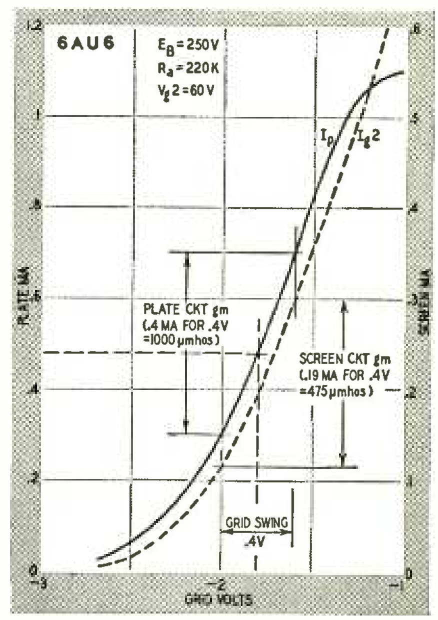
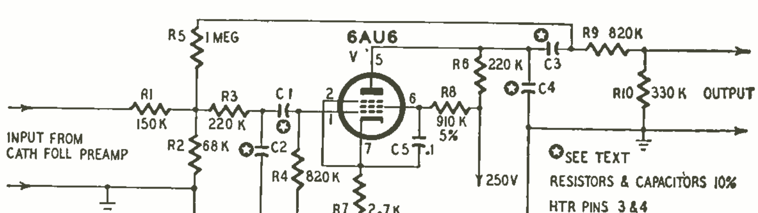


Fig. 2—Plate- and screen-current characteristics of the 6AU6, showing how values are chosen to give minimum distortion in the circuit of Fig. 1.



R1—150,000 ohms
R2—68,000 ohms
R3, 6—220,000 ohms
R4, 9—820,000 ohms
R5—1 megohm
R7—2,700 ohms
R8—910,000 ohms, 5%
R10—330,000 ohms
All resistors ½ watt, 10% unless noted
C1, 2, 3, 4—See text
C5—0.1 μf
All capacitors, ceramic, molded or high-quality paper; 10% tolerance
V—6AU6

Fig. 1—Basic circuit of bandpass channel filter giving 12-db-per-octave rolloffs.

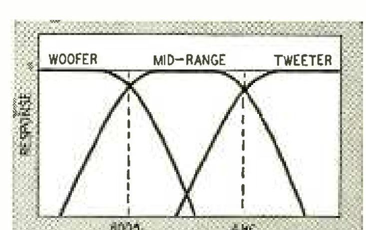
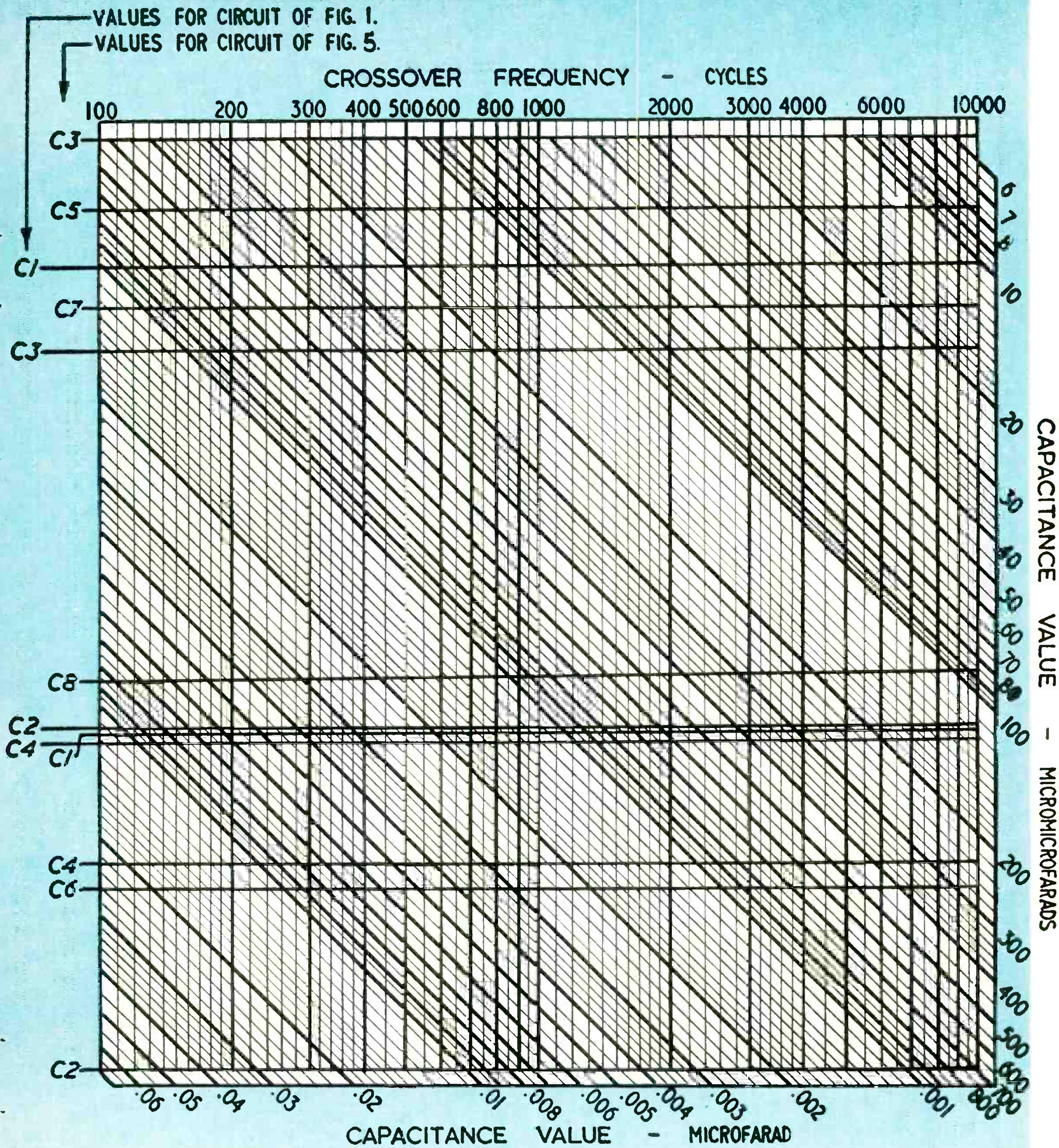
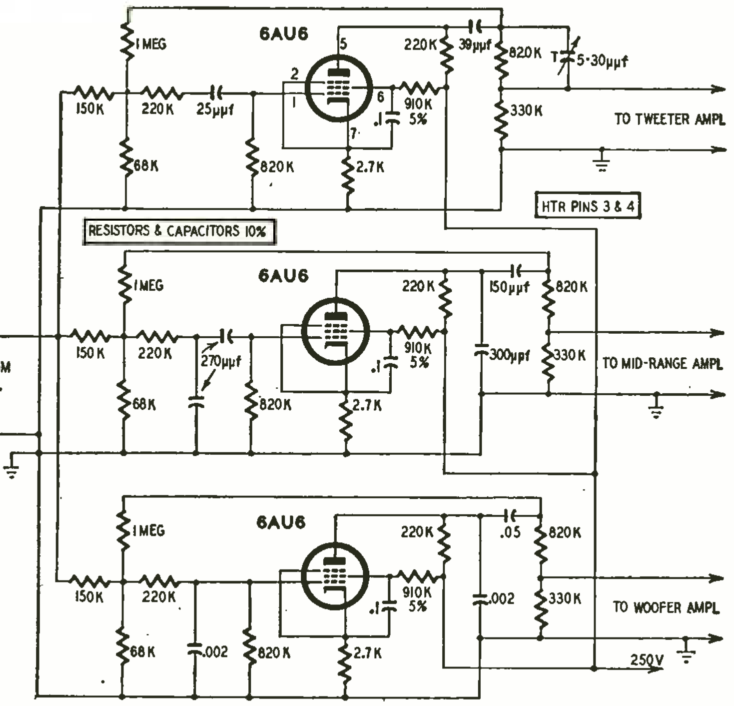


Fig. 3—The frequency distribution used for the sample calculations in the text.



CAPACITOR RATINGS FOR ELECTRONIC CROSSOVER CIRCUITS



NOTE: When purchasing parts for this circuit, use parts list for Fig. 1 and multiply the number of individual components by the number of channels in the system. Some capacitors are omitted in the tweeter and woofer channels. See text.

Fig. 4—Complete circuit of 3-way separator with 12-db-per-octave rolloffs.

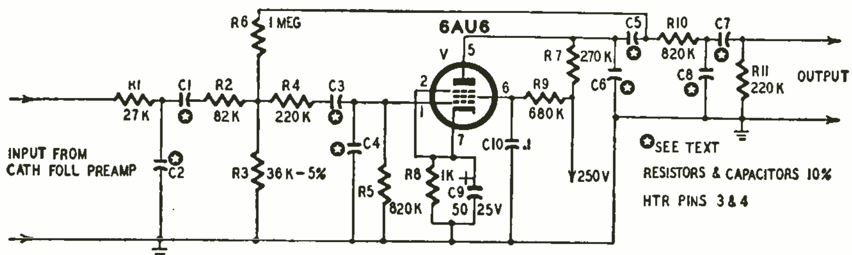
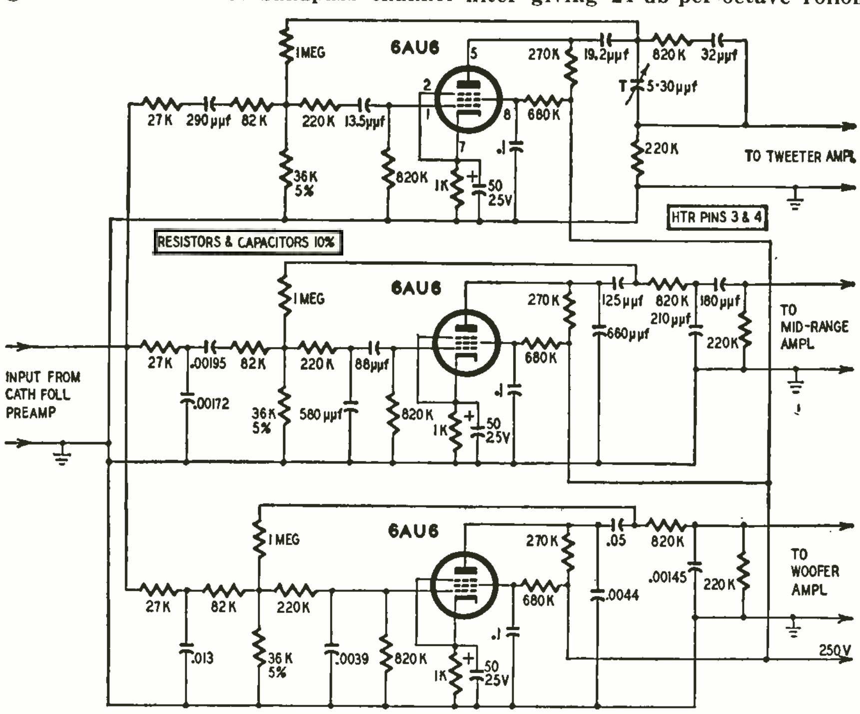


Fig. 5—Basic circuit of bandpass channel filter giving 24-db-per-octave rolloffs.



NOTE: When purchasing parts for this circuit, use parts list for Fig. 5 and multiply the number of individual components by the number of channels in the system. Some capacitors are omitted in the tweeter and woofer channels. See text.

Fig. 6—Complete circuit for 3-way separator with 24-db-per-octave rolloffs.

is increased by using about 14 db of degenerative feedback through the 2,700-ohm bias resistor in the cathode circuit. Values of plate and screen feed resistors are such that the operating condition works the tube around the point where the curvature of plate and screen current is very similar (Fig. 2). This is important because the cathode resistor linearizes the total signal current. If the curvatures of plate and screen current differ, the feedback may well produce more distortion rather than less.

The cathode feedback gain reduction is not frequency-discriminating and leaves a highly linear amplifier with a gain of 30. The 1-megohm resistor from output to input reduces the gain, this time including the rolloff components, by a further 6 db, leaving the tube with a working gain of 15. The 220,000- and 820,000-ohm resistors in the grid circuit reduce this to 12. Finally, input and output resistor networks dissipate the rest of the gain, so the output voltage is approximately equal to that of the input.

The 6-db controlling feedback is dependent on the circuit being fed from

Parts List for Fig. 5.

R1—27,000 ohms
R2—82,000 ohms
R3—36,000 ohms, 5%
R4, 11—220,000 ohms
R5, 10—820,000 ohms
R6—1 megohm
R7—270,000 ohms
R8—1,000 ohms
R9—680,000 ohms
All resistors ½ watt, 10% unless noted
C1-8—See text
C9—50 μf, 25 volts, electrolytic
C10—0.1 μf
All capacitors are ceramic, molded or high-quality paper, 10% tolerance unless noted
V—6AU6

a cathode follower with a source resistance of not more than about 5,000 ohms. If the filters are fed from the plate circuit of a preamplifier tube, subtract the tube's plate resistance from 150,000 ohms for the input feed resistor R1.

The capacitors responsible for low-frequency rolloff are C1 and C3, while those for high-frequency rolloff are C2 and C4. For a section to feed a mid-range speaker all these capacitors will be needed. For the woofer unit C1 is not needed, and C3 can be a convenient value, .05 μf. Capacitors C2 and C4 are selected (using the chart) according to the crossover frequency desired from woofer to mid-range unit.

For the mid-range, C1 and C3 are determined for the crossover frequency between woofer and mid-range, while C2 and C4 are determined for the crossover from mid-range to tweeter. For the feed to the amplifier supplying the tweeter C2 and C4 are omitted and the chart supplies values for C1 and C3 to get the right low-frequency rolloff to match the mid-range unit according to crossover frequency.

For example, assume the desired crossover frequencies are 600 and 4,000 cycles (Fig. 3). For the woofer unit, C2 is .00185 μf and C4 .002 μf. This circuit is not highly critical and if one capacitor is a little higher and one a

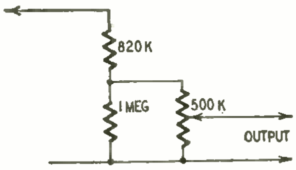


Fig. 7—How to combine the amplifier's gain control with outputs of Fig. 4 to provide a balance adjustment.

little lower than the indicated value the result will come out about right. Both capacitors could be .002 nominal, and response would probably come pretty close to the desired performance.

For the mid-range unit, C1 is 170 μμf and C3 is 260 μμf. These are calculated using the 600-cycle design frequency. One at 150 and one at 270 or 300 μμf will probably be close enough. Alternatively, both at 220 would also come pretty close. Capacitors C2 and C4 are calculated with the 4,000-cycle design frequency and come out to 280 and 300 μμf, respectively. Capacitors of 270 and 300 μμf will do nicely.

For the tweeter unit C1 and C3 are 26 and 40 μμf, respectively. Thus, we have all the values to build up a three-way filter which can conveniently be fed from a preamp's cathode-follower output. The complete three-channel circuit is shown in Fig. 4.

24-db-per-octave roll-off

The more complicated 24-db circuit (see Fig. 5) uses 18 db of feedback from plate to grid and consequently does not need the cathode degenerative feedback employed with the simpler circuit. Now, the circuit has to be arranged to get the maximum possible gain out of the 6AU6, if we are to adjust circuit values to get a reasonable degree of independence in action.

The working gain of the tube, with the values shown, is 250. The output provides a voltage stepdown of 5 to 1. Feedback reduces the working gain by an effective 8 to 1. The grid circuit drops it by 5 to 4 and the input attenuation arrangement gets rid of the rest.

Correct response is dependent on feeding from a cathode follower. It would be difficult to allow the kind of latitude needed for plate-coupled circuits, with a 24-db-per-octave type. Outside the passband the rate of rolloff approaches 24 db per octave at each end.

As before, for the woofer unit, the odd-numbered capacitors can be omitted where they are not required for dc blocking purposes—only C5 is required, which can be some convenient value, like .05 μf. The capacitors with even numbers are selected (use the chart) using the low-frequency crossover point.

With the same example of 600 cycles, the values required for the feed unit to the woofer amplifier are: C2, .0115 μf; C4 .0039 μf; C6, .0044 μf, and C8 .00145 μf.

For the mid-range feed, using the same frequency at 600 cycles to select the capacitors with odd numbers, we get: C1, .00195 μf; C3, 88 μμf; C5, 125 μμf, and C7, 210 μμf. For the even-number capacitors in the mid-range feed the 4,000-cycle frequency is used, giving the following values: C2, .00172 μf; C4, 580 μμf; C6, 660 μμf, and C8, 210 μμf.

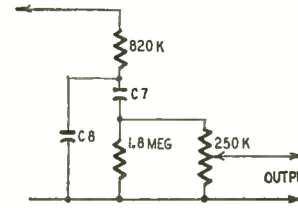


Fig. 8—How to combine the amplifier's gain control with outputs of Fig. 6 to provide a balance adjustment.

For the tweeter unit, the odd-numbered capacitors are again calculated with 4,000 cycles: C1, 290 μμf; C3, 13.5 μμf; C5, 19.2 μμf, and C7, 32 μμf. For the tweeter unit, C2, C4, C6 and C8 are omitted. The complete three-channel circuit is shown in Fig. 6.

If the power amplifier's input capacitance in conjunction with the output resistances of these circuits produces a high-frequency loss on the tweeter unit (above 10,000 cycles), compensation must be provided. Use a small trimmer, about 5 to 30 μμf, across the upper resistor of the output voltage divider. As shown at Figs. 4 and 6, that can be used to adjust the frequency response obtained in the tweeter unit.

Most feedback amplifiers have their gain control right in the input circuit. This will shunt the output of the filters, altering both gain and response. Using a 500,000-ohm input potentiometer in the circuit of Fig. 1 and a 250,000-ohm input potentiometer for the circuit of Fig. 5, the output circuits will be as in Figs. 7 and 8. END

NEXT MONTH

Servicing Transistor Auto Radios

Veteran service technician *Jack Darr* tells of some of the things the service tech will run into in the newer sets, and some of the differences between them and their older tube counterparts.

New Amplifier Uses KT88's

Dave Hafler, one of the originators of the Ultra-Linear circuit, tells how certain features of the new tubes are used to advantage in a 60-watt 20–20,000-cycle amplifier.

All-transistor Direct-reading AF Meter

The man who services high-quality audio equipment will find this a valuable instrument, as will the advanced hi-fi enthusiast.

Tube Data and Amplifier Design

Part II—Tube data for R-C-coupled triode circuits and swing to drive output tubes

By HERBERT RAVENSWOOD

LAST month we discussed the use of information presented in tube manuals for designing R-C-coupled pentode amplifiers. This month we shall cover triode circuits.

Let's use a 12AY7, a very good input stage for audio work. The RCA manual does not list this one. The Sylvania does; in fact it gives a table for it. But let's assume for the purpose of this article that we don't have the Sylvania book. It often happens that the tube we want is not in the book we have. But in one of those comprehensive tube data manuals that list every tube made, we find the following (ratings may differ in different manuals:

Type	Heater volts	Heater amps	Plate volts	Plate ma	Negative grid volts	Plate resistance	Trans-conductance μmhos	Ampl factor
12AY7	6.3	0.3	150	2.0	2.5	26,500	1550	40
	12.6	0.15	250	3.0	4.0	23,500	1700	40

For a low-level input stage, we shall probably decouple so that the plate supply point is about 150 volts. With a plate resistance of 26,500 ohms, the coupling resistor should be at least three times this and, allowing for the increase of plate resistance at lower currents, 100,000 ohms would seem a good value. Assuming that the biggest part of the supply voltage will drop across this, we should have about 1 ma of plate current, with a plate voltage in the region of 50. For 150 volts on the plate, a 2.5-volt bias gives a plate current of 2 ma. Reducing everything to one-third, 50 volts on the plate should give a plate current of 0.67 ma with a negative grid voltage of 1.67. So 1 milliamp would require rather lower grid voltage, say 1.5. This means the cathode resistor should be 1,500 ohms. For this kind of stage the following grid resistor could well be 470,000 ohms.

We will estimate the gain on this basis. As ratings are proportional to those listed we can assume that the amplification factor will still be about 40. But due to the drop in plate current, plate resistance will be higher. On the previous basis, as the current is halved, we would expect the g_m to be divided by about 1.6. The square of 1.6 is 2.56, and 2 is an approximate mean between 1.6 and 2.56. So the ac resistance will be multiplied by 1.6, to keep the same amplification factor, giving a value of $26.5 \times 1.6 = 42{,}500$. The 100,000-ohm plate resistor is parallel, ac-wise, with the 470,000-ohm grid resistor following, giving a plate load of about 82,000 ohms. So the stage gain is likely to approximate

$$40 \times \frac{82}{42.5 + 82} = 26.$$

Taking a peep at the Sylvania table, we find values for a plate supply of 150 and of 250 volts. By averaging the gain figures and bias values, it would seem that we may be a little conservative on the gain, and the bias and operating condition we hit about right. Using the tube characteristic as a check—which we have to get from the Tung-Sol book (Fig. 1)—we will get a gain of 27 with these values (cathode properly bypassed) and the plate current will be 0.82 ma, the bias 1.23 volts and the plate voltage 68. On the whole as good a guess as can be expected from the information we used!

To complete the stage design, we want suitable coupling capacitors. With a following grid resistor of 470,000 ohms, the reactance of the coupling capacitor must be less than 470,000 ohms down to 20 cycles. A .02-μf capacitor satisfies this with 400,000 ohms, or a .05-μf capacitor will give a better margin, with 160,000 ohms.

For the cathode bypass, we first calculate the gain without it. With a 1,500-ohm cathode resistor and a gain of 26 (taking our own figure) into 82,000 ohms, the gain from *grid to cathode* will be $26 \times \frac{1.5}{82} = 0.475$. This means that we need 1.475 volts in to get 1 volt from grid to cathode, without the bypass. This represents a gain reduction of almost exactly 3 db due to the 1,500-ohm cathode resistor. This means there will be a loss of 1.5 db when the reactance of the bypass capacitor is 1,500 ohms. A value of 5.5 μf gives a reactance of 1,500 ohms at 20 cycles. So anything above 10 μf should be OK.

The circuit for a two-stage amplifier developing a gain of 675 to 730 (according to whether you take the guess figure of 26 or the one from the tube characteristic, 27), is shown in Fig. 2.

Other design problems

Another job in R-C-coupled amplifier design that often sets problems is providing sufficient swing to drive the output tubes. The more straightforward circuits require only a relatively small swing but some need a very large one —for example, the cathode-follower output stage. None of the tabulated data gives a large enough swing for this purpose. How can we get more?

Increasing the B-supply voltage enables a stage to provide a larger output: the highest working voltage listed in the RCA manual is 300, and in some other manuals it is only 250, but supplies for output stages deliver as much as 450. Here's an example.

Looking through the RCA manual, the best triode tube for providing a large output swing is the 6SN7 group. If need be, we can work two in push-pull, which will help by cancelling the second harmonic which is bound to predominate in any tube operating at this large swing. Suppose we are limited on the output tube grid resistors to 500,000 ohms. The table lists two combinations at 300 volts using a 470,000-ohm grid resistor R_g: one with R_p of 100,000 ohms, giving a maximum E_o of 96, and the other with R_p of 220,000 ohms, giving an E_o of 85. Obviously the latter arrangement fails to improve the output because the high resistance values are starving the tube of current and working it too far round the bend.

Fig. 3 shows the tube characteristics for one half of a 6SN7-GT, with load lines drawn for 100,000- and 470,000-ohm conditions. First the 100,000-ohm line is drawn by aligning 300 volts with 3 ma, and the operating point found from the cathode resistor given in the manual, 3,900 ohms. The operating point is 1.55 ma, −6 volts bias, from which the plate voltage is seen to be about 137. Now draw a load line through this point to represent the ac resistance of 100,000 ohms in parallel with 470,000 or 82,000 ohms. This can be done by aligning 5 ma and 410 volts with a straightedge and then drawing a parallel line through the found operating point.

We now have the limits of voltage excursion for a 6-volt grid swing each way from the −6-volt bias point: 33 and 225. This is a peak-to-peak swing of 192 volts, or a peak output of 96 volts, which agrees with the manual. Next we can see how much second harmonic we have.

The midpoint between 33 and 225 is 129 volts. But the operating position is

137 volts. So the swing is 8 volts off center in a peak-to-peak of 192. This represents a second harmonic of just over 4% (8/192).

Now let's see what we can do with 450 volts of B plus: Drawing the 100,000-ohm line by aligning 450 volts with 4.5 ma, we select an operating point at about 200 volts. This would represent a bias of about 8.8 volts, so the total swing would go almost to −18 volts, which looks as if it is getting well into the curvature. Dropping a little, to 8.5 volts bias, the plate current is 2.5 ma so the bias resistor calculates to the convenient value of 3,300 ohms. Now we draw the 82,000-ohm load line through this point and note the voltages corresponding with 0 and −17 volts on the grid: 48 and 323. A peak-to-peak swing of 275, or $E_o = 137.5$.

To estimate distortion, the midpoint between 48 and 323 is 185.5, while the operating point is 196. This is a difference of 10.5 volts in a peak-to-peak of 275, representing about 3.8% second harmonic, which is a little lower than the previous figure. We could use a little more bias and get a little more swing. Say we use 3,600 ohms, giving 9 volts bias with 2.5 ma. The relevant voltages will then be 48, 202 and 380, which works out to an E_o of 166 volts with still less than 4% distortion.

The chart in Fig. 3 comes from the Tung-Sol manual. If you have been following along in another book, you may not read exactly the same voltages. These curves differ slightly from one source to another.

But even allowing for differences, investigation has shown the trend on which we can base our "inspired guesswork" when the only data available are not enough. Going back to the table, we find that, using the same values of R_p and R_g at the three voltages of 90, 180 and 300, E_o steps up by a slightly larger ratio than B plus each time. The first step is double, but E_o goes from 23 to 51, which is more than double—a ratio of 2.2. The second step, from 180 to 300, is a ratio of 1 to 1.67, but E_o jumps from 51 to 96, a ratio of 1 to 1.88. The third step, from 300 to 450, is a ratio of 1 to 1.5, but E_o jumps from 96 to 166, a ratio of 1 to 1.73. So the pattern is fairly consistent and should enable us to make a reasonable estimate. Notice what happens to the cathode resistor: In order, the values for 90, 180, 300 and 450 volts are: 4,800, 4,140, 3,900 and 3,600 ohms. Again a consistent trend.

There are some points that must be watched in pushing up the B plus. See that tube ratings—voltage or dissipation—are not exceeded. This is usually fairly safe, but a danger that may be overlooked is the condition during warmup. Single-ended tubes (plate connection at the base) have a maximum plate voltage rating that should be watched. If it is seriously exceeded during warmup, there is risk of internal flashover. Either get a special type in which allowance is made for this (such as the 6SN7-GTA, whose maximum plate voltage is extended from 300 to 450) or use a slow warmup rectifier to insure that the tube heater is "up" before B plus arrives.

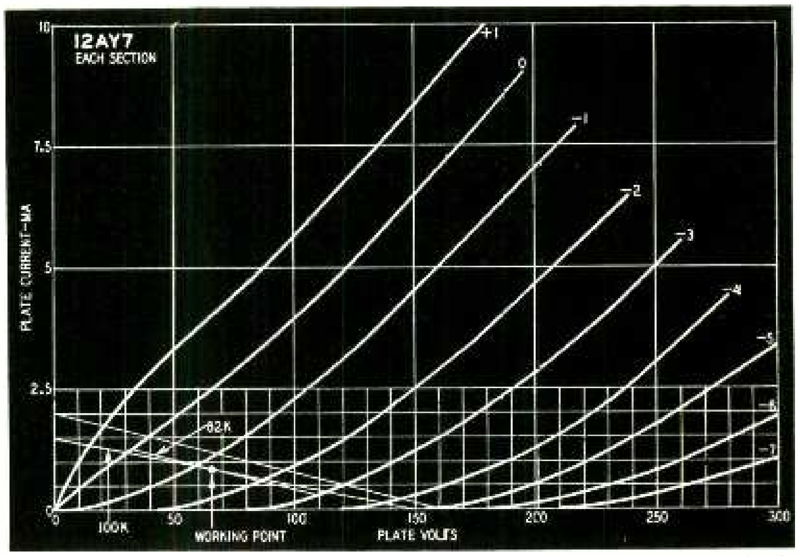


Fig. 1—Characteristic curves of a 12AY7.

Using a larger cathode bias resistor with the same plate circuit resistors will always increase the available swing before clipping occurs, but will also increase the curvature producing second harmonic. If you don't need the full swing, operation will be better with a somewhat lower cathode resistor. This will reduce second-harmonic curvature and the operating plate voltage and plate dissipation, when high-value plate resistors are used.

In general we use a certain amount of guesswork unless we can get the tube characteristics and use the full method, based on load-line technique, which has been discussed elsewhere (RADIO-ELECTRONICS, June, 1955; April, 1956). After a little practice, the guesswork becomes almost inspired!

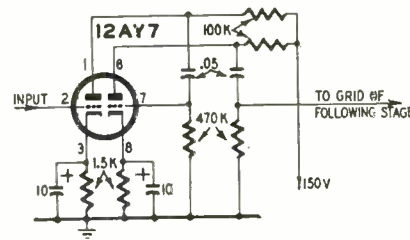


Fig. 2—Two-stage, R-C-coupled triode amplifier.

Even when we have access to tube characteristics and can draw load lines to our heart's content, some adjustment is sometimes necessary experimentally. So we are not much worse off without this advantage. The best data for R-C-coupled design is undoubtedly the kind given in the RCA manual and similar publications, *when the tube we want to use happens to be included.* Otherwise we have to resort to the kind of estimating outlined in this article. END

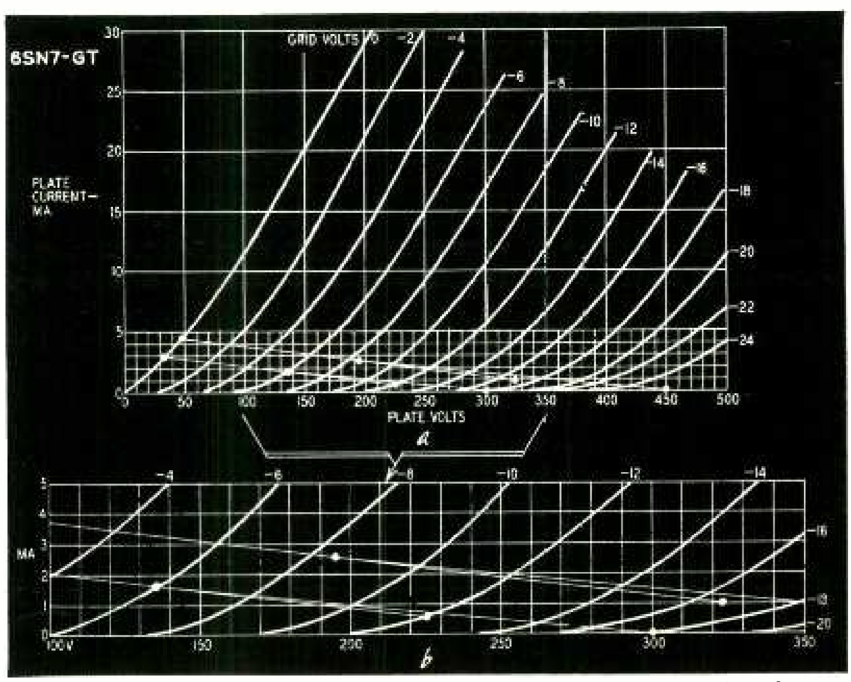
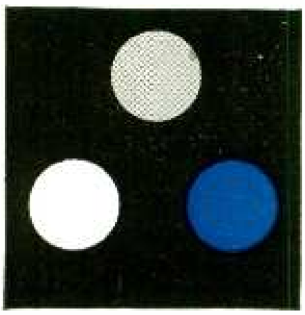


Fig. 3-a—Characteristics of a 6SN7-GT triode section; b—expanded section indicating load lines and operating points.



color installation problems

Fuzz tells Red of his problems during his latest color job—red and green dots are like horsefeathers; they're all over

By **BOB MIDDLETON***
TELEVISION CONSULTANT

"I PULLED your egg and forgot to wreck it," Bess apologized.

"Skip it," Fuzzball replied. "At least you didn't forget it entirely."

Turning with a hurt look to Red, he said, "Did you do me dirty the other day!"

"Did I?" asked Red noncommittally.

"Yes, you dog, you did."

"What now?"

"You told me that the blue lateral corrector moves the blue beam left and right on the screen, didn't you?"

"Sure did," Red replied.

"Then why doesn't it do what you say?"

"Maybe the blue lateral corrector was mounted in the 2 o'clock position on the picture tube's neck.

"You mean that makes a difference?" asked Fuzzball in amazement.

"Looks like you found out the hard way," Red observed. "Reckon I ought to have told you. There are two ways to mount the corrector magnet."

"Now you tell me," Fuzzball protested. "Here I am slowly going crazy trying to remember everything you said, and you didn't even say it."

Bess dropped the corner of her mouth open. "You've gone, boy, if you ask me."

"Nobody . . ." Fuzz started to say, as Red reached for the sugar and stuck his elbow in Fuzzball's mouth.

"Yes," continued Red, "on some sets you'll find the corrector magnet is *not* mounted directly over the blue gun. Instead, it's turned to the 2 o'clock position, if you call the blue gun 12 o'clock."

"Why?" Fuzz asked.

"Gives a little better purity, that way," Red explained.

Where's 2 o'clock?

"I see," Fuzzball said, nodding his head slowly. Then a crafty look crossed his face. "Do you mean 2 o'clock standing in front or behind the set?"

"Well, let's put it this way," Red replied, "just remember that the 2 o'clock position is between the blue and green guns."

"I guess that ties it down OK," admitted Fuzzball, "but will you or can you explain that crazy motion I was fighting on the blue dot?"

Red lit a fag thoughtfully, and then replied, "It *is* a little harder to get the color dots together, with a 2 o'clock corrector."

"You're the guy that's making it hard," Fuzzball protested. "Why don't you tell me these things before I go out on the job?"

"Look, Fuzz," Red replied evenly, "life is like that. Who do you suppose told *me?* Nobody, but nobody. It's lumps on the head."

"Excuse me for living," Fuzzball said resignedly, "but how *does* the blue dot move?"

"It moves in a sort of an ellipse. Here, Fuzz. Here is a drawing that I tore out of RADIO-ELECTRONICS. Glom on to that." (See Fig. 1.)

"Dig them crazy dots," Fuzzball remarked. "That's what makes it so rough—the red and green dots are like horse feathers—they're all over."

"But not so much," Red observed. "The blue dots move the most."

"It's a lot tougher to bring in a blue dot on an ellipse than on a straight line," Fuzzball bellyached.

Red exhaled a perfect smoke ring, making no comment.

"I'm just lucky I could stall on the job until tomorrow," Fuzzball continued.

"It *is* a little tougher to converge the blue dots with a 2 o'clock corrector," Red finally agreed. "But it's still a lot easier than making the dynamic convergence."

"Don't remind me," Fuzzball groaned.

"How did you make out on the purity?" Red asked.

"I fought it for a while, and finally ended up with the degaussing coil, and got it looking OK."

"Tell you what," Red remarked, "I was talking to Jack Darr, and he recommends that we should degauss picture tubes as a matter of course."

"Before we adjust the purity?"

"Yep. The way Jack puts it, you save time on the average. It makes a lot of sense."

"Are you going to follow Jack's advice?" asked Fuzz.

"Sure am," Red replied. "That's a shop rule from now on."

"How's Jack making out with this color racket?"

"Good enough, it seems," Red replied. "But he sure got hold of a weird dog last week, on black-and-white."

"What's the scoop?"

"Well, this was a Raytheon, last year's model—14AY21, or something like that. Had pix and no sound. On turning the *volume control* full up, it gave a fairly good picture. But, when the volume control was turned down, the picture quietly folded up in the middle, overlaped, pulled in from the sides, and the screen went black."

"What could cause that?" asked Fuzzball.

"Well, that's a good question," Red remarked. "I couldn't figure it, myself. He explained that a coupling capacitor had shorted from the plate line to the audio grid, so that it was grounded at one end by action of the volume control."

"Why did the screen go black?" asked Fuzzball with a puzzled look.

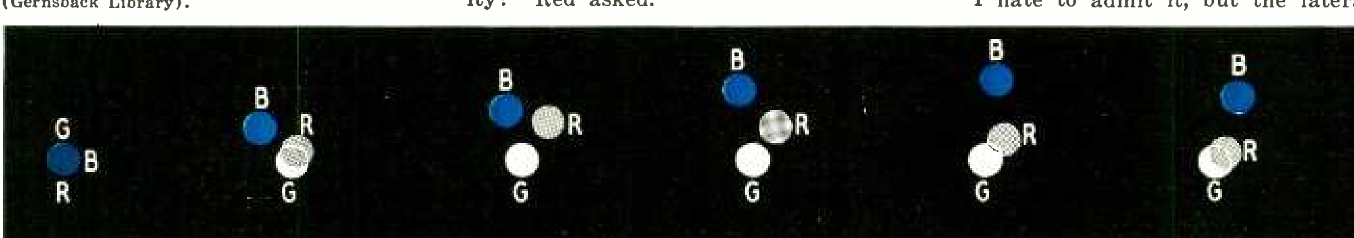
"Well," Red explained, "he pointed out that this grounded the 150-volt line which supplies plate voltage to the horizontal oscillator."

"That's the d...........t symptom I ever heard of," Fuzzball said, shaking his head.

"Worse than the 2 o'clock lateral corrector?" asked Red with a grin.

"I hate to admit it, but the lateral

* Author, *Servicing Color TV* and *Sweep and Marker Generators for Television and Radio* (Gernsback Library).



deal is a breeze compared to something like that," Fuzzball said meekly.

"How did you make out on dynamic convergence?" Red asked.

"Tell you the truth . . ." Fuzzball started.

"Do so, by all means," Red encouraged him.

"I got so fouled up on the 2 o'clock corrector that I never got that far."

"We all go through the same mill," Red advised him. "Dame History is a very old lady and likes to repeat herself."

Dynamic-convergence tips

"Can you give me some handy-dandy tips to save headaches on the dynamic convergence?" Fuzzball asked.

"I wouldn't be splashed," agreed Red. "Just remember, No. 1, that you bear down on the vertical dynamic convergence before going to the horizontal."

"I won't forget," Fuzz promised.

"And No. 2, it helps to start the job with crosshatch, instead of white dots."

"Why?" asked Fuzzball.

"Simply because we start the dynamic job by lining up the red and green columns to make them straight and parallel. Look, here's a photo." (See Fig. 2.)

"You say it's easier to start with lines than with dots?" Fuzz persisted.

"My opinion is yes," Red asserted. "Maybe you wouldn't agree, but take a look at this other photo showing the dot deal. See the difference?" (See Fig. 3.)

Fuzzball compared the photos carefully. "I would go along," he announced. "It's quite a bit easier to size up the columns on the crosshatch pattern."

"Thank you, Mr. F." Red returned humbly. "I am greatly honored to have my own judgment confirmed by no less an authority than yourself."

"Cut the sarcasm," Fuzz said, "anyone would think I was a Ph.D. or something, trying to fix his own TV set."

"What's a Ph.D.?" asked Red innocently.

Fuzzball looked sharply at Red, to see if he was joking. His face was blank.

"For your information," said Fuzzball, "a Ph.D. is a degree from an institution—it means piled high and deep, or something like that."

"Do you notice anything about this photo (Fig. 2)?" Red asked.

"The blue line is out," Fuzzball suggested.

"Right," Red agreed. "You don't have to cut off the blue gun, but lot's of guys figure it makes things less confusing to start."

"Tell me something, now," Fuzzball blurted.

"OK."

"On this interaction business that drives me nuts, what effect do the blue vertical amplitude and blue vertical tilt have on red and green lines?"

"There's some interaction," Red advised him.

"So, even after I get the red and green lines straightened up, I can't forget about them until after the blue has been brought in?"

"They'll be giving you a gold star on your report card," Red remarked. "Just remember one thing, now. Set up the *red* and *green* lines with the *crosshatch*, like we've been saying. But bring in the *blue* gun on the *dots*."

"Any fool can see that," agreed Fuzzball. "*I* can see it."

"You might remember it," suggested Red, "by making it a rule to always start a job with crosshatch and always end with dots."

"By a job I guess you mean static convergence, vertical dynamic and horizontal dynamic—that would make three jobs."

"You're right in the groove, Buddy," Red agreed.

Horizontal yoke balancer?

"There's just one thing that's got me in the dark," Fuzzball recalled, "and that's a little coil on top of the deflection yoke. Motorola I worked on yesterday had it. There's a slug can be slid up and down in the coil."

"Old Eagle-Eye Fuzzball," Red exulted, patting him on the back. "Yep, that's part of the convergence line-up on that model. That, Fuzz, is a horizontal yoke balancer."

"OK, you joker," Fuzzball replied, "What's a yoke balancer?"

"Well, on a color set, the yoke is very critical. If there's a little more inductance in one coil than the other, edge convergence won't come in right. The nearer the edge you get, the more serious it becomes. So, the yoke balancer is a gismo which lets you add or subtract a little inductance on one coil and throw it over to the other."

"What's that got to do with the price of peas?"

"Well, you don't worry about the yoke balancer until you get near the end of the horizontal convergence. Then, when you have the dots pretty well in, except for the ends of the pattern, you diddle with the yoke balancer."

"So I suppose I have interaction between the horizontal controls and the yoke balancer, already."

"A little," Red agreed. "But it's a small price to pay for the improvement in edge convergence."

"Next thing you know," Fuzzball predicted, "we'll be having vertical yoke balancers too."

"We already have," Red advised him. "The 21-inch model has both horizontal and vertical balancers."

"Great gosh and little goldfish," Fuzzball exclaimed.

"Relax, man," Red suggested. "I realize that the yoke balancers and the dynamic controls make 14 adjustments to fiddle with. But it's like learning to play horsetail poker—you got kings and queens and aces and deuces and four colors instead of three. But I never saw you in no bind in horsetail poker."

"That's different," Fuzzball protested. "But tell me, how long should I take to tame them little color dots?"

"The boss gives you three days on your first job," Red advised, "but he charges the set owner for a half hour of convergence time."

"You mean the shop's losing money on me?" asked Fuzzball in an unbelieving tone.

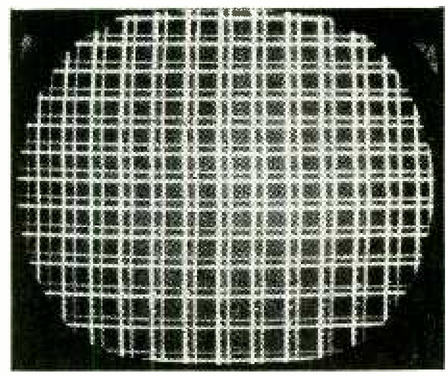


Fig. 2—The red and green columns must be lined up straight and parallel with each other.

"No," said Red, "at least I don't figure it is. The boss is investing money in you—leastways, he's taking a calculated risk as he says, and hopes that it's an investment."

"I never thought of it quite like that," Fuzzball remarked.

"Them's the conditions that prevail," Red advised.

A grin crossed Fuzzball's face. "Suppose I throw in the sponge?" he asked.

"You'll get stomped," Red promised.

"Can I make a suggestion?" Bess asked, and without waiting for a reply, said, "Don't just sit there, boys—buy something."

"OK. Couple cups of mud and sinkers, Bess. How was the egg, Fuzzball?" Red asked.

Fuzzball cast a wary eye in Bess' direction and lowered his voice. "I was

(*Continued on page 76*)

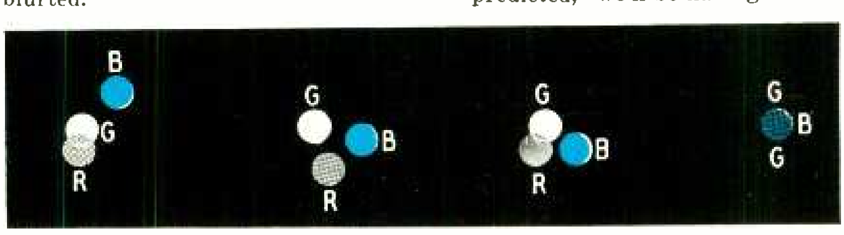
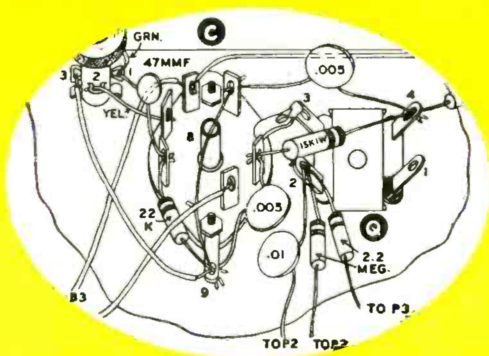


Fig. 1—Motions of the blue, red and green dots when a 2 o'clock lateral corrector is adjusted.

everybody's doing it!

FRANK PERKINS

Composer and arranger Frank Perkins listens attentively to his Decca hi-fi album "Music For My Lady" as its beautiful sounds are recreated with Heath high fidelity equipment. Music is a very important part of Frank's life, since his background includes composing and arranging musical scores for motion pictures, and for music publishers. Songs he has written include "Stars Fell on Alabama", "Emaline", "The Scat Song", "The Way I Feel Tonight", "After All These Years", and "Turn Back The Clock". Frank Perkins has discovered the beauty of Heath Hi-Fi sound . . . and the fun of "do-it-yourself" Heathkit construction. So, why don't you!



You'll get plenty of these detailed pictorial diagrams in your Heathkit construction manual to show where each and every wire and part is to be placed. Everything you do is spelled out in pictures so you can't go wrong. That's what makes it such fun!

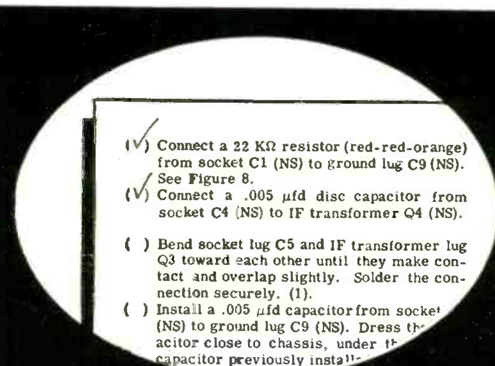
Heathkits®

By DAYSTROM

...fun to build and a thrill to own!

and here's why...

1. You get higher quality at lower cost by dealing direct, and by doing your own assembly.
2. You receive personal, friendly, service (before and after sale) for complete satisfaction.
3. You benefit from the latest in engineering designs because of our concentration on kit-form equipment only.
4. You may depend on performance as advertised—backed by Heath's world-wide reputation for quality.
5. You can take a full year to pay with the HEATH EASY TIME PAYMENT PLAN.



(✓) Connect a 22 KΩ resistor (red-red-orange) from socket C1 (NS) to ground lug C9 (NS). See Figure 8.

(✓) Connect a .005 μfd disc capacitor from socket C4 (NS) to IF transformer Q4 (NS).

( ) Bend socket lug C5 and IF transformer lug Q3 toward each other until they make contact and overlap slightly. Solder the connection securely. (1).

( ) Install a .005 μfd capacitor from socket (NS) to ground lug C9 (NS). Dress the acitor close to chassis, under the capacitor previously insta...

Read the step . . . perform the operation . . . and check it off—it's just that simple. These plainly-worded, easy-to-follow, steps are combined with pictorial diagrams to take you through every phase of assembly. Let our experience be your teacher!

TIME PAYMENTS . . .

The Heath Time Payment Plan was designed for your convenience. Now, you can order the kits of your choice, and pay for them in small monthly installments. Write for full details.

HEATHKIT EXTRA PERFORMANCE 70-WATT AMPLIFIER KIT

For really high performance, with plenty of reserve power, the W-6M is a natural. The full 70-watts output will seldom, if ever, be required. However, this reserve insures distortion-less sound on power peaks. The W-6M will loaf along at normal listening levels and yet is always ready to extend itself when program material demands it, without the least amount of strain. The output circuit employs 6550 tubes with a special-design Peerless output transformer for maximum stability at all power levels. A quick-change plug selects 4, 8 and 16 ohms or 70-volt output and the correct feedback resistance. A variable damping control is also provided for optimum performance with any speaker system. Extremely good power supply regulation is possible through the use of a heavy-duty transformer along with silicon-diode rectifiers, which are noted for their very long life, and yet are smaller than a house fuse. Frequency response at 1 watt is ±1 db from 5 cps to 80 kc with controlled hf rolloff above 100 kc. At 70 watts output harmonic distortion is below 2%, 20 to 20,000 cps and IM distortion below 1%, 60 and 6,000 cps. Hum and noise 88 db below full output. In addition to high performance, its fine appearance makes it a pleasure to display in your living room. Proper layout of chassis insures ease of assembly by eliminating those cramped and difficult places to get at. Clear instructions—and top-quality components. Get started now and make this amplifier the heart of your hi-fi system. Shipped express only. Shpg. Wt. 50 lbs.

MODEL W-6M

$109.95

MODEL W-6: Consists of W-6M kit, plus WA-P2 preamplifier. Express only. Shpg. Wt. 59 lbs. $129.70

HEATHKIT HIGH FIDELITY FM TUNER KIT

This tuner can bring you a rich store of FM programming, your least expensive source of high fidelity material. It covers the complete FM band from 88 to 108 mc. Stabilized, temperature-compensated oscillator assures negligible drift after initial warmup. Features broadbanded circuits for full fidelity, and better than 10 uv sensitivity for 20 db of quieting, to pull in stations with clarity and full volume. Employs a high gain, cascode RF amplifier, and has AGC. A ratio detector provides high-efficiency demodulation without sacrificing hi-fi performance. IF and ratio transformers are prealigned, as is the front end tuning unit. Special alignment equipment is not necessary. Edge-lighted glass dial for easy tuning. Here is FM for your home at a price you can afford. Shpg. Wt. 8 lbs.

MODEL FM-3A

$25.95

(with cabinet)

HEATHKIT BROADBAND AM TUNER KIT

This AM tuner was designed especially for high fidelity applications. It incorporates a special detector using crystal diodes, and the IF circuits feature broad band-width, to insure low signal distortion. Audio response is ±1 db from 20 cps to 9 kc, with 5 db of preemphasis at 10 kc to compensate for station rolloff. Sensitivity and selectivity are excellent, and tuner covers complete broadcast band from 550 to 1600 kc. Quiet performance is assured by 6 db signal-to-noise ratio at 2.5 UV. Prealigned RF and IF coils eliminate the need for special alignment equipment. Incorporates AVC, two outputs, two antenna inputs, and built-in power supply. Edge-lighted glass slide-rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 8 lbs.

MODEL BC-1A

$25.95

(with cabinet)

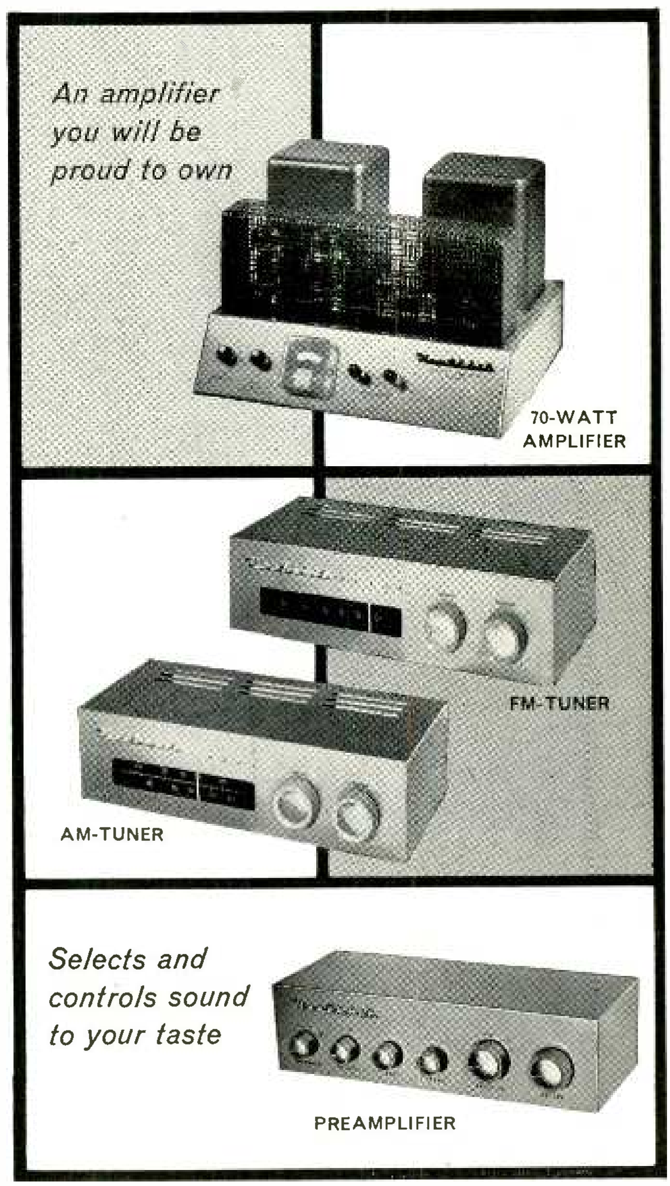
HEATHKIT MASTER CONTROL PREAMPLIFIER KIT

Designed for use with any of the Williamson-type amplifiers, the WA-P2 has five switch-selected inputs, each having its own level control to eliminate blasting or fading while switching through the various inputs, plus a tape recorder output. A hum control allows setting for minimum hum level. Frequency response is within ±1½ db from 15 to 35,000 cps. Equalization provided for LP, RIAA, AES, and early 78's. Separate bass and treble controls. Low impedance cathode follower output circuit. All components were specially selected for their high quality. Includes many features which will eventually be desired. Shpg. Wt. 7 lbs.

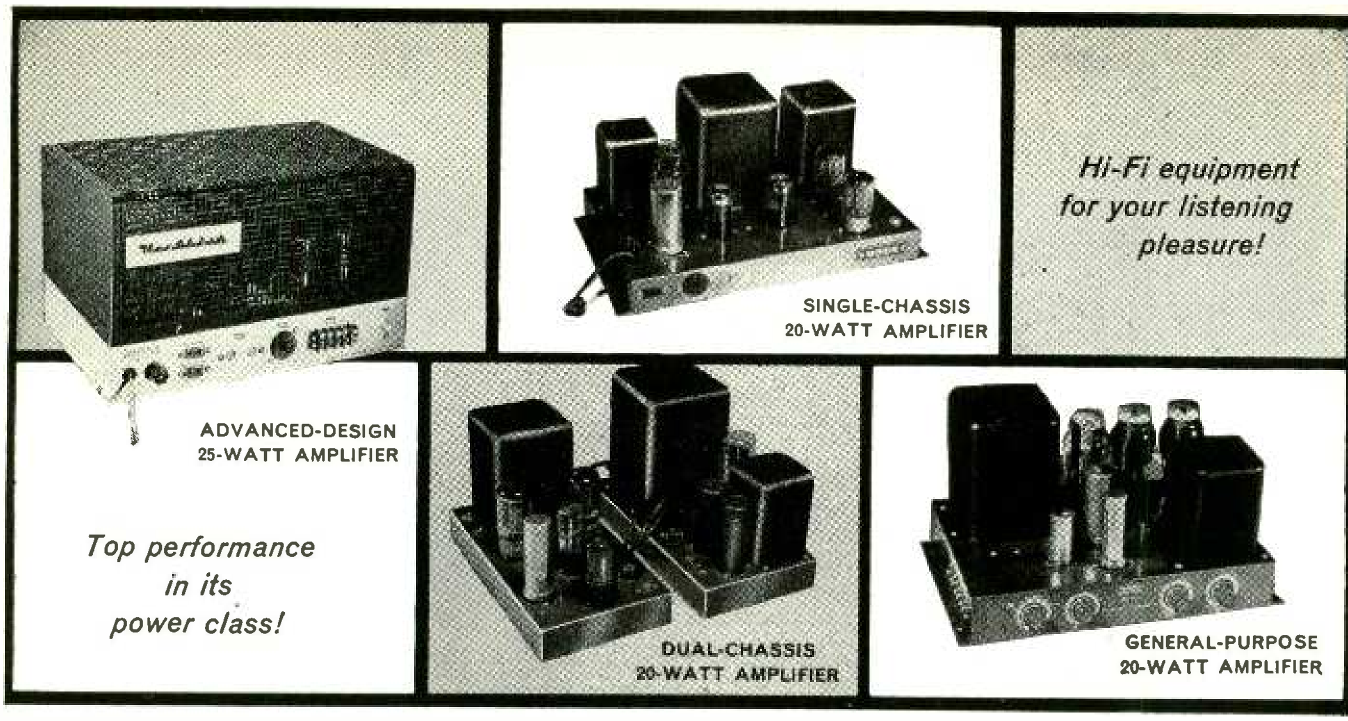
MODEL WA-P2

$19.75

(with cabinet)



HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICH.**



HEATHKIT ADVANCED-DESIGN 25-WATT HIGH FIDELITY AMPLIFIER KIT

Designed especially to satisfy critical audio requirements, the W-5M incorporates the extra features needed to compliment the finest in program sources and speaker systems. Faithful sound reproduction is assured with a frequency response of ±1 db from 5 to 160,000 cps at 1 watt, and harmonic distortion is less than 1% at 25 watts, with IM distortion less than 1% at 20 watts. Hum and noise are a full 99 db below rated output, assuring quiet, hum-free operation. Output taps are 4, 8 and 16 ohms. Exclusive Heathkit features include the "tweeter saver", and the "bas-bal" balancing circuit, requiring only a voltmeter for indication. Years of reliable service are guaranteed through the use of conservatively rated, high quality components. KT66 tubes and Peerless output transformer are typical. Shipped express only. Shpg. Wt. 31 lbs.

MODEL W-5: Consists of W-5M kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 38 lbs. $79.50

MODEL W-5M **$59.75**

HEATHKIT SINGLE-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W4-AM Williamson-type amplifier will amaze you with its outstanding performance. A true Williamson circuit, featuring extended frequency response, low distortion, and low hum levels, this amplifier can provide you with many hours of listening enjoyment with only a minimum investment compared to other units on the market. 5881 tubes and a special Chicago-standard output transformer are employed to give you full fidelity at minimum cost. Frequency response extending from 10 cps to 100 kc within ±1 db at 1 watt assures you of full coverage of the audio range, and clean clear sound amplification takes place in circuits that hold harmonic distortion at 1.5% and IM distortion below 2.7% at full 20 watt output. Hum and noise are 95 db below full output. Taps on the output transformer are at 4, 8 or 16 ohms. Shipped express only. Shpg. Wt. 28 lbs.

MODEL W-4A: Consists of W-4AM kit above, plus model WA-P2 preamplifier. Express only. Shpg. Wt. 35 lbs. $59.50.

MODEL W4-AM **$39.75**

HEATHKIT DUAL-CHASSIS 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model W3-AM is a Williamson-type amplifier built on two separate chassis. The power supply is on one chassis, and the amplifier stages are on the other chassis. Using two separate chassis provides additional flexibility in installation. Features include the famous acrosound model TO-300 "ultralinear" output transformer and 5881 tubes for broad frequency response, low distortion, and low hum level. The result is exceptionally fine overall tone quality. Frequency response is ±1 db from 6 cps to 150 kc at 1 watt. Harmonic distortion is less than 1% and IM distortion is less than 1.3% at 20 watts. Hum and noise are 88 db below 20 watts. Designed to match the speaker system of your choice, with taps for 4, 8 or 16 ohms impedance. A very popular high fidelity unit employing top quality components throughout. Shipped express only. Shpg. Wt. 29 lbs.

MODEL W-3A: Consists of W-3AM kit above plus model WA-P2 preamplifier. Express only. Shpg. Wt. 37 lbs. $69.50

MODEL W-3AM **$49.75**

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bring you the lasting satisfaction of personal accomplishment

HEATHKIT GENERAL-PURPOSE 20-WATT HIGH FIDELITY AMPLIFIER KIT

The model A-9C will provide you with high quality sound at low cost. Features a built-in preamplifier with four separate inputs, and individual volume, bass and treble controls. Frequency response covers 20 to 20,000 cps within ±1 db. Total harmonic distortion is less than 1% at 3 db below rated output. Push-pull 6L6 tubes are used, with output transformer tapped at 4, 8, 16 and 500 ohms. A true hi-fi unit using high-quality components throughout, including heavy-duty "potted" transformers. Shpg. Wt. 23 lbs.

MODEL A-9C **$35.50**

HEATHKIT "BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

The extremely popular Heathkit model SS-1 Speaker System provides amazing high fidelity performance for its size. Features two high-quality Jensen speakers, an 8" mid-range woofer and compression-type tweeter with flared horn. Covers from 50 to 12,000 CPS within ±5 db, in a special-design ducted-port, bass reflex enclosure. Impedance is 16 ohms. Cabinet measures 11½" H x 23" W x 11¾" D. Constructed of veneer-surfaced plywood, ½" thick, suitable for light or dark finish. All wood parts are precut and predrilled for easy, quick assembly. Shpg. Wt. 30 lbs.

MODEL SS-1
$39.95

HEATHKIT "RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

Extends the range of the SS-1 to ±5 db from 35 to 16,000 CPS. Uses 15" woofer and super-tweeter both by Jensen. Kit includes crossover circuit. Impedance is 16 ohms and power rating is 35 watts. Measures 29" H x 23" W x 17½" D. Constructed of veneer-surfaced plywood ¾" thick. Easy to build! Shpg. Wt. 80 lbs.

MODEL SS-1B
$99.95

HEATHKIT "LEGATO" HIGH FIDELITY SPEAKER SYSTEM KIT

The quality of the Legato, in terms of the engineering that went into the initial design, and in terms of the materials used in its construction, is matched in only the most expensive speaker systems available today. The listening experience it provides approaches the ultimate in esthetic satisfaction. Two 15" theater-type Altec Lansing speakers cover 25 to 500 CPS, and an Altec Lansing high-frequency driver with sectoral horn covers 500 to 20,000 CPS. A precise amount of phase shift in the crossover network brings the high frequency channel into phase with the low frequency channel to eliminate peaks or valleys at the crossover point, by equalizing the acoustical centers of the speakers. The enclosure is a modified infinite baffle type, especially designed for these speakers. Cabinet is constructed of veneer-surfaced plywood, ¾" thick, precut and predrilled for easy assembly. Frequency response 25 to 20,000 CPS. Power rating, 50 watts program material. Impedance is 16 ohms. Cabinet dimensions 41" L x 22¼" D x 34" H.

Choice of two beautiful cabinets. Model HH-1-C in imported white birch for light finishes, and HH-1-CM in African mahogany for dark finishes. Shpg. Wt. 195 lbs.

MODEL HH-1-C
MODEL HH-1-CM
$325.00
EACH

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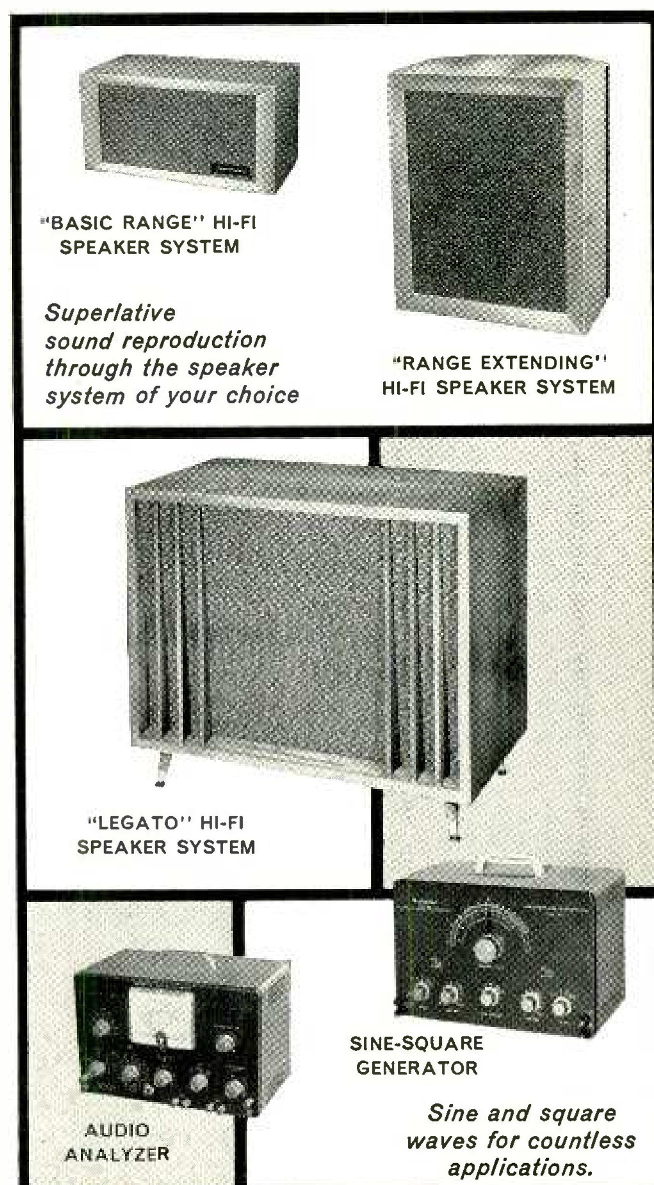
let you save up to ½ or more on all types of electronic equipment.



HEATHKIT SINE-SQUARE GENERATOR

The new AG-10 provides high quality, sine and square waves over a wide range, for countless applications. Some of these are; radio and TV repair work, checking scope performance, as a variable trigger source for telemetering and pulse work, and checking audio, video and hi-fi amplifier response. Frequency response is ±1.5 db from 20 CPS to 1 MC on both sine and square waves, with less than .25% sine wave distortion, 20 to 20,000 CPS. Sine wave output impedance 600 ohms, square wave output impedance 50 ohms, (except on 10v ranges). Square wave rise time less than .15 usec. Five-position band switch—continuously variable tuning—shielded oscillator circuit—separate step and variable output attenuators in ranges of 10, 1, and .1 volts for both sine and square wave, with extra range of .01 volt on sine wave. Both sine and square wave can be used at the same time without affecting either wave form. Power supply uses silicon-diode rectifiers. Shpg. Wt. 12 lbs.

MODEL AG-10
$49.95

HEATHKIT AUDIO ANALYZER KIT

The AA-1 is actually three instruments in one compact package. It combines the functions of an AC VTVM, an audio wattmeter, and an intermodulation analyzer. Input and output terminals are combined, and high and low frequency oscillators are built in. VTVM ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts (RMS). Wattmeter ranges are .15 mw, 1.5 mw, 15 mw, 150 mw, 1.5 w, 15 w and 150 w. IM scales are 1%, 3%, 10%, 30% and 100%. Provides internal load resistors of 4, 8, 16 or 600 ohms. A tremendous dollar value. Shpg. Wt. 13 lbs.

MODEL AA-1
$49.95

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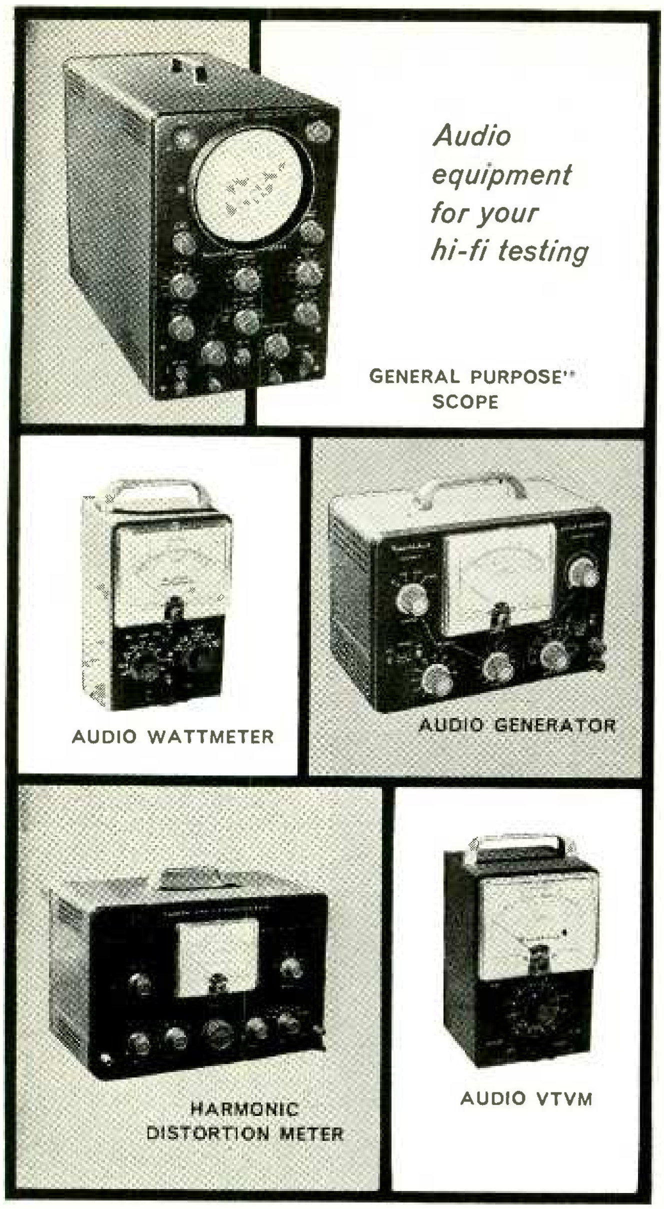

HEATHKIT "GENERAL PURPOSE" 5" OSCILLOSCOPE KIT

The model OM-2 Oscilloscope is especially popular with part-time service technicians, students, and high fidelity enthusiasts. It features good vertical frequency response ±3 db from 4 cps to over 1.2 mc. A full five-inch crt. and sweep generator operation from 20 cps to over 150 kc. Stability is excellent and calibrated grid screen allows precise signal observation. Extra features include external or internal sweep and sync, 1-volt peak-to-peak calibrating reference, 3-position step-attenuated input, adjustable spot shape control, push-pull horizontal and vertical amplifiers, and modern etched-metal circuits. Easy to build and a pleasure to use. Ideal for use with other audio equipment for checking amplifiers. Shpg. Wt. 21 lbs.

MODEL OM-2

$42.50

HEATHKIT AUDIO WATTMETER KIT

The AW-1 Audio Wattmeter can be used in any application where audio power output is to be measured. Non-inductive LOAD resistors are built in for 4, 8, 16 or 600 ohms impedance. Five power ranges cover 0-5 mw, 50 mw, 500 mw, 5 w, and 50 w full scale. Five switch-selected db ranges cover −10 db to +30 db. All indications are read directly on a large 4½" 200 microampere meter. Frequency response is ±1 db from 10 cps to 250 kc. Precision type multiplier resistors used for high accuracy, and crystal diode bridge for wide-range frequency response. This meter is used in many recording studios and broadcast stations as a monitor as well as servicing. A fine meter to help supply the answers to your audio operating or power output problems. Shpg. Wt. 6 lbs.

MODEL AW-1

$29.50

HEATHKIT AUDIO SIGNAL GENERATOR KIT

The model AG-9A is "made to order" for high fidelity applications, and provides quick and accurate selection of low-distortion signals throughout the audio range. Three rotary switches select two significant figures and a multiplier to determine audio frequency. Incorporates step-type and a continuously variable output attenuator. Output indicated on large 4½" panel meter, calibrated in volts and db. Attenuator system operates in 10 db steps, corresponding to meter calibration, in ranges of 0-.003, .01, .03, .1, .3, 1,3 and 10 volts RMS. "Load" switch permits use of built-in 600-ohm load, or external load of different impedance. Output and frequency indicators accurate to within ±5%. Distortion less than .1 of 1% between 20 and 20,000 cps. Total range is 10 cps to 100 kc. Shpg. Wt. 8 lbs.

MODEL AG-9A

$34.50

HEATHKIT HARMONIC DISTORTION METER KIT

All sounds consist of dominant tones plus harmonics (overtones). These harmonics enrich the quality and brightness of the music. However, additional harmonics which originate in the audio equipment, represent distortion. Used with an audio signal generator, the HD-1 will accurately measure this harmonic distortion at any or all frequencies between 20 and 20,000 cps. Distortion is read directly on the panel meter in ranges of 0-1, 3, 10, 30 and 100% full scale. Voltage ranges of 0-1, 3, 10 and 30 volts are provided for the initial reference settings. Signal-to-noise ratio measurements are also permitted through the use of a separate meter scale calibrated in db. High quality components insure years of outstanding performance. Full instructions are provided. Shpg. Wt. 13 lbs.

MODEL HD-1

$49.50

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are well known for their high quality and reliability.

HEATHKIT AUDIO VTVM KIT

This new and improved AC Vacuum Tube Voltmeter is designed especially for audio measurements and low-level AC measurements in power supply filters, etc. Employs an entirely new circuit featuring a cascode amplifier with cathode-follower isolation between the input and the amplifier, and between the output stage and the preceding stages. It emphasizes stability, broad frequency response, and sensitivity. Frequency response is essentially flat from 10 cps to 200 kc. Input impedance is 1 megohm at 1000 cps. AC (RMS) voltage ranges are 0-.01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts. Db ranges cover −52 db to +52 db. Features large 4½" 200 microampere meter, with increased damping in meter circuit for stability in low frequency tests. 1% precision resistors employed for maximum accuracy. Stable, reliable performance in all applications. Shpg. Wt. 5 lbs.

MODEL AV-3

$29.95

HEATHKIT RF SIGNAL GENERATOR KIT

Even a beginner can build this prealigned signal generator, designed especially for use in service work. Produces RF signals from 160 kc to 110 mc on fundamentals in five bands. Covers 110 mc to 220 mc on calibrated harmonics. Low impedance RF output in excess of 100,000 microvolts, is controllable with a step-type and continuously variable attenuator. Selection of unmodulated RF, modulated RF, or audio at 400 CPS. Ideal for fast and easy alignment of radio receivers, and finds application in FM and TV work as well. Thousands of these units are in use in service shops all over the country. Easy to build and a real time saver, even for the part-time service technician or hobbyist. Shpg. Wt. 8 lbs.

MODEL SG-8

$19.50

HEATHKIT LABORATORY RF GENERATOR KIT

Tackle all kinds of laboratory alignment jobs with confidence by employing the LG-1. It features voltage-regulated B+, double shielding of oscillator circuits, copper-plated chassis, variable modulation level, metered output, and many other "extras" for critical alignment work. Generates RF signals from 100 kc to 30 mc on fundamentals in five bands. Meter reads RF output in microvolts or modulation level in percentage. RF output available up to 100,000 microvolts, controlled by a fixed-step and a variable attenuator. Provision for external modulation where necessary. Buy and use this high-quality RF signal generator that may be depended upon for stability and accuracy. Shpg. Wt. 16 lbs.

MODEL LG-1

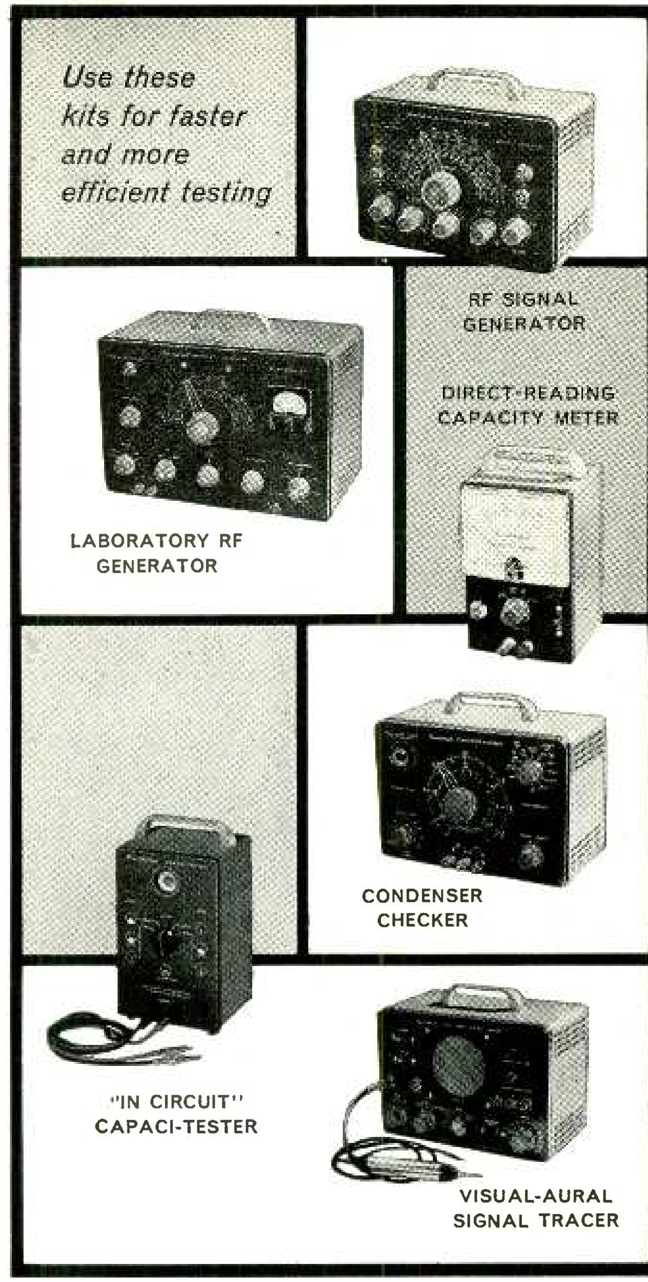
$48.95

HEATHKIT DIRECT-READING CAPACITY METER KIT

Here's a fast, simple capacity meter. A capacitor to be checked is merely connected to the terminals, the proper range selected, and the value read directly on the large 4½" panel meter calibrated in mmf and mfd. Ranges are 0 to 100 mmf, 1,000 mmf, .01 mfd, .1 mfd full scale. Not affected by hand capacity. Shpg. Wt. 7 lbs.

MODEL CM-1

$29.50



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are educational
as well as functional

HEATHKIT "IN-CIRCUIT" CAPACI-TESTER KIT

With the CT-1 it is no longer necessary to disconnect one capacitor lead to check the part, you can check most capacitors for "open" or "short" right in the circuit. Fast and easy—to save your valuable time in the service shop or lab. Detects open capacitors from about 50 mmf up, so long as the capacitor is not shunted by excessively low resistance value. Will detect shorted capacitors up to 20 mfd (not shunted by less than 10 ohms). (Does not detect leakage.) Employs 60 cycles and 19 megacycle test frequencies. Electron beam "eye" tube used as indicator. Compact, easy-to-build, and inexpensive. Test leads included. Shpg. Wt. 5 lbs.

MODEL CT-1

$7.95

HEATHKIT CONDENSER CHECKER KIT

This handy instrument uses an electron beam "eye" tube as an indicator to measure capacity in ranges of .00001 to .005 mfd, .5 mfd, 50 mfd and 1000 mfd. Also measures resistance from 100 ohms to 5 megohms in two ranges. Checks paper, mica, ceramic and electrolytic capacitors. Selection of five polarizing voltages. Shpg. Wt. 7 lbs.

MODEL C-3

$19.50

HEATHKIT VISUAL-AURAL SIGNAL TRACER KIT

Although designed originally for radio receiver work, the T-3 finds application in FM and TV servicing as well. Features high-gain channel with demodulator probe, and low-gain channel with audio probe. Traces signals in all sections of radio receivers and in many sections of FM and TV receivers. Built-in speaker and electron beam eye tube indicate relative gain, etc. Also features built-in noise locator circuit. Provision for patching speaker and/or output transformer to external set. Shpg. Wt. 9 lbs.

MODEL T-3

$23.50

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICH.**

HEATHKIT IMPEDANCE BRIDGE KIT

The model IB-2A employs a Wheatstone Bridge, a Capacity Comparison Bridge, a Maxwell Bridge, and a Hay Bridge in one compact package. Measures resistance from 0.1 ohm to 10 megohms, capacitance from 100 mmf to 100 mfd, inductance from 0.1 mh to 100 h, dissipation factor (D) from 0.002 to 1, and storage factor (Q) from 0.1 to 1000. A 100-0-100 ua meter provides for null indications. The decade resistors employed are of 1% tolerance for maximum accuracy. Completely self-contained. Has built in power supply, 1000-cycle generator, and vacuum-tube detector. Special two-section CRL dial insures convenient operation. Instruction manual has entirely new schematic that clarifies circuit functions in various switch positions. A true laboratory instrument, that will provide you with many years of fine performance. Shpg. Wt. 12 lbs.

MODEL IB-2A

$59.50

HEATHKIT "LOW RIPPLE" BATTERY ELIMINATOR KIT

This modern battery eliminator incorporates an extra low-ripple filter circuit so that it can be used to power all the newest transistor-type circuits requiring 0 to 12 volts DC, and the new "hybrid" automobile radios using both transistors and vacuum tubes. Its DC output, at either 6 or 12 volts, contains less than .3% AC ripple. Separate output terminals are provided for low-ripple or normal filtering. Supplies up to 15 amps on 6 volt range or up to 7 amps on 12 volt range. Output is variable from 0 to 8 or 0 to 16 volts. Two meters constantly monitor output voltage and current. Will also double as a battery charger. Shpg. Wt. 23 lbs.

MODEL BE-5

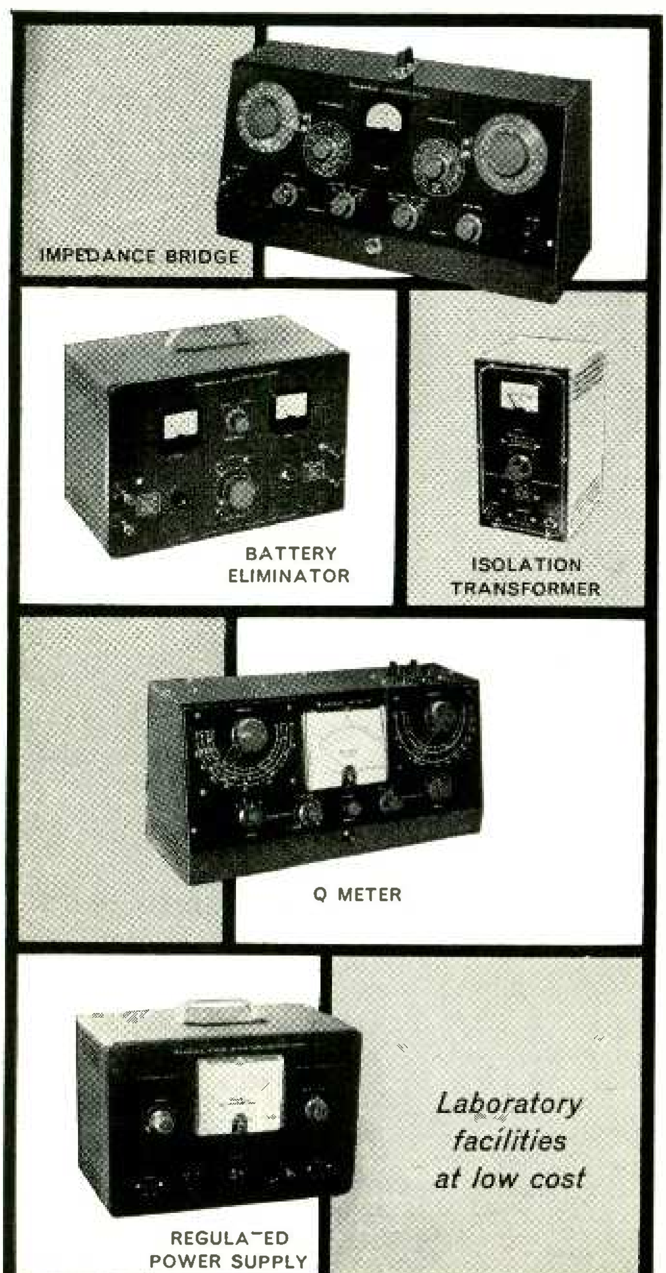
$39.95

HEATHKIT ISOLATION TRANSFORMER KIT

The model IT-1 is one of the handiest units for the service shop, home workshop or laboratory. Provides complete isolation from the power line. AC-DC sets may be plugged directly into the IT-1 without the chassis becoming "hot". Output voltage is variable from 90 volts to 130 volts allowing checks of equipment under adverse conditions such as low line voltage. Rated for 100 volt amperes continuously or 200 volt amperes intermittently. Panel meter monitors output voltage. Shpg. Wt. 9 lbs.

MODEL IT-1

$16.50



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are designed with high-quality, name-brand components to insure long service life

HEATHKIT "Q" METER KIT

At this price the laboratory facilities of a Q Meter may be had by the average service technician or home experimenter. The Q Meter permits measurement of inductance from 1 microhenry to 10 milihenry, "Q" on a scale calibrated up to 250 full scale, with multipliers of 1 or 2, and capacitance from 40 mmf to 450 mmf ± 3 mmf. Built in oscillator permits testing components from 150 kc to 18 mc. Large 4½" panel meter is featured. Very handy for checking peaking coils, chokes, etc. Use to determine values of unknown condensers, both variable and fixed, compile data for coil winding purposes, or measure RF resistance. Also checks distributed capacity and Q of coils. No special equipment is required for calibration. A special test coil is furnished, along with easy-to-follow instructions. Shpg. Wt. 14 lbs.

MODEL QM-1

$44.50

HEATHKIT REGULATED POWER SUPPLY KIT

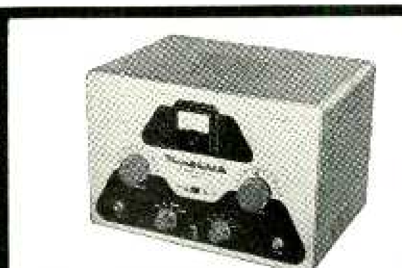
Here is a power supply that will provide DC plate voltage and AC filament voltage for all kinds of experimental circuits. The DC supply is regulated for stability, and yet the amount of DC output voltage available from the power supply can be controlled manually from 0 up to 500 volts. At 450 volts DC output, the power supply will provide up to 10 ma of current, and provide progressively higher current as the output voltage is lowered. Current rating is 130 ma at 200 volts output. In addition to furnishing B+ the power supply also provides 6.3 volts AC at up to 4 amperes for filaments. Both the B+ output and the filament output are isolated from ground. Ideal unit for use in laboratory, home workshop, ham shack, or service shop. A large 4½" meter on the front panel reads output voltage or output current, selectable with a panel switch. Shpg. Wt. 17 lbs.

MODEL PS-3

$35.50

Terrific values in amateur equipment!

DX-20 TRANSMITTER



DX-35 TRANSMITTER

DX-100 TRANSMITTER

HEATHKIT DX-20 CW TRANSMITTER KIT

The Heathkit model DX-20 "straight-CW" transmitter features high efficiency at low cost. It uses a single 6DQ6A tube in the final amplifier stage for plate power input of 50 watts. A 6CL6 serves as crystal oscillator, with a 5U4GB rectifier. It is an ideal transmitter for the novice, as well as the advanced-class CW operator. Single-knob band switching is featured to cover 80, 40, 20, 15, 11 and 10 meters. Pi network output circuit matches various antenna impedances between 50 and 1000 ohms and reduces harmonic output. Top-quality parts are featured throughout, including "potted" transformers, etc., for long life. It has been given full "TVI" treatment. Access into the cabinet for crystal changing is provided by a removable metal pull-out plug on the left end of the cabinet. Very easy to build from the complete step-by-step instructions supplied, even if you have never built electronic equipment before. If you appreciate a good, clean signal on the CW bands, this is the transmitter for you! Shpg. Wt. 18 lbs.

MODEL DX-20
\$35.95

Heathkits...

By DAYSTROM

are designed by licensed ham-engineers, especially for you

HEATHKIT DX-35 PHONE AND CW TRANSMITTER KIT

The DX-35 transmitter can be thought of as the "little brother" of the DX-100. It features both phone and CW operation on 80, 40, 20, 15, 11 and 10 meters. A single 6146 tube is used in the final amplifier stage to provide full 65 watt plate power input on CW, or controlled carrier modulation peaks up to 50 watts for phone operation. Modulator and power supplies are built right in and single knob band switching is combined with a pi network output circuit for complete operating convenience. The tight fitting cabinet presents a most attractive appearance, and is designed for complete shielding to minimize TVI. Back panel control provides convenient switch selection of three different crystals, reached through access door at rear of cabinet. A most remarkable power package for the price. Complete step-by-step instructions with pictorial diagrams to assure your success in assembly. Shpg. Wt. 24 lbs.

MODEL DX-35
\$56.95

HEATHKIT DX-100 PHONE AND CW TRANSMITTER KIT

Listen to any ham band between 160 meters and 10 meters and note how many DX-100 transmitters you hear! The number of these fine rigs now on the air testifies to the enthusiasm with which it has been accepted by the amateur fraternity. No other transmitter in this power class combines high quality and real economy so effectively. The DX-100 features a built in VFO, modulator and power supplies, complete shielding to minimize TVI, and pi network output coupling to match impedances from approximately 50 to 600 ohms. Its RF output is in excess of 100 watts on phone and 120 watts on CW, for a clean strong signal on all the ham bands from 10 to 160 meters. Single-knob band switching and illuminated VFO dial and meter face add real operating convenience. RF output stage uses a pair of 6146 tubes in parallel, modulated by a pair of 1625's. High quality components are used throughout, such as "potted" transformers, silver-plated or solid coin silver switch terminals, aluminum heat-dissipating caps on the final tubes, copper plated chassis, etc. This transmitter was designed exclusively for easy step-by-step assembly. Shpg. Wt. 107 lbs.

MODEL DX-100
\$189.50

FUNCTIONAL DESIGN . . .

The transmitters described on this page were designed for the ham, by hams who know what features are desirable and needed. This assures you of the best possible performance and convenience, and adds much to your enjoyment in the ham shack.

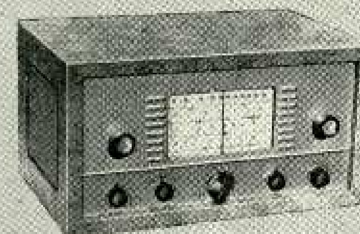
HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICH.**

Automatically turns off transmitter and gives visual signal

"AUTOMATIC" CONELRAD ALARM

GRID DIP METER

"Q" MULTIPLIER



COMMUNICATIONS-TYPE RECEIVER

An ideal receiver for the beginning ham or short wave listener

HEATHKIT "AUTOMATIC" CONELRAD ALARM KIT

This conelrad alarm works with any radio receiver; AC-DC-transformer operated—or battery powered, so long as the receiver has AVC. Fully complies with FCC regulations for amateurs. When the monitored station goes off the air, the CA-1 automatically cuts the AC power to your transmitter, and lights a red indicator. A manual "reset" button reactivates the transmitter. Incorporates a heavy-duty six-ampere relay, a thyratron tube to activate the relay, and its own built-in power supply. A neon lamp shows that the alarm is working, by indicating the presence of B+ in the alarm circuit. Simple to install and connect. Your transmitter plugs into an AC receptacle on the CA-1, and a cable connects to the AVC circuit of a nearby receiver. A built-in sensitivity control allows adjustment to various AVC levels. Receiver volume control can be turned up or down, without affecting alarm operation. Build a Heathkit CA-1 in one evening and comply with FCC regulations now! Shpg. Wt. 4 lbs.

MODEL CA-1
$13.95

HEATHKIT "Q" MULTIPLIER KIT

The Heathkit Q Multiplier functions with any AM receiver having an IF frequency between 450 and 460 KC, that is not "AC-DC" type. It derives its power from the receiver, and needs only 6.3 volts AC at 300 ma (or 12 VAC at 150 ma) and 150 to 250 volts DC at 2 ma. Simple to connect with cable and plugs supplied. Adds additional selectivity for separating signals, or will reject one signal and eliminate heterodyne. A tremendous help on crowded phone and CW bands. Effective Q of 4000 for sharp "peak" or "null". Tunes any signal within IF band pass without changing the main receiver tuning dial. A convenient tuning knob on the front panel with vernier reduction between the tuning knob and the tuning capacitor gives added flexibility in operation. Uses a 12AX7 tube, and special high-Q shielded coils. Instructions for connecting to the receiver and operation are provided in the construction manual. A worthwhile addition to any communications, or broadcast receiver. It may also be used with a receiver which already has a crystal filter to obtain two simultaneous functions, such as peaking the desired signal with the crystal filter and nulling an adjacent signal with the Q Multiplier. Shpg. Wt. 3 lbs.

MODEL QF-1
$9.95

HEATHKIT GRID DIP METER KIT

A grid dip meter is basically an RF oscillator for determining the frequency of other oscillators, or of tuned circuits. Extremely useful in locating parasitics, neutralizing, identifying harmonics, coil winding, etc. Features continuous frequency coverage from 2 mc to 250 mc, with a complete set of prewound coils, and a 500 ua panel meter. Front panel has a sensitivity control for the meter, and a phone jack for listening to the "zero-beat." Will also double as an absorption-type wave meter. Shpg. Wt. 4 lbs.

Low Frequency Coil Kit: Two extra plug-in coils to extend frequency coverage down to 350 kc. Shpg. Wt. 1 lb. No. 341-A. $3.00

MODEL GD-1B
$19.95

HEATHKIT ALL-BAND COMMUNICATIONS-TYPE RECEIVER KIT

This communications-receiver covers 550 kc to 30 mc in four bands, and provides good sensitivity, selectivity, and fine image rejection. Ham bands are clearly marked on an illuminated dial scale. Features a transformer-type power supply—electrical band spread—antenna trimmer—headphone jack—automatic gain control and beat frequency oscillator. Accessory sockets are provided on the rear of the chassis for using the Heathkit model QF-1, Q Multiplier. Accessory socket is handy, also, for operating other devices that require plate and filament potentials. Will supply +250 VDC at 15 ma and 12.6 VAC at 300 ma. Ideal for the beginning ham or short wave listener. Shpg. Wt. 12 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Part no. 91-15A. Shpg. Wt. 5 lbs. $4.95.

MODEL AR-3
$29.95
(Less cabinet)

Heathkits...

By DAYSTROM

are outstanding in performance and dollar value

HEATHKIT REFLECTED POWER METER KIT

The Heathkit reflected power meter, model AM-2, makes an excellent instrument for checking the match of the antenna transmission system, by measuring the forward and reflected power or standing wave ratio. The AM-2 is designed to handle a peak power of well over 1 kilowatt of energy and may be left in the antenna system feed line at all times. Band coverage is 160 meters through 2 meters. Input and output impedances for 50 or 75 ohm lines. No external power required for operation. Meter indicates percentage forward and reflected power, and standing wave ratio from 1:1 to 6:1. Another application for the AM-2 is matching impedances between exciters or R.F. sources and grounded grid amplifiers. Power losses between transmitter output and antenna tuner may be very easily computed by inserting the AM-2 in the line connecting the two. No insertion loss is introduced into the feeder system, due to the fact that the AM-2 is a portion of coaxial line in series with the feeder system and no internal connections are actually made to the line. Complete circuit description and operation instructions are provided in the manual. Cabinet size is 7-3/8" x 4-1/16" x 4-5/8". Can be conveniently located at operating position. Shpg. Wt. 3 lbs.

MODEL AM-2

$15.95

HEATHKIT VARIABLE FREQUENCY OSCILLATOR KIT

Enjoy the convenience and flexibility of VFO operation by obtaining the Heathkit model VF-1 Variable Frequency Oscillator. Covers 160-80-40-20-15-11 and 10 meters with three basic oscillator frequencies. Better than 10 volt average RF output on fundamentals. Plenty of output to drive most modern transmitters. It features voltage regulation for frequency stability. Dial is illuminated for easy reading. Vernier reduction is used between the main tuning knob and the tuning condenser. Requires a power source of only 250 volts DC at 15 to 20 miliamperes and 6.3 volts AC at 0.45 amperes. Extra features include copper-plated chassis, ceramic coil forms, extensive shielding, etc. High quality parts throughout. VFO operation allows you to move out from under interference and select a portion of the band you want to use without having to be tied down to only two or three frequencies through use of crystals. "Zero in" on the other fellow's signal and return his CQ on his own frequency! Crystals are not cheap, and it takes quite a number of them to give anything even approaching comprehensive coverage of all bands. Why hesitate? The model VF-1 with its low price and high quality will add more operating enjoyment to your ham activities. Shpg. Wt. 7 lbs.

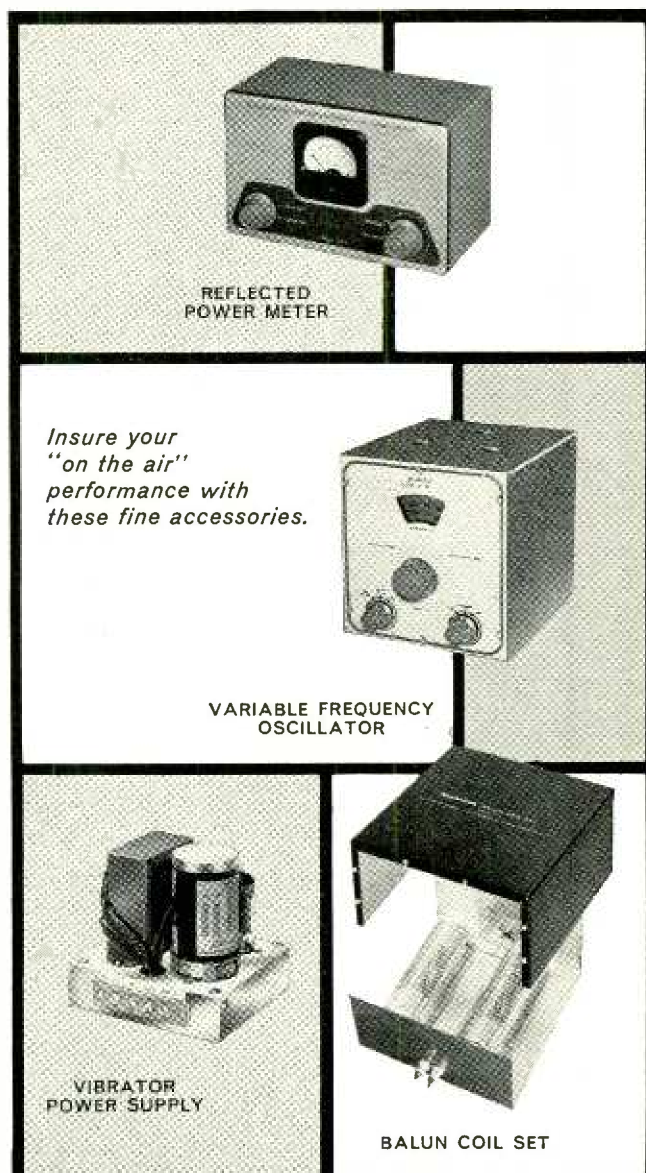
MODEL VF-1

$19.50

Heathkits...

By DAYSTROM

are the answer for your electronics hobby.



HEATHKIT BALUN COIL KIT

The Heathkit Balun Coil Kit model B-1 is a convenient transmitter accessory, which has the capability of matching unbalanced coax lines, used on most modern transmitters, to balance lines of either 75 or 300 ohms impedance. Design of the bifilar wound balun coils will enable transmitters with unbalanced output to operate into balanced transmission line, such as used with dipoles, folded dipoles, or any balanced antenna system. The balun coil set can be used with transmitters and receivers without adjustment over the frequency range of 80 through 10 meters, and will easily handle power inputs up to 250 watts. Cabinet size is 9" square by 5" deep and it may be located any distance from the transmitter or from the antenna. Completely enclosed for outdoor installation. Shpg. Wt. 4 lbs.

MODEL B-1

$8.95

HEATHKIT 6 OR 12 VOLT VIBRATOR POWER SUPPLY KITS

These little power supply kits are ideal for all portable applications with 6 volt or 12 volt batteries, when you are operating electronic equipment away from power lines. By replacing the power supplies of receivers, small public address systems, or even miniature transmitters with these units, they can be used with conventional 6 or 12 volt batteries. Use in boats, automobiles, light aircraft, or any field application. Each unit provides 260 volts DC output at up to 60 miliamperes. More than one power supply of the same model may be connected in parallel for increased current capacity at the same output voltage. Everything is provided in the kit, including a vibrator transformer, a vibrator, 6X4 or 12X4 rectifier, and the necessary buffer capacitor, hash filter, and output filter capacitor. Shpg. Wt. 4 lbs.

6 VOLT MODEL VP-1-6
12 VOLT MODEL VP-1-12

$7.95 Each

HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICH.**

HEATHKIT ELECTRONIC IGNITION ANALYZER KIT

Previous electronic experience is not necessary to build this fine ignition analyzer. The construction manual supplied has complete step-by-step instructions plus large pictorial diagrams showing the exact placement and value of each component. All parts are clearly marked so that they are easily identified. The IA-1 is an ideal tool for engine mechanics, tune-up men, and auto hobbyists, since it traces the dynamic action of voltage in an ignition system on a cathode-ray tube screen. The wave-form produced is affected by the condition of the coil, condenser, points, plugs, and ignition wiring, so it can be analyzed, and used as a "sign-post" to ignition system performance. This analyzer will detect inequality of spark intensity, a poor spark plug, defective plug wiring, breaker-point bounce, an open condenser, and allow setting of dwell-time percentage for the points. An important feature of this instrument is its ability to check dynamic performance, with the engine in operation (400 to 5000 RPM). It will show the complete engine cycle, or only one complete cylinder. Can be used on all types of internal combustion engines where breaker-points are accessible. Use it on automobiles, boats, aircraft engines, etc. Shpg. Wt. 18 lbs.

MODEL IA-1

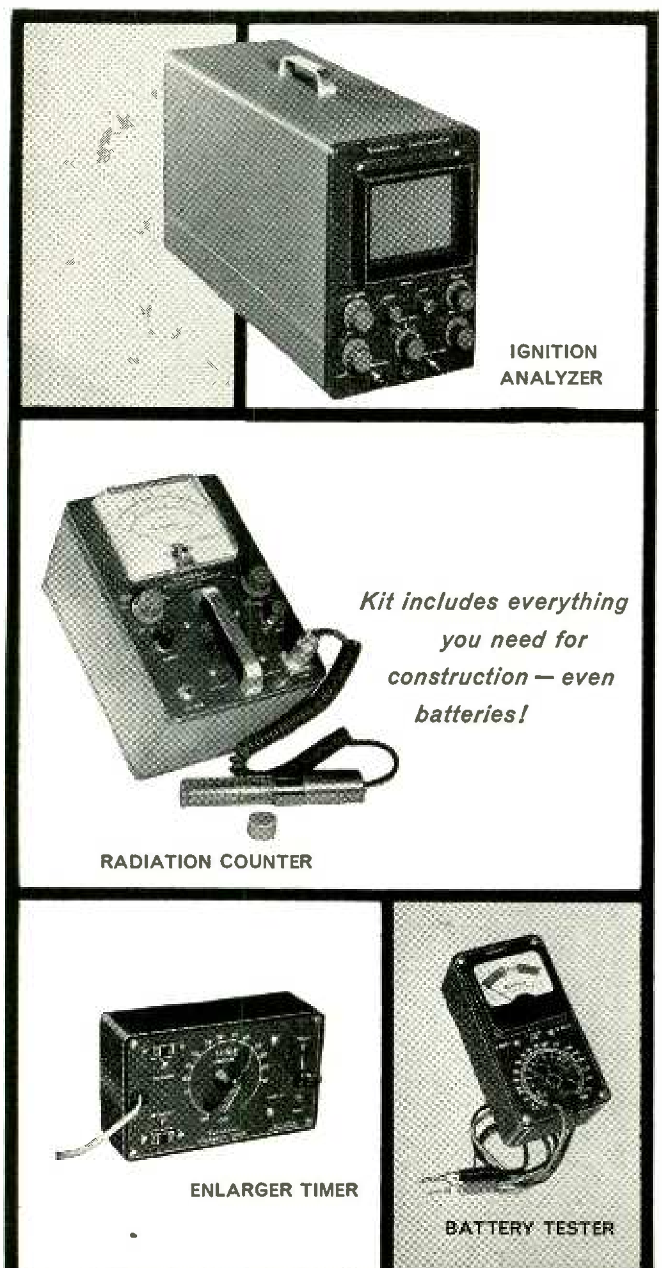
$59.95

HEATHKIT PROFESSIONAL RADIATION COUNTER KIT

This Heathkit professional-type radiation counter is simple to build successfully, even if you have never built a kit before. Complete step-by-step instructions are combined with giant-size pictorial diagrams for easy assembly. By "building it yourself" you can have a modern-design, professional radiation counter priced far below comparable units. Provides high sensitivity with ranges from 0-100, 600, 6000 and 60,000 counts-per-minute, and 0-.02, .1, 1 and 10 miliroentgens-per-hour. Employs 900-volt bismuth tube in beta/gamma sensitive probe. Probe and 8-foot expandable cable included in kit price, as is a radiation sample for calibration. Use it in medical laboratories, or as a prospecting tool, and for civil defense to detect radioactive fallout, or other unknown radiation levels. Features a selectable time constant. Meter calibrated in CPM or mR/hour in addition to "beep" or "click" from panel-mounted speaker. Prebuilt "packaged" high voltage power supply with reserve capacity above 900 volt level at which it is regulated. Merely changing regulator tube type would allow use of scintillation probe if desired. Employs five tubes (plus a transistor) to insure stable and reliable operation. Kit price includes batteries. Shpg. Wt. 8 lbs.

MODEL RC-1

$79.95



Heathkits...

By DAYSTROM

are supplied with comprehensive instructions that eliminate costly mistakes and save valuable time

HEATHKIT ENLARGER TIMER KIT

The ET-1 is an easy-to-build electronic device to be used by amateur or professional photographers in timing enlarger operations. The calibrated dial on the timer covers 0 to 1 minute, calibrated in 5-second gradations. The continuously variable control allows setting of the "on" cycle of your enlarger, which is plugged into a receptacle on the front panel of the ET-1. A "safe light" can also be plugged in so that it is automatically turned "on" when the enlarger is turned "off." Handles up to 350 watts with built-in relay. All-electronic timing cycle insures maximum accuracy. Timer does not have to be reset after each cycle, merely flip lever switch to print, to repeat time cycle. A control is provided for initial calibration. Housed in a compact plastic case that will resist attack of photographic chemicals. A fine addition to any dark room. Shpg. Wt. 3 lbs.

MODEL ET-1

$11.50

HEATHKIT BATTERY TESTER KIT

The BT-1 is a special battery testing device that actually "loads" the battery under test (draws current from it) while it is being tested. Weak batteries often test "good" with an ordinary voltmeter but the built-in load resistance of the BT-1 automatically draws enough current from the battery to reveal its true condition. Simple to operate with "good-weak-replace" scale. Tests all kinds of dry cell batteries within ranges of 0-15 volts and 0-180 volts. Slide switch provides for either 10 ma or 100 ma load, depending on whether you're testing an A or B battery. Not only determines when battery is completely exhausted, but makes it possible to anticipate failure by noting weak condition. Ideal for testing dry cell hearing aid, flashlight, portable radio, and model airplane batteries. Test batteries in a way your customers can understand and stimulate battery sales. Shpg. Wt. 2 lbs.

MODEL BT-1

$8.50

HEATHKIT CRYSTAL RADIO KIT

The Heathkit model CR-1 crystal radio is similar to the "crystal sets" of the early radio days except that it has been improved by the use of sealed germanium diodes and efficient "high-Q" coils. The sealed diodes eliminate the critical "cats whisker" adjustment, and the ferrite coils are much more efficient for greater signal strength. Housed in a compact plastic box, the CR-1 uses two tuned circuits, each with a variable tuning capacitor, to select the local station. It covers the broadcast band from 540 to 1600 kc. Requires no external power whatsoever. This receiver could prove valuable to emergency reception of civil defense signals should there be a power failure. The low kit price even includes headphones. Complete step-by-step instructions and large pictorial diagrams are supplied for easy assembly. The instruction manual also provides the builder with the basic fundamentals of signal reception so that he understands how the crystal receiver functions. An interesting and valuable "do-it-yourself" project for all ages. Shpg. Wt. 3 lbs.

MODEL CR-1
$7^{95}

Heathkits...

By DAYSTROM

are easy and fun to build, and they let you learn by "doing-it-yourself"

HEATHKIT TRANSISTOR PORTABLE RADIO KIT

Heath engineers set out to develop a "universal" AM radio, suitable for use anywhere. Their objective was a portable that would be as much "at home" inside as it is outside, and would feature top quality components for high performance and long service life. The model XR-1 is the result of these efforts. Six name-brand (Texas Instrument) transistors were selected for extra good sensitivity and selectivity. A 4" by 6" PM speaker with heavy magnet was chosen to insure fine tone quality. The power supply was designed to use six standard size "D" flashlight cells because they are readily available, inexpensive, and because they afford extremely long battery life (between 500 and 1000 hours). Costs you no more to operate from batteries than what you pay for operating a small table-model radio from the power line. An unbreakable molded plastic was selected for cabinet material because of its durability and striking beauty. Circuit is compact and efficient, yet components are not excessively crowded. Transformers are prealigned so it is ready for service as soon as construction is completed. Has built in rod-type antenna for reception in all locations. Cabinet dimensions are 9" L x 8" H x 3¾" D. Comes in holiday gray, with gold-anodized metal speaker grille. Compare this portable, feature by feature, to all others on the market, and you'll appreciate what a tremendous dollar value it represents! Shpg. Wt. 4 lbs.

MODEL XR-1
$34^{95}
(Less batteries)
(With cabinet)

HEATHKIT BROADCAST BAND RADIO KIT

This table-model broadcast radio is fun to build, and is a fine little receiver for your home. It covers the standard broadcast band from 550 to 1600 kc with good sensitivity and selectivity. The 5½" PM speaker provides surprisingly good tone quality. High-gain IF transformers, miniature tubes, and a rod-type built in antenna, assure good reception in all locations. The power supply is transformer operated, as opposed to many of the economy "AC-DC" types. It's easy to build from the step-by-step instructions, and the construction manual includes information on operational theory, for educational purposes. Your success is assured by completely detailed information which also explains resistor and capacitor color codes, soldering techniques, use of tools, etc. A signal generator is recommended for final alignment. Shpg. Wt. 10 lbs.

Cabinet: Fabric covered cabinet with aluminum panel as shown. Shpg. Wt. 5 lbs. Part no. 91-9A. $4.95.

MODEL BR-2
$18^{95}
(Less cabinet)

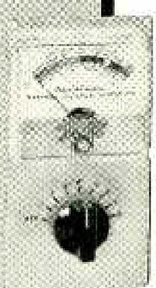
HEATH COMPANY *A Subsidiary of Daystrom, Inc.* **BENTON HARBOR 20, MICH.**

protects against possible explosion and fire from undetected fuel vapor

FUEL VAPOR DETECTOR

detects electrolysis currents which cause deterioration of underwater metal fittings on your boat

ELECTROLYSIS DETECTOR



indicates condition and charge of batteries for safe cruising

BATTERY CHARGE INDICATOR

R.F. POWER METER

HEATHKIT FUEL VAPOR DETECTOR KIT

Protect your boat and its passengers against fire or explosion from undetected fuel vapor by building and using one of these fine units. The Heathkit Fuel Vapor Detector indicates the presence of fumes on a three-color "safe-dangerous" meter scale and immediately shows if it is safe to start the engine. A pilot light on the front panel shows when the detector is operating, and it can be left on continuously, or just used intermittently. A panel control enables initial calibration of the detector when installed. Features a hermetically-sealed meter with chrome bezel, and a chrome-plated brass panel. It is very simple to build and install, even by one not having previous experience. Models FD-1-6 (6 volts DC) and FD-1-12 (12 volts DC) operate from your boat batteries. The kit is complete in every detail, even to the inclusion of a spare detector unit. Shpg. Wt. 4 lbs.

6 volt MODEL FD-1-6
12 volt MODEL FD-1-12
$35.95 EACH

HEATHKIT BATTERY CHARGE INDICATOR KIT

The Heathkit model CI-1 Marine Battery Charge Indicator has been designed especially for the boat owner, although it has found use in service stations, power stations, and radio stations where banks of batteries are kept in reserve for emergency power. It is intended to replace the hydrometer method of checking storage batteries, and to eliminate the necessity for working with acid in small, below-decks enclosures. Now it is possible to check as few as one, or as many as eight storage batteries, merely by turning the switch and watching the meter. A glance at the meter tells you instantly whether your batteries are sufficiently charged for safe cruising. Dimensions are 2-7/8" W x 5-11/16" H x 2" D. Operates on either 6 or 12 volt systems using lead-acid batteries, regardless of size. Simple installation can be accomplished by the boat owner in fifteen minutes. Shpg. Wt. 3 lbs.

MODEL CI-1
$16.95

HEATHKIT ELECTROLYSIS DETECTOR KIT

The Heathkit model ED-1 Electrolysis Detector indicates the extent of electrolysis currents between the boat's common ground and underwater fittings, except on boats having metal hulls. These currents, undetected, could cause gradual corrosion and deterioration of the propeller or other metal fittings below the water line. It is particularly helpful when installing electrical equipment of any kind, or to determine proper polarity when power is obtained from a shore supply. Easy-to-build, the model ED-1 consists of a hermetically-sealed, waterproof meter, special sensing plate, and sufficient wire to install, including the necessary hardware. Mounts on instrument panel where it can be easily seen. Requires no power for operation, and gives instant warning to guard your boat for a lifetime. Shpg. Wt. 2 lbs.

MODEL ED-1
$9.95

HEATHKIT RF POWER METER KIT

The Heathkit RF Power Meter Kit is designed to sample the RF field in the vicinity of your transmitter, whether it be marine, mobile, or fixed. Output meter is merely placed in some location close to the transmitter, to pick up RF radiation from the antenna. Requires no batteries, electricity, nor direct connection to the transmitter. It provides you with a continuing indication of transmitter operation. You can easily detect if power is dropping off by comparing present meter readings with past ones. Operates with any transmitter having output frequencies between 100 kc and 250 mc, regardless of power. Sensitivity is 0.3 volts RMS full scale, and a special control on the panel allows for further adjustment of the sensitivity. Meter is a 200 ua unit, mounted on a chrome-plated brass panel. The entire PM-1 measures only 3¾" W x 6¼" L x 2" D. An easy way to put your mind at ease concerning transmitter operation. Shpg. Wt. 2 lbs.

MODEL PM-1
$14.95

Heathkits...

By DAYSTROM

now offer you completely modern marine equipment with outstanding design features

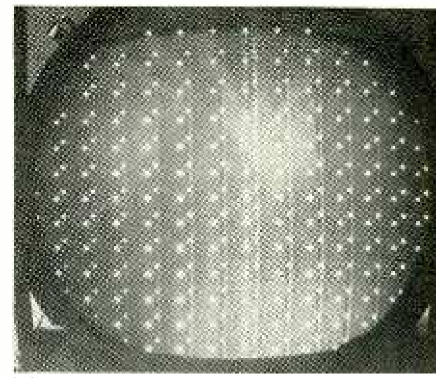


Fig. 3—Column lineup is not as evident when a dot pattern is used.

(*Continued from page* 59)

lucky. I harpooned it before it got up and ran off."

"Say, Red . . ."

"What now?"

"I hear they got a hoot-nanny out that you can plug on the base of the picture tube. It's supposed to have a switch that you use to turn on the red or blue or green by itself."

"Nothing wrong with your hearing," Red remarked. "Yep, what it does is to ground two grids at a time. The cathodes run positive in a color set, so that's the same as putting a negative bias on the grids."

"Seems like that would be real fine for checking field purity," Fuzzball suggested.

"It's a timesaver," Red agreed. "In fact we have half a dozen on order. We're going to use them on the bench, too."

"For what?"

"Well," replied Red, "it's got six other switch positions, too. You can switch a pair of binding posts into the different grid and cathode circuits of the picture tube for a quick voltage check all around."

"You connect a meter to the hoot-nanny?"

"Yep. Has a pair of binding posts for connecting the meter."

"What won't they think of next?" asked Fuzzball.

"Do you really want to know?" asked Red challengingly.

"Reckon I'll pass," Fuzzball replied. "What other gimmicks should I know about for installation work?"

"Well, in case you are working on your own set sometime, where you are interested in doing a good job, you'll find a low-power pocket microscope is handy."

"A microscope?"

"M-I-C-R-O-S-C-O-P-E," Red spelled out emphatically.

"All right, you don't have to throw your weight around," Fuzzball grumbled; "what would I be doing with a microscope?"

"It's for checking field purity," Red explained. "It's a sort of head shrinker that reduces a swelled head real fast."

"How do I use it?" asked Fuzzball.

"Let's get into that one another time," suggested Red. "Bess is getting ready to throw us out." END

build with the best... JBL signature loudspeakers!

The careful work you do in building your high fidelity sound system will be shown off to best advantage if you use precision-made JBL SIGNATURE Loudspeakers. These are the most efficient units to be found anywhere, made with the most exacting care, meticulous attention to detail. Remember, it takes no more effort on your part to build with the best.

MODEL D130
15" Extended Range Loudspeaker

The only 15" extended range speaker made with a 4" voice coil is the world-famous JBL Signature D130. The large voice coil stiffens the cone for crisp, clean bass; smooth, extended highs. Your basic speaker, the D130 works alone at first, later becomes a low frequency driver when you add a JBL Signature high frequency unit and dividing network to achieve the ultimate excellence of a JBL Signature two-way system.

MODEL D208
8" Extended Range Loudspeaker

A precision transducer in every sense of the word, the famed JBL Signature 8" D208 is made with the same care and precision as the larger units in the James B. Lansing Sound, Inc., line. If space and cost are major considerations, the D208, properly enclosed, provides the most lastingly satisfactory sound you can get. It is widely used in top quality systems where extension speakers are desired for areas other than the main listening room.

MODEL D123
12" Extended Range Loudspeaker

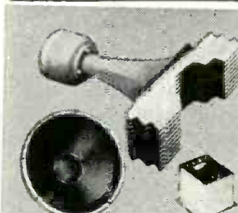
With outstancing "presence" and clean response throughout the entire audio spectrum, the D123 features an unusual shallow construction. Only 3⅝" deep, it is designed to mount flush with the wall, between studding, in any standard wall or partition. Frequently, the D123 is used in multiples in "infinite baffle" wall installations. In this case the JBL Signature 075 is a logical high frequency unit to add when you advance to a two-way system.

MODEL 075
High Frequency Unit

Another exclusive for James B. Lansing Sound, Inc., is the ring radiator in the JBL Signature 075 high frequency unit. A ring, rather than a diaphragm, radiates into the annular throat of an exponential horn. The result is high frequency reproduction of unmatched smoothness and clarity, absolutely free of resonances and strident peaks. The horn is beautifully machined from aluminum, the entire unit a gratifying, solid piece of fine craftsmanship. Designed for crossover at 2500 cycles with the JBL Signature N2500 Network.

MODEL 175DLH High Frequency Assembly

The acoustical lens is only available on JBL Signature high frequency units. The 14 element lens on the 175DLH disperses sound within the listening area over a 90° solid angle, smoothly, with equal intensity regardless of frequency. The acoustical lens is the greatest contribution to lifelike high frequency reproduction in 20 years, and it was developed for use with high fidelity equipment by James B. Lansing Sound, Inc. In addition to the lens the 175DLH consists of a high precision driver with complex phasing plug and a machined aluminum exponential horn. Designed for crossover at 1200 cycles with the JBL Signature N1200 Network.



JBL Signature Two-way Systems Are Available As Kits

086 KIT This two-way system is made up of units which have been acclaimed by impartial authorities as the finest available anywhere today. Included in the kit are the 150-4C Low Frequency Driver, N500H Network, 375 High Frequency Driver, 537-509 Horn-Lens Assembly. These are the same units—including the serpentine acoustical lens—which are used in The Hartsfield . . . units designed originally for installation in the most modern theaters in the world.

There are many more kits and loudspeakers in the JBL Signature line. Whatever your needs, you will find exactly the right unit or system in the complete JBL Signature catalog. Send for your free copy. A limited number of technical bulletins are also available. Please ask only for those in which you are vitally interested.

JBL *means* **James B. Lansing Sound, Inc.**

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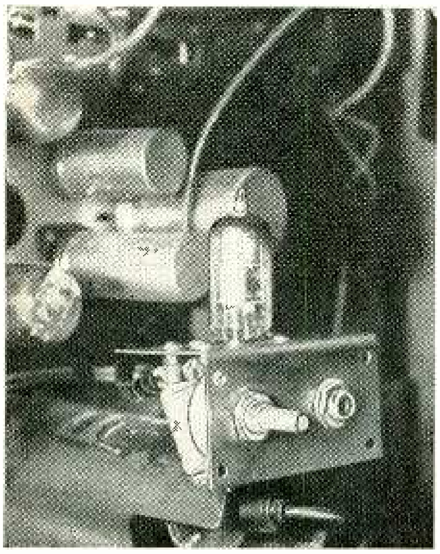
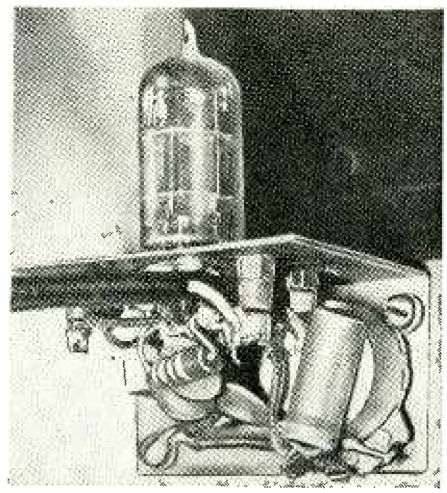
TELEVISION HEARING AID

A separate amplifier and volume control for individual listening

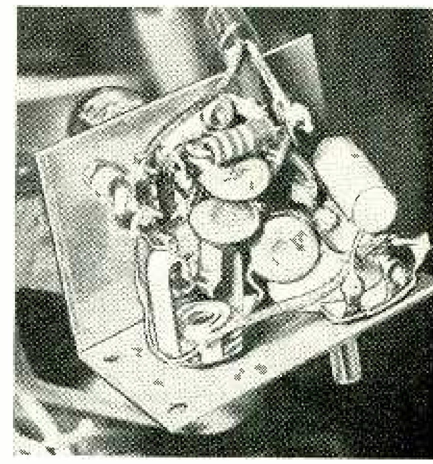
By JOSEPH COZZO



Front view shows control and jack.

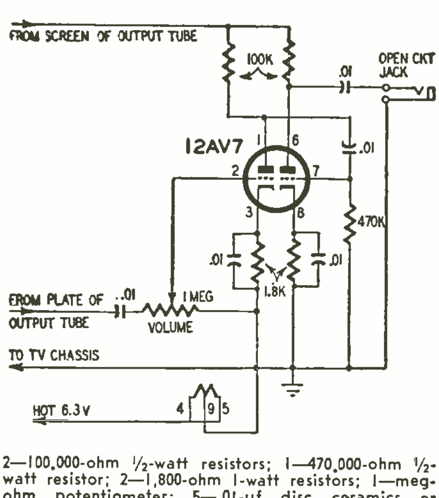


Amplifier on rear of front panel.



The underchassis of the amplifier.

ONE member of our family could get no pleasure out of the TV set because he is hard of hearing. No matter how high the volume was turned up it did no good and of course there were others to consider. A hearing aid didn't help much as it picked up too much noise from sources other than the TV set. A phono jack could have been used but the volume control then could be set only either for loudspeaker or phones.



2—100,000-ohm ½-watt resistors; 1—470,000-ohm ½-watt resistor; 2—1,800-ohm 1-watt resistors; 1—meg-ohm potentiometer; 5—.01-μf disc ceramics or tubular capacitors; 1—12AV7 tube; 1—9-pin miniature socket; 1—open circuit jack; 1—chassis.

Schematic diagram of the hearing aid.

Obviously, the answer was a separate amplifier and gain control. Preferably, the amplifier should be peaked at the higher frequencies for that is where most of the hearing range of the hard of hearing usually lies. (Many authorities believe that a flat response is more satisfactory to the usual hard-of-hearing person.—*Editor*)

This unit was the result. It is a simple two-stage amplifier (see diagram) and provides more than enough gain. No attempt was made at high fidelity, the only requirements being crispness and clarity.

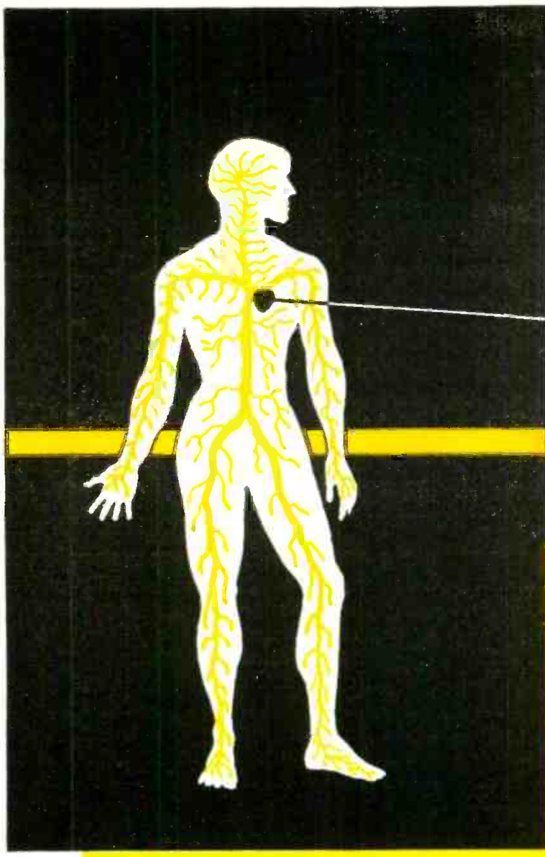
The amplifier input is taken from the audio output tube so that there is always enough signal to drive the amplifier input section even though the speaker volume is turned down to the point where no one else can hear it. This makes it useful for late-hour listening when others are asleep, even for those whose hearing is not impaired.

I took the audio input from the plate (pin 5) of a 6AQ5. The B plus for the hearing aid came from the screen grid (pin 6). Pin 3 supplies the hot 6.3-volt side of the heater and ground return was made to the chassis. For other output tubes use the same system, connecting the leads to corresponding pins. The input lead should be shielded and the shield itself used for ground and heater return. Make all grounds to one point on the chassis. A word of caution: before wiring in the hot heater lead, check to see which is the ground side. If this connection is not properly made, it will short the 6.3-volt winding of the power transformer to ground and probably burn out your transformer.

The chassis is a sheet-metal angle and can be made any convenient size. It is held to the inside of the TV cabinet by screws and the necessary holes drilled in the front of the cabinet for the gain control and earphone jack. If it is not desirable to drill holes in the cabinet, the amplifier can be built in a small box and kept near the receiver.

The circuit shown in the diagram was designed for a receiver having its heaters in parallel. Series-string heaters will require some modification, especially if the chassis is transformerless. In such case a .01-μf capacitor should be placed between the output jack and the lead to the TV chassis. This will isolate the phones from the ac line.

The 12AV7 draws 450 ma with its heaters in parallel. This may exceed the safe operating limits of the existing power transformer or make it difficult to use in series strings. The problem can be overcome by using a separate heater transformer or a tube such as the 12AU7 which draws only 300 ma. If a 12AU7 is used, the plate and cathode resistor values may have to be varied slightly to obtain maximum gain. END



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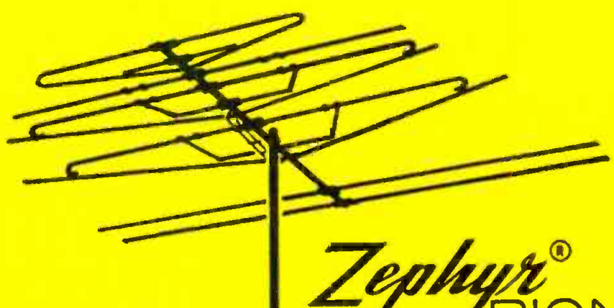

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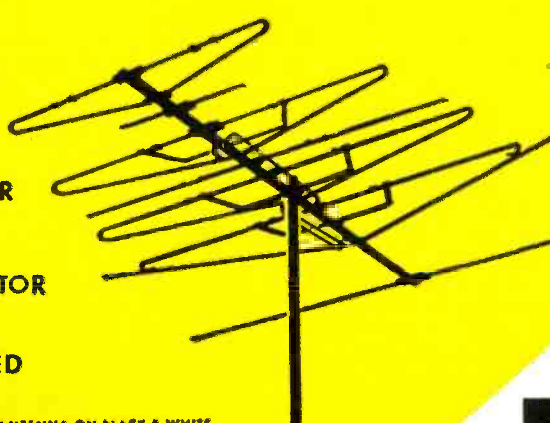

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Understanding auxiliary TV circuits

The tail ends you rarely hear about, but often cause trouble

By CHARLES GARRETT

TV RECEIVERS are spotted with a number of special circuits and circuit components that can be troublesome to the service technician unless he is throughly aware of their normal and abnormal operation.

Horizontal peaking

The largest group of auxiliary circuits (circuits and components most often ignored or left out when discussing or simplifying the TV receiver's main circuitry) is located in the deflection oscillators and their associated circuitry. Some of these networks are shown in Fig. 1. The networks labeled a, b, c and d are all sawtooth-forming circuits. As their fundamental operation is the same, only network a is detailed. It is the sawtooth-forming network for a horizontal multivibrator.

The output from a multivibrator cannot be used directly to drive the horizontal output tube and deflection circuits as it is basically a square wave and not the sawtooth usually thought of in its connection. Photo A shows the output of the horizontal multivibrator with the sawtooth-forming network removed. The sawtooth has to be formed from this "square wave" to obtain a linear raster.

In normal operation the capacitor (called either charging or discharging capacitor) prevents the horizontal plate voltage from rising sharply by storing the rapid voltage change during its steady charging period. It releases its charge when the horizontal oscillator fires during the horizontal retrace period.

The series resistor in this circuit, by slowing down the capacitor's discharge, forms a negative pulse following the capacitor discharge. Photo B is the square wave found at the junction of the capacitor and resistor in circuits 1-a, 1-c and 1-d. This waveform combines with the capacitor waveform to form a modified sawtooth wave. The resistor determines the size of the negative pulse the sawtooth waveform will have. The size of the negative pulse that is needed is determined by the type of horizontal output tube used, and the design of the output transformer and output circuit whose inductance has to be overcome before the sawtooth portion can produce a linear sweep and raster. Photo C shows the waveform at the horizontal multivibrator's plate, with the resistor in circuit 1-a removed and the capacitor going directly to ground. The modified sawtooth in Photo D appears at the plate of the horizontal multivibrator with circuit 1-a connected. This waveform is found in the older TV sets. Photo E shows another modified waveform found at the plate of a horizontal multivibrator with circuit 1-a connected. This is the normal plate waveform in most modern sets.

Improper operation of this circuit is not always obvious. The symptoms are very similar to those that can originate in other circuits and components. For example, in many receivers, when the capacitor or resistor opens, the only symptom is a slightly nonlinear raster on the left half of the screen. In this case, the damper or linearity circuit would normally be suspected instead of the sawtooth-forming network. However, overdrive bars in the center of the screen or even complete loss of raster are the more common symptoms of an open sawtooth-forming network. A shorted resistor or one that has decreased in resistance will cause the raster to narrow somewhat and be nonlinear near its center. But several other circuit defects or misadjustments can produce similar symptoms.

In every case of stubborn nonlinearity or insufficient width or heighth, an oscilloscope check should be made of the waveform at test points TP in Fig. 1 to determine if the source of the trouble is in the sawtooth-forming network.

Circuit 1-b is the sawtooth capacitor in a pulse-width type of horizontal oscillator. When this capacitor opens, it so greatly upsets the characteristics of this circuit that it usually kills the raster. This is because the normal waveform at the tap on the oscillator or transformer is destroyed and the oscillator is thrown way off frequency. Direct substitution is the easiest way to check this capacitor.

Stabilizing circuits

Networks a and b in Fig. 2 are horizontal stabilizing or ringing coils. Their function is not vital to the receiver's performance—horizontal oscillators could function without them, though not without some sacrifice of picture stability. Photo F shows the effect of a misaligned horizontal ringing coil. Notice how the letters are distorted.

Their normal operation is as follows: When correctly tuned to the horizontal frequency of 15,750 cycles, they are shocked into sine-wave oscillation and this voltage combines with the normal circuit waveform.

This combined negative voltage (during cutoff) holds the second grid of the horizontal multivibrator or pulse-width oscillator more negative and more evenly negative until the tube is properly triggered by the positive-going sync pulses. Thus, positive noise pulses have to overcome an even greater negative voltage before they can prematurely fire the circuit. Also, the positive half of the sine wave will properly trigger the tube into conduction even if sync pulses are temporarily absent.

The sine wave formed by this circuit is finally eliminated by the sawtooth-forming capacitor, as previously described.

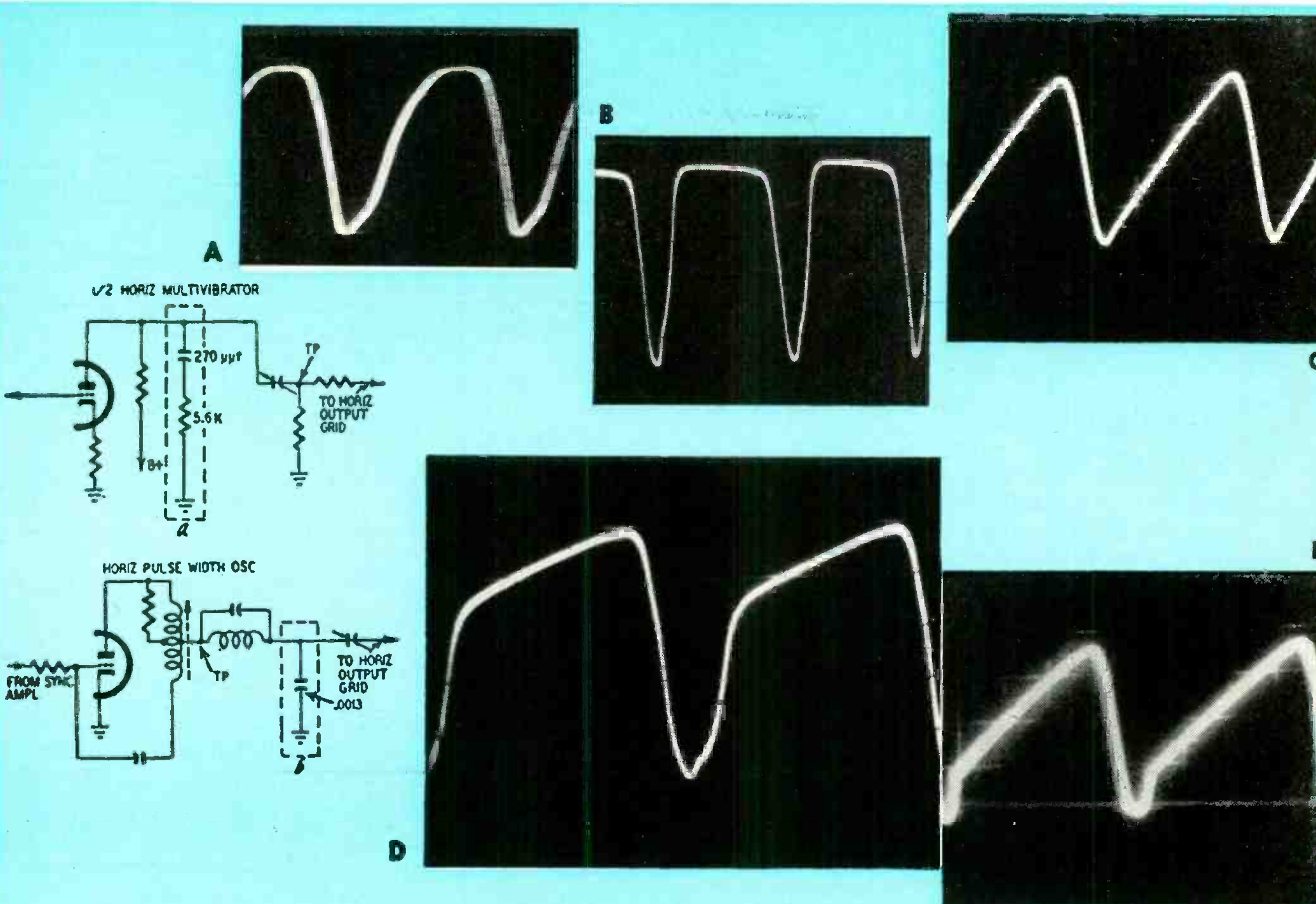
Circuit 2-a is normally aligned with a voltmeter. A jumper is first placed across the coil and the negative voltage on the multivibrator input grid test point is measured and recorded. The jumper is then removed and the coil aligned by adjusting it until grid voltage returns to the value it had with the jumper in place.

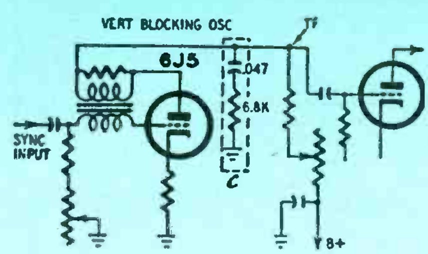
If the coil is not responsive to adjustment, it may be open, contain shorted turns or its shunting resistor or capacitor may be defective.

Circuit 2-b is aligned with an oscilloscope. The slug of coil L2 is adjusted until a waveform like that in Photo G is formed. This waveform should be present at the tap on L1. Adjustment of L1's slug may be required to hold the picture in horizontal sync during alignment of L2.

This circuit can produce severe raster tearing when it approaches correct alignment. Photo H shows raster breakup due to incorrect adjustment of horizontal stabilizing coils. Therefore, once the proper scope waveform is formed, some slight touchup may be required to keep the raster from breaking up within the normal horizontal-hold range of the set.

That about closes the shop for this month. Look for more on accessory circuits in a future issue. Retrace blanking, vertical peaking and yoke damping defects will be discussed. END





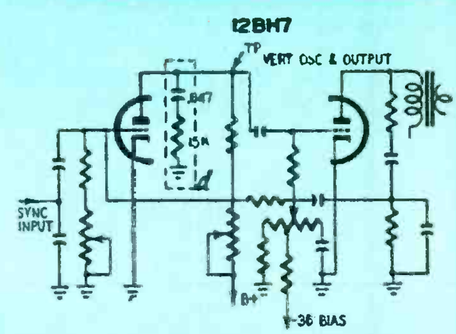
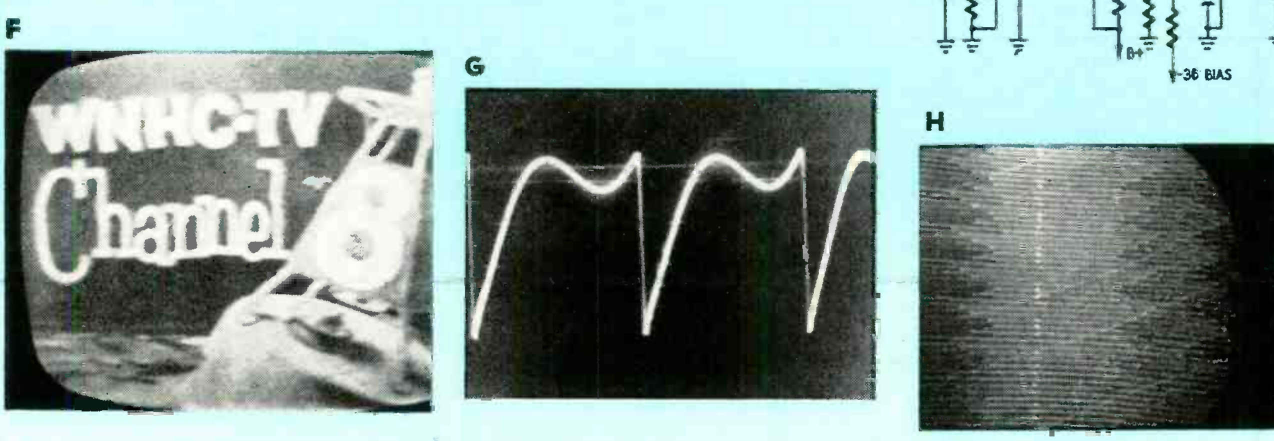


Fig. 1—Sections of deflection oscillator circuits: a, b, c, and d are sawtooth forming networks.



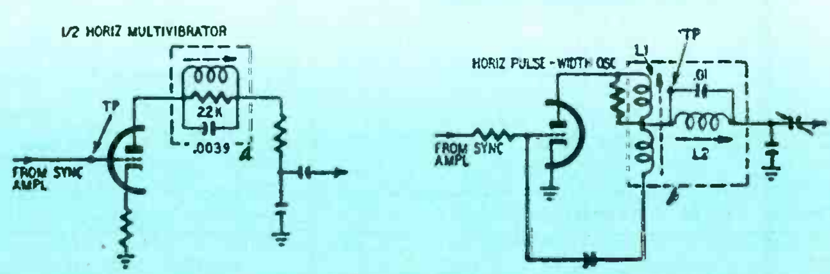


Fig. 2—Horizontal stabilizing or ringing coils are found in horizontal oscillator circuits.

TELEVISION

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Our record books showed more than the usual number of calls for service, far exceeding the average for the fine set we had sold.

Finally we got the story from a disgruntled neighbor of the loud-mouthed brother. Unwilling to pay the legitimate price for a receiver like the one his brother had bought from us, the mouthy man had purchased an exactly similar one from a fly-by-night discounter at a substantial price reduction.

He couldn't get service from the discounter, on the low price he'd paid. So, each time the set conked out, he'd cart it over to the brother's house and hook it up in place of the one we'd sold. Then the brother would phone us that his set was on the blink.

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(The Miller concern has our sympathy, but not too much of it. We have always insisted that a service shop should have the serial number of every set that is repaired—Mr. Miller's experience is only one of the many reasons for that. For a dealer this precaution is many times more necessary than it is for a service technician.—*Editor*)

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TV Service CLINIC

conducted by

ROBERT G. MIDDLETON

A COLOR TV receiver can be a rather frightening object, when we go out on our first service call. All the confidence that we feel back at the shop seems to sort of ooze out of our pores as we turn on the receiver and begin to study the symptoms.

However, most color receiver servicing requires only replacement of defective tubes. Fig. 1 shows a partial block diagram of a color receiver. You can see that a faulty tube can sometimes be localized by observing the reproduction (or lack of reproduction) of chroma, black-and-white and audio signals. Even the noise reproduction has a definite story to tell about the receiver's circuits.

A complaint of no sound and no picture may indicate a faulty tube in the front end or in the if stages prior to the sound takeoff point.

A complaint of no color picture, but with black-and-white reproduction and sound OK, points to a faulty tube in the chroma or possibly in the color sync sections. For example, if the chroma bandpass amplifier tube is dead, no chroma signal can pass. In some cases, when the color afc tube is defective, the color signal rolls so fast on the screen that the colors produce a neutral gray, and the color drops out of the picture.

If the color picture is satisfactory but the sound is dead, the tubes in the sound channel should be checked, just as in a black-and-white receiver.

When the symptom is very poor definition, with colors dim and bluish, check the tubes in the Y channel between the color takeoff point and the picture tube.

Clear distinction must be made between *raster* colors and *signal* colors on the screen of the picture tube. Raster colors are present during black-and-white reception and in the absence of a signal. It is necessary to apply a color signal to the receiver before a check of the *signal* colors can be obtained. Signal colors appear superimposed upon the raster colors.

Raster colors are controlled by dc voltages on the cathodes, grids and screen grids of the color picture tube. Since modern color receivers often use dc coupling in the chroma channels, a tube fault which affects the signal may affect the background too. Here, the circuit diagram for the receiver is a valuable guide.

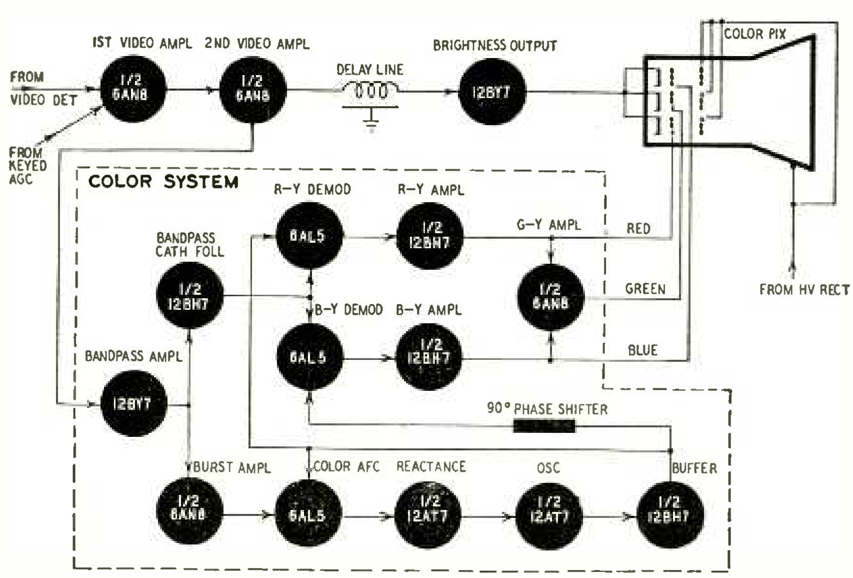

Fig. 1—Block diagram of color circuits in the Motorola TS-902.

Blown fuses

A few days after an Olympic 24-inch set (chassis 4CG26) was installed, it started blowing the ⅜-amp 250-volt fuses. A replacement fuse would last only a couple of days. The factory advised me to return to the flyback transformer. However, it seemed to me that the filter choke was grounding out. I replaced the choke with a resistor, slipped in a new fuse and the set operated OK for another day or so.

Then the damper tube blew and something in the horizontal output circuit is shorting out and smoking. The set is dead. Where should I start to nail this one down once and for all?—J. J. B., New Jersey.

I would suggest that the initial trouble with this receiver was a defect in the flyback, which occasionally drew excessive current from the horizontal output tube. However, there is also the possibility that the B-plus drain is marginal, due to an unsuspected leaky electrolytic capacitor in the power supply system. It is easy to confuse such a fault with an apparent grounding of the filter choke, which you noted. I suggest that you check through all the B-plus circuits to find out which one is drawing too much current (which causes the smoke that you mentioned). This check should lead you to the main difficulty. Even an ohmmeter check of the B-plus branch circuits should serve.

No sound

Complaint on a Crosley GC21TOL was "sound dead." The picture was normal. I found at the grid of the 25L6 a voltage of 170 instead of 142. Why is this voltage high and killing the sound?—A. F., Hamilton, Ont.

Use a .01-μf series capacitor with a pair of headphones as an audio signal tracer. Find out where the sound stops, and go to work at that point in the circuit. It is certainly true that a voltage of 170 on the grid of the 25L6 will kill the sound, if the cathode is running at the specified 150 volts. The 25L6 in this receiver is used as a voltage divider. If the receiver is operating normally except for sound, look for trouble in the divider resistors which bring the 280-volt supply down to 142 volts.

Dim raster

I am working on a G-E model 21C208U with symptoms that would seem to indicate a simple repair job. However, I have worked myself blue in the face and cannot come up with the trouble. It is a condition of intermittent dimming of the raster with insufficient vertical sweep. The set may be OK for a day or the trouble may occur when it is first turned on. All voltages and resistances check OK except the cathode of the 6V3 which reads 740 volts instead of 645.—R. R., Westernport, Md.

This intermittent trouble sounds very much like a bad electrolytic which is breaking down on occasion. The de-

(*Continued on page 93*)

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- 8 Inputs For Every Possible Signal Source
- Full 30 Watts Output • Custom-Styled Beauty

Comparable to the best in Hi-Fi—at far less cost! Deluxe features include: Linear-deluxe Williamson-type circuit for flawless response; equalization for all records within ½ db of recommended accuracy; 2 exclusive new printed circuit switches in preamp section (no complex wiring to do); 3 printed circuit boards for time-saving, error-free assembly; separate, continuously variable Level and Loudness controls; use of premium 12AY7 tube for low noise and hum; DC on all filaments of preamp tubes; exclusive A-AB-B speaker selector switch (use speakers of mixed impedances without mismatch). 8 inputs: Tape Head direct; G.E. and Pickering cartridges; Ceramic cartridge; Microphone; Auxiliary; Tape Preamp; Tuner (with separate Level Set control). Power amplifier response, ± ½ db, 15-100,000 cps at full 30 watt level; distortion—harmonic, 0.55% at 30 watts—IM, 0.74% at 20 watts. Separate Bass and Treble controls; rumble filter switch; variable damping. Output, 8 and 16 ohms. With smart French-gray cabinet, 4 x 15 x 15". Ready for easy, money-saving assembly. Shpg. wt., 32 lbs.

Model Y-762. 30-Watt Hi-Fi Amplifier Kit. Net only **$76.95**

knight-kit High Fidelity FM Tuner Kit

Model Y-751

$38.95

Only $3.89 down

- Authentic High Fidelity FM Response
- Flywheel Tuning • Automatic Frequency Control
- Printed Circuit • Pre-Adjusted Coils and IF's
- 4 Microvolt Sensitivity Guaranteed

Here is top value in creative engineering, impressive hi-fi performance and distinctive design—a tuner you'll be proud to build and own. Covers the full FM band, 88 to 108 mc. Features Automatic Frequency Control (with disabling feature) to "lock-in" stations and prevent drift; Inertia Flywheel Tuning for velvet-smooth, accurate station selection; pre-adjusted RF coils; pre-aligned IF's; cascode broad-band RF amplifier; drift-compensated oscillator; neon bulb pointer. All critical wiring is already done for you in the form of a printed circuit board—assembly is simple. Sensitivity is 4 microvolts for 20 db of quieting across entire band; output, 2 volts at 1000 microvolts input; IF bandwidth, 200 kc; response, 20-20,000 cps. with only 0.6% distortion. Output jacks for amplifier and tape recorder; cathode follower output. Ideal for use with the KNIGHT-KIT amplifiers, or any amplifier with phono-tuner switch. Features custom-styled case in French-gray, with tapered chrome-finished feet, 4 x 13 x 8". Includes all parts, tubes and step-by-step instructions for easy assembly. Shpg. wt., 12 lbs.

Model Y-751. Hi-Fi FM Tuner Kit. Net only **$38.95**

knight-kit Deluxe 3-Way Speaker System Kit

Model Y-937

$89.50

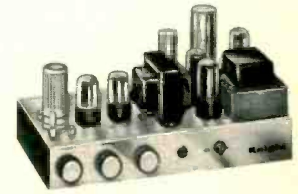
Only $8.95 down

- Pre-Finished "Quik-Craft" Corner Enclosure
- Klipsch Designed and Licensed
- Famous Knight 12" 3-Way Speaker
- Easy to Assemble—Top Hi-Fi Quality
- Choice of Enclosure Finishes

3-Way Speaker

Deluxe quality high fidelity speaker system at a money-saving low price. Easy to assemble—all you need is a screwdriver. System includes KNIGHT "Quik-Craft" corner-type folded-horn enclosure kit, and the famous-value KNIGHT 3-Way 12-inch speaker. Just assemble the enclosure—*no finishing required*—all surfaces are finished in hand-rubbed Korina blonde, mahogany or walnut. The speaker is the new 3-way type: 12" woofer cone for bass (full 1¾ pound woofer magnet), conical radiator for mid-frequencies, built-in compression-type tweeter (with wired level control and calibrated dial) for highest frequencies. Unexcelled enclosure efficiency and superb speaker performance combine to cover the whole spectrum of audible sound for true hi-fi response from 35 to 15,000 cps, ± 3 db. Kit includes 12" 3-Way speaker, prefinished enclosure panels, grille cloth, hardware and instructions. *Specify Korina blonde, mahogany or walnut when ordering.* Shpg. wt., 44 lbs.

Model Y-937. 3-Way Speaker System Kit. Net only **$89.50**



knight-kit 10-Watt Hi-Fi Amplifier Kit

Y-753

$23.50

$2.35 down

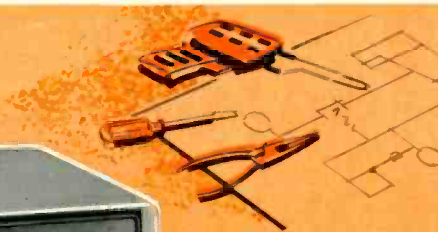
Low-cost, authentic hi-fi amplifier. Response, ± 1 db, 30-20,000 cps. Input for crystal phono or tuner; chrome-plated chassis is punched for preamp kit below, to permit use of magnetic phono. Only 0.5 volt drives amplifier to full output. Separate bass and treble controls. Only 1% harmonic distortion. Matches 8-ohm speaker. 7 x 13 x 6". With all parts, tubes and instructions. Shpg. wt., 13 lbs.

Model Y-753. Net only .. **$23.50**
Y-235. Preamp Kit..... **$ 3.10**
Y-757. Metal Cover .... **$ 3.95**

ALLIED RADIO *America's Pioneer in Electronic Kits*

knight-kits

THE VERY FINEST MUSICAL QUALITY—SO EASY TO BUILD
MONEY-SAVING HI-FI EVERYONE CAN AFFORD



So Easy To Build
Anyone can build KNIGHT-KIT HI-FI. No experience required to get top results!

knight-kit High Fidelity Preamplifier Kit

Model Y-754
$39.95
Only $3.99 down

- Exclusive Printed Circuit Switches and Boards
- Equalization ±½ db of Recommended Accuracy
- 8 Inputs Including Tape Head
- Self-Powered
- DC on All Tube Filaments
- Custom-Styled

Sensational Hi-Fi design at amazing low cost. Provides precise record equalization guaranteed within ½ db of recommended accuracy!—more accurate than all but the most expensive factory-built preamps. Includes exclusive new KNIGHT-KIT printed circuit switches for easy, error-free assembly; 2 printed circuit boards eliminate all other wiring, except for power supply and control leads—so easy to build. Has built-in power supply; includes premium 12AY7 and ECC82 tubes. Frequency response, ± 0.5 db, 10-50,000 cps. Has 8 inputs: Tape Head; G.E. Phono; Pickering Phono; Ceramic; Microphone; Auxiliary; Tape Preamp; Tuner. Level adjustment for tuner input. Includes separate Bass and Treble controls; separate Level and Loudness controls; Rumble Filter switch; DC on all tube filaments; cathode follower output; 2 extra AC outlets. You get every advanced hi-fi feature in this easy-to-build preamplifier at the lowest possible cost. Includes beautiful custom-styled French-gray case, with tapered chrome-finished legs, 4 x 13 x 8". With all parts, tubes, step-by-step instructions; ready for easy assembly. Shpg. wt., 12½ lbs.

Model Y-754. Hi-Fi Preamp Kit. Net only **$39.95**

knight-kit 25-Watt Hi-Fi Basic Amplifier Kit

Model Y-755
$44.50
Only $4.45 down

- Hi-Fi Response, ± 0.5 db, 10 to 120,000 cps
- Only 0.15% Distortion at 30 Watts Output
- Printed Circuit Wiring Board • Chrome-Plated Chassis
- Williamson-Type Circuit with Over 25 Watts Output

Here's superb Hi-Fi performance at less than half the cost of a comparable commercially-assembled unit. Williamson-type linear-deluxe circuit delivers over 25 watts of virtually undistorted reproduction. Ideal for use with the KNIGHT-KIT preamp at left. Includes printed circuit board for simplified, error-free assembly. Remarkable hi-fi response, ± 0.5 db, 10-120,000 cps at 20 watts. Harmonic distortion, 0.15% at 30 watts; IM, 0.4% at 20 watts. Hum level, 85 db below 25 watts output. Output impedances, 4, 8 and 16 ohms; output tubes, 2-5881. Includes balance control for precise matching of the output tubes; variable damping control for maximum performance with any speaker system—prevents low-frequency distortion from overdamping or underdamping. Very attractive black and chrome styling, 6¼ x 14 x 9". An outstanding engineering achievement in a basic hi-fi amplifier, delivering performance equal to the finest commercially assembled units. Includes all parts and tubes; with step-by-step instructions, ready for easy assembly. Shpg wt., 25 lbs.

Model Y-755. 25-Watt Amplifier Kit. Net only **$44.50**
Y-759. Metal Cover for above; black finish. 5 lbs. Net **$4.25**

knight-kit 20-Watt Hi-Fi Amplifier Kit

Y-750
$35.75
$3.57 down

True hi-fi for less! Complete with full set of controls and built-in preamplifier. Response, ± 1 db, 20-20,000 cps; distortion 1% at 20 watts. Inputs for magnetic phono, microphone, crystal phono or recorder, and tuner. Compensation positions for 78 and LP records. Separate bass and treble controls. Output impedances, 4, 8, 16 and 500 ohms. Chrome-plated chassis. 7 x 13 x 8¾". Ready for easy assembly. Shpg. wt., 20 lbs.

Model Y-750. Net only . . **$35.75**
Y-758. Metal Cover **$4.15**

knight-kit 2-Way Hi-Fi Speaker System Kit

Model Y-789
$49.95
Only $4.99 down

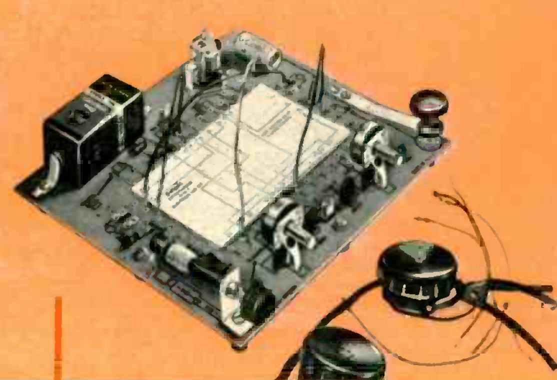
- Easy to Assemble—Pre-Finished Enclosure
- High Fidelity Response, 45 to 14,000 cps
- 12" Woofer and Horn-Type Tweeter
- A Wonderful Money-Saving Speaker Value

BIG SAVINGS—assemble your own quality KNIGHT-KIT 2-way speaker system—it's quick and easy! The cabinet is *pre-finished* in full-grained, high luster blonde or mahogany—you just assemble 7 pieces, mount the speaker components and enjoy rich, thrilling hi-fi sound—at incomparably low cost. Special Jensen-engineered baffle features "ducted port" construction to bring out the full beauty of bass notes, perfectly matching the Jensen woofer and compression tweeter; genuine L-pad control is rear-mounted to permit adjustment of tweeter for best tonal balance. Impedance, 16 ohms. The assembled unit delivers a frequency response of 45 to 14,000 cps. Enclosure measures 26 x 19 x 14". Beautifully styled to blend in any room. Kit includes Jensen 12" woofer, Jensen compression-type tweeter, pre-finished wood parts (with grille cloth installed), acoustic material, glue, hardware and step-by-step instructions. Absolutely no furniture finishing required. *Specify blonde or mahogany finish when ordering.* Shpg. wt., 33 lbs.

Model Y-789. 2-Way Speaker System Kit. Net only **$49.95**

knight-kit HI·FI IS AVAILABLE ON EASY TERMS TO FIT YOUR BUDGET

Fascinating ALLIED **knight-kits** FOR EXPERIMENTERS AND HOBBYISTS



knight-kit 2-Transistor Pocket Radio Receiver Kit

Model Y-262

$14.65

- Loud, Clear Local Reception
- Newest Printed Circuit Board
- Built-In Loop Antenna
- Complete Kit—Nothing Else To Buy

It's fun to build this pocket-size two-transistor radio —and you'll enjoy its crystal-clear local broadcast-band reception wherever you go! Fits in your pocket, or with its button-down flap, can be worn from your belt. Completely self-contained with built-in ferrite loopstick antenna—no external antenna needed. Extremely efficient reflex type 2-transistor circuit actually does the work of 3 transistors. Printed circuit board reduces building time to about one hour. Has air-dielectric variable capacitor for easy, accurate station tuning. Operates for months and months on long-life alkaline battery supplied. Sensitive miniature earpiece provides crystal-clear tone. Handsome tan carrying case, plastic-impregnated, is styled to resemble leather; only 4x3¾x1¾". Kit includes all parts, transistors, earpiece, battery and case. Shpg. wt., 1½ lbs.

Model Y-262. Net only **$14.65**

knight-kit "Trans-Midge" Transistor Receiver Kit

Model Y-767

$2.45

Tiny, cigarette-pack-size one-transistor radio kit—fascinating to build—so low-priced. This novel miniature receiver will provide endless listening pleasure the moment assembly is completed. Covers the local AM broadcast band with exceptional sensitivity and selectivity. Special features include: Efficient, slug-tuned coil for excellent station separation; external knob for easy station tuning; low-drain transistor operating for months from single penlight cell supplied; hinged-back, red plastic case. Kit includes all parts, transistor, battery, compact case and easy-to-follow instructions for quick assembly. (External antenna and headphones required.) Shpg. wt., 8 oz.

Model Y-767. Net only **$2.45**
J-149. 4000 Ohm Headphones. 1 lb. .. **$2.15**
C-100. Antenna Kit. 1½ lbs. **$1.03**

knight-kit 10-Circuit Transistor Lab Kit

Model Y-299

$15.75

Sensational experimenters' transistor kit—an electronic marvel! Perfect for experimenter, student or hobbyist. Assemble basic parts once, then complete project after project (10 in all), by simply plugging leads into proper jacks on printed circuit board—no wiring changes needed. You learn how transistors operate by "plugging in" to make any one of the following circuits; AM radio for strong headphone reception; 2-stage audio amplifier; wireless broadcaster; code practice oscillator; electronic timer; electronic switch; electronic flasher; photoelectronic relay; voice-operated relay; capacity-operated relay. Includes all parts, 2 transistors, battery, headphones, circuit leads, relay, photocell, special guide cards for each project, explanation of each circuit. 3 lbs.

Model Y-299. Net only **$15.75**

knight-kit 5-Transistor Superhet Personal Portable Radio Kit

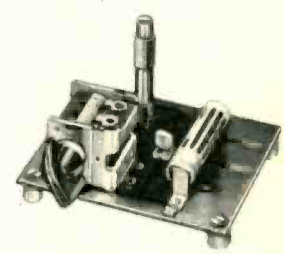
Model Y-766

$29.95

- Styled to Equal the Finest
- Push-Pull Audio Drives 3½" Speaker
- Printed Circuit for Easy Building
- 200 Hour Battery Playing Life

Beautiful, easy-to-build transistorized personal portable with every ultra-modern design feature: 5 Texas Instrument Co. transistors; latest printed circuit chassis for easy, error-free assembly; bigger-than-average 3½" speaker; class B push-pull audio output; built-in high-gain ferrite loopstick antenna; plus phone jack output for private listening. Provides sensitive reception of the AM broadcast band with exceptional tone quality. Ultra-smart high-impact ivory plastic case has handsome gold trim with ebony accents; includes pull-out handle; only 7½x3⅝x1¾". With all parts, transistors, 9 volt transistor radio battery, carrying case and instructions anyone can easily follow. Shpg. wt., 2 lbs.

Model Y-766. Net only **$29.95**



1-Transistor Radio Kit

$3.95

Offers excellent AM local broadcast headphone reception. Printed circuit board for easy assembly. Operates from single penlight cell for months. Complete with all parts, transistor and penlight cell. (Antenna and headphones required.) Shpg. wt., 1 lb.

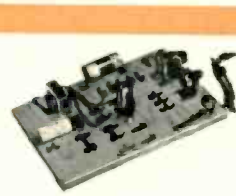
Model Y-765. Net only **$3.95**

"10-In-One" Electronic Lab Kit

$12.65

Famous experimenters' kit. Builds any of 10 fascinating projects, including broadcast receiver, wireless phono oscillator, code practice oscillator, signal tracer, relays, etc. Shpg. wt., 5 lbs.

Model Y-265. Net only **$12.65**



"6-In-One" Electronic Lab Kit

$8.45

A favorite with beginners. After basic wiring is completed, you make circuit changes without soldering. Builds any of six favorite projects, including radio, wireless broadcaster, etc. Shpg. wt., 3 lbs.

Model Y-770. Net only **$8.45**

Crystal Set Hobby Kit

$2.15

Entertaining, educational. Delivers clear headphone reception of local broadcast stations. With all parts, ready for easy assembly. (Antenna and headphones required.) Shpg. wt., 1 lb.

Model Y-261. Net only **$2.15**

Wireless Broadcaster Kit

$9.50

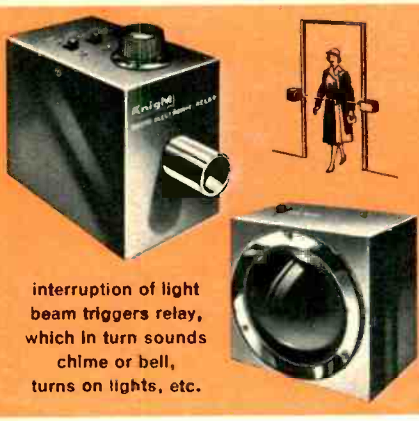
Play music or make announcements through your radio set—no connection to set required! Loads of fun—easy to build. Works up to 50 feet from set. Shpg. wt., 3 lbs.

Model Y-705. Net only **$9.50**

ORDER FROM ALLIED RADIO 100 N. WESTERN AVE. • CHICAGO 80, ILL.

FUN TO BUILD . . . INSTRUCTIVE . . . LATEST CIRCUITS FOR TOP PERFORMANCE

WIDEST CHOICE OF QUALITY HOBBYIST KITS



interruption of light beam triggers relay, which in turn sounds chime or bell, turns on lights, etc.

knight-kit Photoelectronic Relay Kit

Model Y-702 $13^{50}

Advanced-design, ultra-sensitive photoelectronic relay—build it yourself and save! Dozens of uses: for automatic control of lights, door announcer, burglar alarm, counting devices, etc. Provides dependable operation up to 250 feet with white light, up to 125 feet with "unseen" light (red filter) from Light Source Kit listed below. Selectable operation, with "trip" for burglar alarm to provide continuous ringing of alarm; and "auto" if relay is to operate each time beam is broken (for chimes, counting devices, turning on lights at darkness). Has SPST relay operated from thyratron; 6.3 v. terminals provide power for accessories. For 105-120 v. 50-60 cy. AC use. 6 lbs.

Model Y-702. Relay Kit. Net only . . **$13.50**

Model Y-703. Light Source Kit. With bulb and red filter. Shpg. wt., 3½ lbs. Net . **$6.75**

knight-kit "Ocean Hopper" All-Wave Radio Kit

Model Y-740 $11^{95}

This top-performing regenerative receiver puts a world of listening pleasure at your finger-tips. Tuning range (using coils listed below) is virtually world-wide; covers 155 kc to 35 mc. including every type of radio transmission: AM broadcast, marine, aircraft, distress channels, direction-finding, Amateur, frequency standard, foreign broadcast, and police. With bandspread tuning. For use with headphones or 3-4 ohm PM speaker. Kit is supplied with standard broadcast band coil and all tubes and parts. (Less extra coils, headphones, speaker and cabinet.) Shpg. wt., 5 lbs.

Model Y-740. Net only **$11.95**

Y-746. Cabinet for above. 1½ lbs. Net **$2.90**

Extra coils available: Long Wave Coil (155-470 kc), Net 79c. Short Wave (1.65—4.1 mc; 2.9—7.3 mc; 7—17.5 mc and 15.5—35 mc), Each 65c.

knight-kit "Space-Spanner" Bandswitching World-Wide Radio Kit

Model Y-243 $15^{95}

- Broadcast or Short Wave Reception
- Sensitive Regenerative Circuit
- Convenient Bandspread Tuning
- Built-In Loudspeaker

Imagine the thrill of hearing overseas broadcasts on a precision receiver you've built yourself—and then, at the flip of a switch being able to tune to your favorite local broadcast station! Bandswitch selects exciting short wave, including foreign broadcasts, amateur calls, aircraft, police and marine radio on the 6.5 to 17 mc range, as well as standard 540-1700 kc broadcasts. Features highly sensitive regenerative circuit. Includes built-in 4" PM speaker and beam-power tube for strong volume and clear tone. Headphone connectors are available for private listening; switch cuts out speaker. Controls: Bandspread, Main Tuning, Antenna Trimmer, Bandswitch, Regeneration, Volume. 7x10x6". Easy to build from step-by-step instruction manual. For 110-120 v., 50-60 cy. AC or DC. (Less cabinet.) Shpg. wt., 5 lbs.

Model Y-243. Net only **$15.95**

Y-247. Cabinet for above. Shpg. wt. 2 lbs. Net **$2.90**

"Ranger II" Superhet Receiver Kit

$17^{25}

Popular Broadcast band receiver built and enjoyed by thousands. Features built-in antenna, automatic volume control, ball-bearing tuning condenser, PM dynamic speaker. Handsome plastic cabinet. Easy to assemble. AC or DC operation. Shpg. wt., 8 lbs.

Model Y-735. Net only **$17.25**

knight-kit 2-Way Intercom System Kit

Model Y-295 $14^{75}

- Low Cost—Easy to Assemble
- High Gain—Clear Tone
- Handsome Metal Cabinets
- Includes 50-Foot Cable

Easy to build at lowest cost—ideal for home, office, shop or school. Consists of Master unit and Remote unit. Remote unit may be left "open" for answering calls from a distance, for "baby sitting", etc. Remote also may be set for "private" operation—cannot be "listened-in" on, but it can be called and can originate calls. Master unit includes high-gain 2-stage amplifier, combination volume control and on-off switch, plus pilot light. Each unit has 4" PM dynamic speaker. System responds to even a whisper. Handsome Antique white cabinets, each 4¾x6½x4⅜". With all parts, tubes and 50-ft. cable (up to 200-ft. may be added). For 110-120 v., AC or DC. 8 lbs.

Model Y-295. Master and one Remote. Net only . . **$14.75**

Y-296. Extra Remote Station Kit. 3 lbs. **$3.75**

Phono Amplifier Kit

$9^{45}

Build it yourself—and save! Ideal for use in a portable phonograph—just add record player and 3-4 ohm speaker. 1½ watts output. Inverse feedback circuit. Easy to assemble. Shpg. wt., 3 lbs.

Model Y-790. Net only **$9.45**

Electronic Photoflash Kit

$28^{50}

Ideal for color or black and white photography. 1/700th-of-a-second flash; 50 watt/second output. Synchronizes with any camera with X or O shutter. (Less battery.) Shpg. wt., 4 lbs.

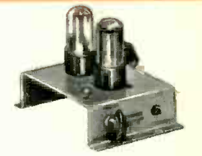
Model Y-244. Net only **$28.50**

Code Practice Oscillator Kit

$3^{95}

Ideal for beginners learning the code. Transistorized circuit. Operates for months from single penlight cell supplied. Clear, crisp 500 cycle tone. Jacks for headphones; screw terminals for key. 1 lb.

Model Y-239. Net only **$3.95**



Phono Oscillator Kit

$5^{85}

"Broadcasts" recorded music through any standard radio set up to 50 feet away. No direct connection to set required. Easy to build—fun to use. Shpg. wt., 2 lbs.

Model Y-760. Net only **$5.85**

FINEST ELECTRONIC EQUIPMENT IN EASY-TO-BUILD MONEY-SAVING KIT FORM

ADVANCED-DESIGN INSTRUMENTS FOR SERVICE, INDUSTRIAL AND RESEARCH USE IN EASIEST-TO-BUILD, MONEY-SAVING KIT FORM

knight-kit 20,000 Ohms/Volt VOM Kit

Model Y-140
$29^{50}

Outstanding quality and performance at money-saving low price. Features 1% precision multipliers; 4½" meter accurate within 2% of full scale deflection; 50 microamp sensitivity for 20,000 ohms/volt input resistance on DC; front panel "Zero adjust"; single switch to select function and range. 32 ranges: AC, DC and output volts, 0-2.5-10-50-250-1000-5000; Resistance, 0-2000-200,000 ohms and 0-20 meg.; DC ma, 0-0.1-10-100; DC amps, 0-1-10; Decibels, −30 to +63 in six ranges. Moisture-resistant film-type resistors for extreme accuracy. Carefully engineered circuit design achieves high sensitivity and extremely versatile application. Kit includes all parts, battery, test leads and black bakelite case with highly legible white markings; size 6¾ x 5¼ x 3¾". Easy to assemble. Shpg. wt., 5 lbs.

Model Y-140. Net only **$29.50**

knight-kit High-Gain Signal Tracer Kit

Model Y-135
$26^{50}

A remarkable value in an easy-to-build instrument which permits visual and aural signal tracing of RF, IF, video and audio circuits. Has *highest gain in its price class.* Traces signal from antenna to speaker. Reproduces signal at plate or grid connection of any stage. Identifies and isolates "dead" stages. Features: usable gain of *91,000;* "magic eye" with calibrated attenuators for signal presence indication and stage-by-stage gain measurements; built-in 4" PM speaker; combination 2-position probe, one for RF (6 mmf. input), the other for audio. Provides noise test; built-in watt-meter calibrated from 25 to *1000 watts;* provision for external scope or VTVM. Binding posts provide output transformer and speaker substitution test, plus external 280 volts B+. With all parts, tubes and probe. 7x10x5". 12 lbs.

Model Y-135. Net only **$26.50**

knight-kit 5" Wide-Band Oscilloscope Kit

Model Y-144
$69^{00}
Only $6.90 down

- 5 mc Width for Color TV
- Horizontal Sweep to 600 kc
- 25 mv/inch Sensitivity
- Z-Axis Input
- Printed Circuit Construction

Equals or betters the performance of commercially wired scopes costing far more. Two printed circuit boards and laced wiring harness assure wiring accuracy and cut assembly time. Ideal for lab use, color TV servicing and high frequency applications. Wide sweep range—*15 to 600,000 cps.* Vertical response, ± 3 db, 5 cps to 5 mc; only 1 db down at 3.58 mc color burst. High vertical sensitivity of .025 rms v/inch. Input capacity, 20 mmf. Outstanding features: cathode follower inputs; 2nd anode provides 1400 volts high-intensity trace; push-pull amplifiers; positive and negative locking; frequency-compensated attenuator; Z-axis input; one volt P-P calibrating voltage; astigmatism control; retrace blanking circuit; DC positioning control. Includes CRT. 14½ x 9½ x 16". 40 lbs.

Model Y-144. Net only **$69.00**
Y-148. Demodulator Probe. Net .... **$ 3.45**
Y-147. Low Capacity Probe. 12 mmf. Net ... **$ 3.45**

Voltage Calibrator Kit

$12^{75}

Permits use of any scope as precision peak-to-peak AC voltmeter. Puts a true square-wave voltage on scope screen. Selects any voltage between .01 and 100 volts; feeds external signal direct to scope for instant comparison. Shpg. wt., 5 lbs.

Model Y-136. Net only **$12.75**

knight-kit 5" General-Purpose Scope Kit

Model Y-146
$42^{00}
Only $4.20 down

- Phantastron Linear Sweep
- 25 mv/inch Sensitivity
- Printed Circuit Board
- Retrace Blanking Circuit

Feature for feature the world's best oscilloscope kit value. A standout in its class with all these fine features: *Printed Circuit* wiring board and laced harness for quick, error-free assembly. *Phantastron Sweep Circuit* for high linearity of sweep from 15 to 150,000 cps. *25 Millivolts Per Inch Sensitivity*—3 times that of similarly priced scope kits. *Calibration Voltage*—1 volt peak-to-peak square wave, fully regulated. *Vertical Amplifier*—frequency response ± 3 db, 3 cps to 1.5 mc (± 6 db to 2.5 mc). Includes: Directly coupled positioning controls; retrace blanking circuit; frequency-compensated vertical input attenuator; positive and negative internal sync; high 2nd-anode voltage for high-intensity trace; input capacity, 45 mmf. Kit includes CRT. 9½ x 13¾ x 17¾". 26 lbs.

Model Y-146. Net only **$42.00**

Resistance Substitution Box

$5^{95}

Easily determines resistor values required in a circuit. Makes available 36 standard 1-watt resistance values in 2 ranges between 15 ohms and 10 megohms, with 10% accuracy. Slide switch selects range; 18-position switch for value selection. Shpg. wt., 2 lbs.

Model Y-139. Net only .... **$ 5.95**

Capacitance Substitution Box

$5^{95}

Makes it easy to find capacitor values needed in a circuit. Provides 18 standard values from .0001 mfd to .22 mfd. ± 20%. All values are 600 volt, except .15 and .22, which are 400 volt. 18-position selector switch. Shpg. wt., 2 lbs.

Model Y-138. Net only .... **$ 5.95**

Audio Generator Kit

$31^{50}

Excellent design; range, 20 cps to 1 mc; less than .25% distortion; 600 ohm output. Ideal for hi-fi testing; offers the flat response of a lab standard. Shpg. wt., 16 lbs.

Model Y-137. Net only **$31.50**

R/C Tester Kit

$19^{50}

Measures capacitance and resistance. Balanced-bridge circuit; indicates power factor; tests capacitors at rated voltage. Large, easy-to-read dial and "magic eye." Shpg. wt., 10 lbs.

Model Y-124. Net only **$19.50**

EASY TERMS AVAILABLE

Take advantage of the most liberal Easy Pay plan in electronics. On Knight-Kit orders totaling $45 or more—just 10% down, small monthly payments thereafter. Low carrying charges—no "red tape."

knight-kits FOR THE RADIO AMATEUR

knight-kit 50-Watt CW Transmitter Kit

Model Y-255

$38^{95}

Only $3.89 down

- Ideal for the Novice
- Pi Antenna Coupler
- Bandswitching—80 to 10 Meters

There's exceptional value in this very popular bandswitching transmitter kit. Compact and versatile, it's the perfect low-power rig for the beginning novice as well as the seasoned veteran. Has bandswitching coverage of 80, 40, 20, 15 and 10 meters. Rated at 50 watts—actually operates at up to 60 watts on 80 and 40 meters. Oscillator is efficient 6AG7; final is reliable 807. Crisp, clean, cathode keying of oscillator and final. Built-in pi coupler permits use with random length antennas. Has highly effective TVI suppression. Other features not usually found in transmitter kits at this low price include: Ceramic-insulated final tank capacitor; pre-assembled switches; pre-wound parasitic chokes; ceramic coil forms; coax connector; crystal and VFO socket on front panel; power take-off jack for accessory equipment. Meter reads either plate or grid current of final. Takes crystal or VFO without circuit changes. Cabinet interior and chassis are copper-finished. Size, 8½ x 10½ x 8¼". With tubes and all parts for easy assembly. (Less crystal and key.) Shpg. wt., 19 lbs.

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- Tunes 540 kc to 31 mc
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- Constant Running HF Oscillator
- Worthy of the Advanced Ham Operator
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- 1.5 μv Sensitivity

A sensational communications receiver value with all the selectivity, sensitivity and features of high-priced commercial units. Uses printed circuitry throughout, including the exclusive new KNIGHT-KIT printed circuit bandswitch, for remarkably easy assembly. Covers 540 kc to 31 mc in 4 ranges; calibrated, electrical bandspread on 80-10 meter Ham bands; slug-tuned Hi-Q coils; continuous, VR tube-regulated B+ applied to HF oscillator lets you switch from standby to receive with no drift; built-in Q-multiplier peaks desired signal or nulls interference; delayed AVC; provision for crystal calibrator (below). Sensitivity, 1.5 microvolts for 10 db signal-to-noise ratio. Selectivity: variable from 300 cps to 4.5 kc at 6 db down. Exalted BFO injection. Controls: Main tuning, bandspread, band selector, Q-multiplier selectivity, Q-multiplier tune, null-off-peak, BFO pitch, RF gain, AF gain, BFO-MVC-AVC-ANL, off-stby-rec-cal, antenna trimmer, and phone jack. Cold-rolled 1/16" steel chassis. Handsome metal cabinet, 10 x 10 x 16½". (Less phones, 8-ohm loudspeaker and S-meter.) 23 lbs.

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Complete with built-in power supply! Careful design and voltage regulation assure high stability. Excellent oscillator keying characteristics for fast break-in without clicks or chirps. Full TVI suppression. Has plenty of bandspread; separate calibrated scales for 80, 40, 20, 15, 11 and 10 meters; vernier drive mechanism. 2-chassis construction keeps heat from frequency determining circuits. Output cable plugs into crystal socket of transmitter. Output: 40v on 80, 20v on 40. With Spot-Off-Transmit switch for spot frequency tuning. Extra switch contacts for operating relays and other equipment. Attractive metal cabinet, 8¾ x 6 x 6". Ready for easy assembly. Shpg. wt., 8 lbs.

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Crystal frequency standard at very low cost. Gives marker every 100 kc up to 32 mc. A "must" for marking band edges. Mounting flanges for installation in or back of receiver cabinet. Size only 1½ x 1½ x 3". Requires 6.3 v. at 0.15 amp and 150-300 v. DC at 3-6 ma. Trimmer for zero-beating with WWV; On-Off switch. Complete with tube, crystal, all parts and easy-to-follow instructions. Shpg. wt., 1 lb.

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Measures standing wave ratio (SWR) and impedance of antenna systems; ideal for adjusting antenna systems for optimum results. Measures impedances from 20 to 400 ohms up to 100 mc; SWR to 150 mc. Any VOM may be used for null indicator. With coax input and output connectors. Meters both input and bridge voltage. Calibrated dial gives direct impedance reading; includes 1% precision resistor for precise calibration adjustment. With all parts and handy plasticized SWR chart (less meter). 2½ x 3 x 4½". Shpg. wt., 1½ lbs.

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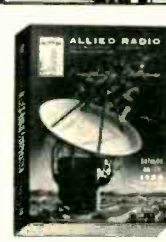

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TELEVISION

(Continued from page 84)

fective electrolytic would be in either the vertical sweep or vertical oscillator circuit. Check the electrolytics carefully and replace those that do not have full capacitance and good power factor. It would also be advisable to make an over-voltage check of the electrolytics by running the line voltage up 15%. A bad electrolytic will break down faster on this test. It will get hot after a while, and you can find the bad one by touching its case.

Ringing

A Pacific Mercury chassis 150 has a severe case of ringing, with numerous vertical bars on the left side of the raster. The manufacturer states that the flyback transformer is probably defective. I replaced the horizontal output transformer and found that the improvement was so slight as to be negligible. I then checked all components in the horizontal output and damper circuits but this did not help either. An oscilloscope check clearly indicates a periodic oscillation in and around the flyback circuit, but the trouble cannot be pinned down. Perhaps I should try another flyback transformer but I am convinced that this is not the fault.

Since all the components check good, I would like to know of some circuit modification that would cure the trouble. Otherwise, perhaps you can recommend some way to re-dress the critical wires in this circuit.—G. B., Cranston, R. I.

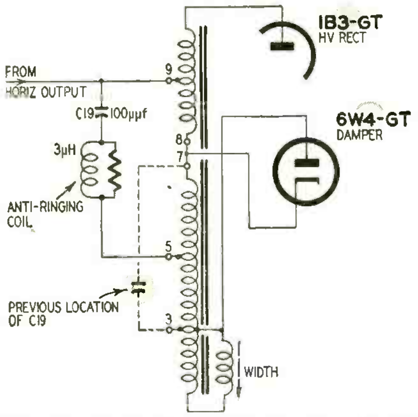

Fig. 2—Flyback circuit in the Pacific Mercury 150.

The manufacturer's recommendation of replacing the flyback was probably based on this trouble appearing in other chassis in this series. Modifying the circuitry would be merely shooting in the dark in this case, and re-dressing wires could possibly make things worse. Because of the nature of the trouble, I feel that the most efficient way out of the trouble is to simply install an anti-ringing coil. (See Fig. 2.)

In installing this coil, you will have to remove capacitor C19, a 100-$\mu\mu$f unit connected between terminals 7 and 3 of the high-voltage transformer. Then connect the anti-ringing coil in series with C19, with C19 tied to terminal 9 of the transformer and the coil to terminal 5. This will place the coil across a major portion of the flyback turns and choke off the ringing which is probably originating somewhere in the damper-yoke circuit. The anti-ringing coil should be approximately 3 μh. If you wind it yourself, use a 1-watt resistor as a form.

Be sure the solder joint between the coil and capacitor C19 is smooth and round. Also, dress the coil and capacitor close to the transformer, as far as possible from the chassis to avoid corona.

Vertical sync instability

The complaint in a Philco TV-350 chassis is intermittent vertical roll. A thorough check of the vertical oscillator and output circuits showed everything to be per manufacturer's specifications. The customer said that before moving here from a strong-signal area the set played perfectly. I then carefully checked the vertical integrator and the sync separator stage, but still without finding anything out of order. A few resistors were slightly off value, but replacing them did not help.

The horizontal sync on this set is extremely stable so I started replacing components in the vertical oscillator stage, and some in the sync stage, but could not improve the situation. Short of replacing all components in the set, I would appreciate any suggestions that you may have.—P. R., Poughkeepsie, N. Y.

There is a possibility that the vertical sync pulses are of lower amplitude than the horizontal pulses. The attenuation could be due to slight misalignment. However, if alignment does not help, you should try the following circuit changes to improve sync stability. Before doing this, however, be sure to replace the 12BY7 (Fig. 3). A gassy tube can deform the vertical pulse and produce rolling.

You can improve the low-frequency coupling to the video amplifier by changing C55 from .068 μf to 0.15 μf. Also, reduce the value of R71 from 1 megohm to 330,000 ohms. Improve the sensitivity and stability of the sync circuit by removing capacitor C58 and resistor R69 from the circuit, and connect capacitor C54 as shown. Next, remove the leads from capacitor C54 and resistor R64 to pin 7 of the 6CS6 sync separator.

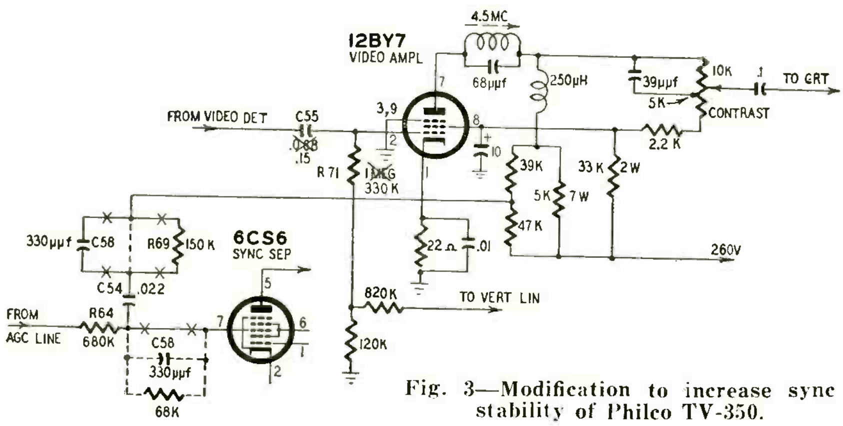

Fig. 3—Modification to increase sync stability of Philco TV-350.

Take the removed 330-μμf capacitor C58 and connect it between pin 7 of the 6CS6 and the leads going to R64 and C54. Finally connect a resistor of about 68,000 ohms in parallel with C58. On several of these chassis the above modification has proved highly successful. And if the trouble is due solely to a signal of less than normal strength, the change will provide good vertical and horizontal synchronization.

Excessive drive

In servicing a Sylvania 1-515 chassis I replaced the horizontal output transformer because of shorted turns. The replacement flyback, obtained from Sylvania, restored the raster but the brightness was excessive and there is a drive line that cannot be eliminated by varying the drive control trimmer. I checked all components in the horizontal output and damper stages, and everything is in order. I tried changing a few component values but, while some helped a bit, they also caused other undesirable effects. Do you think the transformer is defective or is some other component damaged by the original defect?—P. R., Lynn, Mass.

The Sylvania replacement flyback transformer for this and similar chassis will often develop excessive high voltage and produce a drive line which cannot be removed by the drive control. The solution is to reduce the drive to the grid of the horizontal output tube. This can be done by replacing the 470,000-ohm resistor that shunts the drive control with one of about 150,000 ohms. This done, the drive control has adequate range to eliminate any drive bar and restore normal high voltage.

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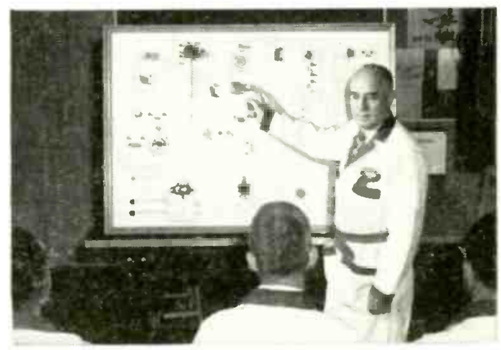

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EMISSION TYPE TUBE TESTER

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- The Experimenter or Part-time Serviceman, who has delayed purchasing a higher priced Tube Tester.
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Speedy, yet efficient operation is accomplished by:

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"Free-point" element switching system. The Model TD-55 incorporates a newly designed element selector switch system which reduces the possibility of obsolescence to an absolute minimum. Any pin may be used as a filament pin and the voltage applied between that pin and any other pin or even the "top-cap."

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Elemental switches are numbered in strict accordance with R.M.A. specification. One of the most important improvements, we believe, is the fact that the 4 position fast-action snap switches are all numbered in exact accordance with the standard R.M.A. numbering system. Thus, if the element terminating in pin No. 7 of a tube is under test, button No. 7 is used for that test.

Complete with carrying case.......... **$26.95 NET**

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Of course you can buy an adapter for about $5—which theoretically will convert your standard tube tester into a picture-tube tester; or a neon type instrument which sells for a little more and is supposed to be "as good as" a metered instrument. Superior does not make nor do they recommend use of C.R.T. adapters or neon gadgets because a Cathode Ray Tube is a very complex device, and to properly test it, you need an instrument designed exclusively to test C. R. Tubes and nothing else.

Tests ALL magnetically deflected tubes . . . in the set . . . out of the set . . . in the carton!

- Tests all magnetically deflected picture tubes from 7 inch to 30 inch types.
- Tests for quality by the well established emission method. All readings on "Good-Bad" scale.
- Tests for inter-element shorts and leakages up to 5 megohms.
- Test for open elements.

EASY TO USE: Simply insert line cord into any 110 volt A.C. outlet, then attach tester socket to tube base (ion trap need not be on tube). Throw switch up for quality test . . . read direct on Good-Bad scale. Throw switch down for all leakage tests.

Only.......... **$15.85 NET**

Superior's New Model TV-12

TRANS-CONDUCTANCE TUBE TESTER

TESTING TUBES

- Employs improved TRANS-CONDUCTANCE circuit. An in-phase signal is impressed on the input section of a tube and the resultant plate current change is measured. This provides the most suitable method of simulating the manner in which tubes actually operate in Radio & TV receivers, amplifiers and other circuits. Amplification factor, plate resistance and cathode emission are all correlated in one meter reading.
- NEW LINE VOLTAGE ADJUSTING SYSTEM. A tapped transformer makes it possible to compensate for line voltage variations to a tolerance of better than 2%.
- SAFETY BUTTON—protects both the tube under test and the instrument meter against damage due to overload or other form of improper switching.
- NEWLY DESIGNED FIVE POSITION LEVER SWITCH ASSEMBLY. Permits application of separate voltages as required for both plate and grid of tube under test, resulting in improved Trans-Conductance circuit.

Extra Feature

Model TV-12 Also Tests Transistors!

A transistor can be safely and adequately tested only under dynamic conditions. The Model TV-12 will test all transistors in that approved manner, and quality is read directly on a special "transistor only" meter scale.

The Model TV-12 will accommodate all transistors including NPN's, PNP's Photo and Tetrodes, whether made of Germanium or Silicon, either point contact or junction contact types.

Housed in hand-rubbed oak cabinet.......... **$72.50 NET**

Superior's New Model TW-11

STANDARD PROFESSIONAL TUBE TESTER

- Tests all tubes, including 4, 5, 6, 7, Octal, Lockin, Hearing Aid, Thyratron, Miniatures, Sub-miniatures, Novals, Sub-minars, Proximity fuse types, etc.
- 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 TW-11 as any of the pins may be placed in the neutral position when necessary.
- The Model TW-11 does not use any 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. All tube listings printed in large easy-to-read type.

NOISE TEST: Phono-jack on front panel for plugging in either phones or external amplifier will detect microphonic tubes or noise due to faulty elements and loose internal connections.

EXTRAORDINARY FEATURE: SEPARATE SCALE FOR LOW-CURRENT TUBES. Previously, on emission-type tube testers, it has been standard practice to use one scale for all tubes. As a result, the calibration for low-current types has been restricted to a small portion of the scale. The extra scale used here greatly simplifies testing of low-current types. ***Housed in hand-rubbed oak cabinet***.......... **$47.50 NET**

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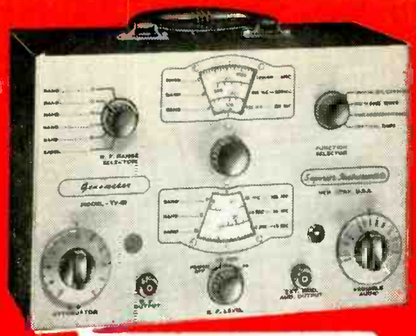
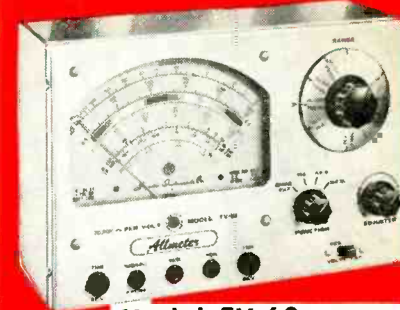


Model TV-50 — Terms: $11.50 after 10 day trial then $6.00 per month for 6 months.

Model 76—Terms: $6.95 after 10 day trial then $5.00 per month for 4 months.



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- IT'S A **RESISTANCE BRIDGE**
- IT'S A **SIGNAL TRACER**
- IT'S A **TV ANTENNA TESTER**

CAPACITY BRIDGE SECTION 4 Ranges: .00001 Microfarad to .005 Microfarad; .001 Microfarad to .5 Microfarad; .1 Microfarad to 50 Microfarads; 20 Microfarads to 1000 Microfarads. Will also measure the power factor of all condensers from .1 to 1000 Microfarads.
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Model TV-60 comes complete with book of instructions; pair of standard test leads; high-voltage probe; detachable line cord; R.F. Signal Tracer Probe and Audio Signal Tracer Probe. Pliofilm bag for all above accessories is also included. Price complete. Nothing else to buy. ONLY **$52.50 NET**

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By ART MARGOLIS

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YOU walk in on a service call. The TV set has no sync. The picture is running in all directions at about 60 miles an hour. You take two screws off the top of the back, peel the fiberboard down and peep in. Right in the middle of the chassis, there is the sync separator, a 12AU7, with only one light burning.

You reach in, pluck out the old tube and insert a new one. The picture snaps into place with a boin-n-g. Your repair is complete. Total time elapsed 3½ minutes.

The set owner says, "While you're here, would you check the TV over and make sure everything is okay?"

What is you next move? Wrinkle up your nose in annoyance and beg off or begin pulling the set apart for a lengthy check? With a combination of the pressure of waiting calls, our natural laziness and a feeling of let well enough alone working on us; the tendency is do the minimum job. But from both a business and technical point of view, it's just not the thing to do.

In our outfit we don't wait for the set owner to ask us to check out a set. With the exception of brand-new or just recently repaired TV's we ask the owner if he would like us to do a maximum job. We explain there is an additional labor charge plus any parts necessary. Here is what we give them.

The chassis is pulled out. The dust is wiped off, the controls lubricated, the tuner cleaned, the C-R tube face is cleaned. All the tubes are checked, resistors and capacitors visually checked, picture set for linearity and any trouble symptoms are traced and eliminated. Of course with the thousands of different makes and models the procedure is tailored to fit the individual set but, in general, that is what we term a maximum job.

There is quite a bit more to completing a maximum job to the customer's satisfaction than a minimum. There is more salesmanship needed, as the price of the repair rises. It has often been said that one of the reasons why people hate to have their TV fixed is that the repair seems to them a negative thing. Just a restoration of status quo, not a new hat or pair of shoes. It's up to the technician to make the repair a positive thing, to provide definite actions or objects so the consumer feels he has received something tangible for his money.

It's hard for a customer to appreciate the complicated repair techniques that flash through your mind. All they can understand are the things they can see clearly. Some of these positive things that satisfy are the labor you go through, a lineup of defective parts or a meter that says something they can understand.

With all its faults, a tube tester is a good customer satisfier. I was servicing a 21-inch Sylvania. The complaint was no raster. I found the 6CD6 out cold. I replaced it and the picture came on. The set was very dusty and the screen filthy. I asked the customer, who happened to be a real estate agent, if she would like me to do a maximum job. She told me to go ahead.

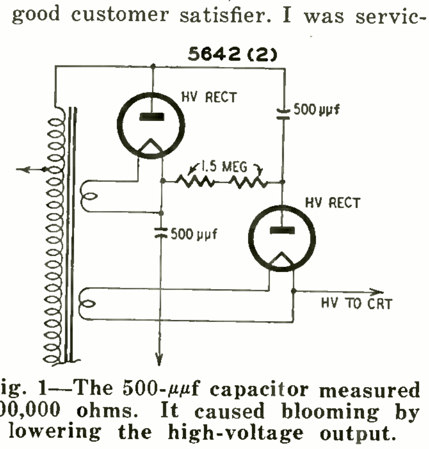

Fig. 1—The 500-$\mu\mu$f capacitor measured 700,000 ohms. It caused blooming by lowering the high-voltage output.

After cleaning it all up, I began checking out the set. There were two weak if's that I changed. As I was adjusting the agc I noticed a bad blooming condition had developed. I checked the two subminiature 5642 high-voltage rectifiers. They were both weak so I replaced them. The bloom cleared a little but there was still some left.

I dug into the high-voltage cage and measured the resistance of the two 500-$\mu\mu$f 10,000-volt capacitors. One of them measured 700,000 ohms (see Fig. 1). I replaced it. The blooming ceased. After that I made up the bill with the additional charges. The female land seller was naturally curious as to what she was paying for. I showed her how the capacitor measured 700,000 ohms on my ohmmeter. She looked at me blankly, completely snowed. I don't think she was too happy about not understanding either.

I finally gave up that tack and demonstrated all the weak tubes, one by one on the tube tester. The meter needle sitting in the red REPLACE zone brought a satisfied smile. Now she felt she was getting her money's worth.

Sell each dollar separately

The majority of your customers will put up no argument and will go along with whatever you, the expert, advise. But, there are always the tough "I'm from Missouri" set owners who don't trust a soul. I have one such customer who is a bill collector. Maybe his job makes him that way, but anyway here's what we do with clients like him.

I arrived after an absence of close to 2 years. When I took the back off of his 21-inch G-E, I could see it hadn't been touched since I was there last. He growled, "The sound is reverberating in the picture."

Sure enough, he had sound bars in the video that could be varied with the volume control. After a few minutes of checking I found the cover can on the fourth if video detector was loose. As the volume control was turned up, the

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City________________ Zone______ State________ cabinet would vibrate, vibrating the can which modulated the video. Snapping the can into place cured the condition.

Only about 5 minutes had elapsed. I advised the customer he could use a maximum job. He gave me the go-ahead, not missing a move. After the routine cleaning, I noticed the vertical sync was a little weak. The picture would roll every now and then. I mentioned this to the customer. He said, "It does roll sometimes but I adjust it back in."

I checked through the vertical circuits. After about a half-hour I found one of the line filters leading into the vertical B plus, a 40-μf electrolytic, was defective. It had evidently decreased in value, allowing some ripple into the vertical sync which rolled the picture (see Fig. 2). A new filter gave the vertical sync much better holding power. Before replacing it I showed my client a before-and-after on the vertical stability. He nodded OK.

The 6BQ7 rf amplifier read weak on the tube tester. I showed the customer a before-and-after on how some of the snow was cleared out of the video. The vertical output tube was weak. And I gave him a before-and-after on the additional vertical sweep that allowed a perfect linearity adjustment.

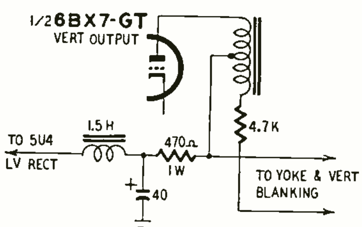

Fig. 2—Defective electrolytic passed dc ripple; picture rolled.

I tapped the damper, it started to arc. I called him over. He amazed me by saying, "OK, OK, I believe you. Do what you think it needs." I completed the maximum job. The only objection I received to the bill was a swallow.

Because you do check over the entire TV set during a maximum job, you might give the impression that your standard guarantee is now unconditional. You must make the point beyond any doubt that the guarantee is only on the actual labor performed and parts installed. You must let the set owner know that checking a part does not guarantee it. *Only replacing it or repairing it carries some form of guarantee.* I learned this lesson the hard way.

I was called by an old customer who has a 12-inch Emerson. His call came in early asking for service before noon. I arrived about 11:30. He had his hat and coat on when I arrived. He said, "It's in bad shape, fix it all up and Dad will pay you." With that he drove off, the only one left in the house besides me was his father, who was reading in another room.

There was no video and a four-sided shrunken picture. I changed a 12AU7 video amplifier and the selenium rectifiers. That restored all. I cleaned and checked the set out, but I couldn't find another defective part. I made up a bill and his father paid me.

About a week later he called again, patient but annoyed, "The picture is much better but it still doesn't work right." I went over on the double. The set was perfect. I had an intermittent on my hands. He described the symptoms, but his words had little meaning. I did manage to make out there was no audio or video, just a shrunken raster. I pulled the chassis.

After the usual waiting, checking and heartache the intermittent condition appeared. Sound and video left and the picture developed extreme horizontal foldover. I changed the damper, the condition cleared. I reinstalled the old damper, the condition reappeared. An open cathode in the damper was converting the sawtooth waveform into a sine wave. I had it.

That was until I presented the set owner with another bill. He legitimately said, "I thought you'd given me a 90-day guarantee on that overhauling job you did for me."

Since I hadn't made the conditions absolutely clear, he had a leg to stand on. I swallowed this time and chalked it up to overhead. A few words of clarification before he left the house in the beginning would have avoided this loss.

Catch the little things

If you do a maximum job for a set owner, he naturally expects perfection. There are always many tiny details about his TV that have been annoying the viewer. These faults have not been major enough for the set owner to call you for these annoyances alone. But while you are there, if you can catch these tiny faults, you will really leave a satisfied customer.

Lots of them are so minor to you that you're not even aware of them. They might be dead pilot bulbs, springs missing from knobs, a dead mosquito under the glass face, some TVI you can eliminate or explain away, or an actual trouble symptom. The only way you can get at these minor complaints is to interrogate the set owner.

I was repairing a 17-inch G-E. The original complaint was no raster. I found this was due to no high voltage. Regular tube checks proved fruitless so I pulled the chassis on the floor. There was no B plus on the screen of the horizontal output tube. I found the 4,700-ohm 4-watt screen resister open. I changed it and the raster returned.

I said to the set owner, "While I have the chassis on the floor, would you like me to check it over?" She gave me the go ahead. While I was tube checking, I gave her the third degree. I managed to pry loose that the contrast hadn't been as good as it used to be. I resolved to check out the video circuits for defects.

About five tubes were in dilapidated shape and the Globar was ready to conk. I changed them all, cleaned all the controls and went through the rest of my maximum-job procedure. Then I turned on the set. The picture was much clearer but the contrast level was down quite a bit. I checked voltages in the video amplifiers. On the plate of the first video amplifier there was supposed to be 75 volts. I measured about 40. I checked all the components in that plate leg. I found a .05-μf cathode bypass that measured 10,000 ohms (see Fig. 3). I changed it. You should have seen the contrast come up then.

She became very excited with the newly found contrast. She remarked, "The picture looks now like when the set was brand new." It's funny, but the restoration of the high voltage didn't faze her one way or the other. That she took as her due. But the bringing back of the contrast that had been needling her for months and months, that in her estimation was really an achievement. It was something that she had accepted as having to be. Something she wouldn't have tried to have fixed.

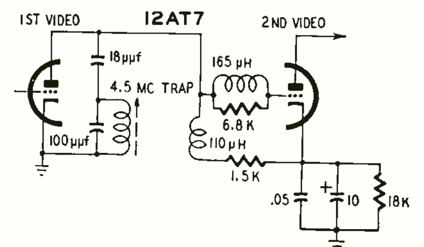

Fig. 3—Low resistance short in the .05-μf capacitor lowered plate voltage and caused lack of contrast.

Contrary to what you may think, doing a maximum job that costs so much more than a straight service call is not unpleasant to set owners. Sure, laying out the cash hurts them for a minute but, if they can feel that their TV is operating at peak performance, that's really what they want.

But the maximum job has to be done correctly. You have to make the repair a positive thing. Sometimes you have really to exert yourself selling the improvements one by one. Spell out whatever guarantee you are going to give and make sure you catch all annoyances, even the little ones.

After a maximum job your customers will get the idea that you are thorough. It is hard for them to remember exactly what you did but the main thing is you will get across the idea of completeness. This idea of completeness is important; don't underestimate it. Even if it comes back to you in a seemingly silly way. Like it did to me after I had done a maximum job on a 16-inch Philco.

A new 12AZ7 local oscillator brought back the high band. A new 6T8 cleared up the garbled sound. A new 6CD6 got rid of some black spaces on the sides. A screen cleaning restored a 50% brilliance loss. Each and every change was positive and made a whale of a difference.

When I received a recommendation call from their neighbor, I was curious enough to ask the neighbor what the original customer had remembered about my repair. The answer, "She told everybody how you put all the screws back into the set." END

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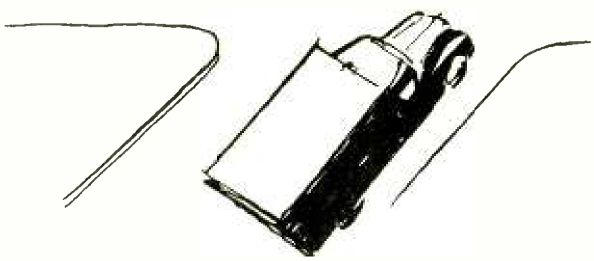
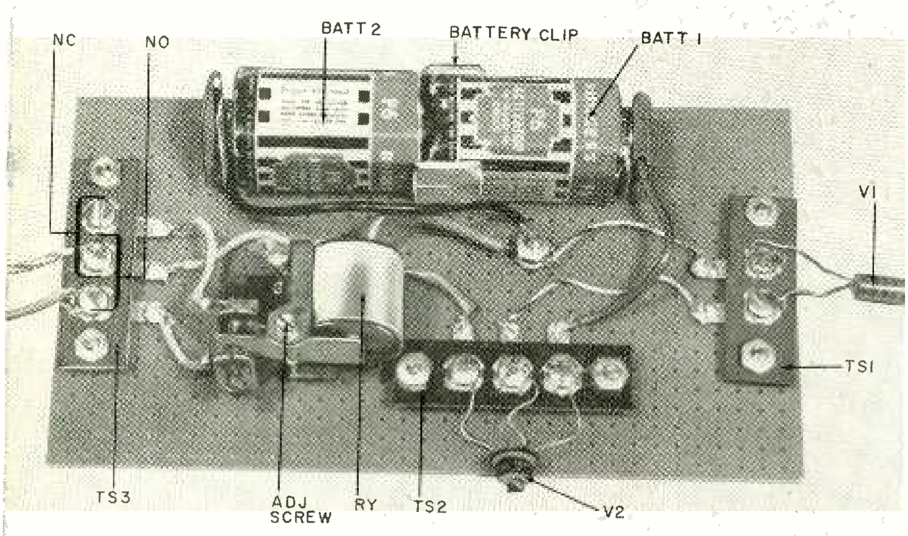
relay averts toyland tragedy

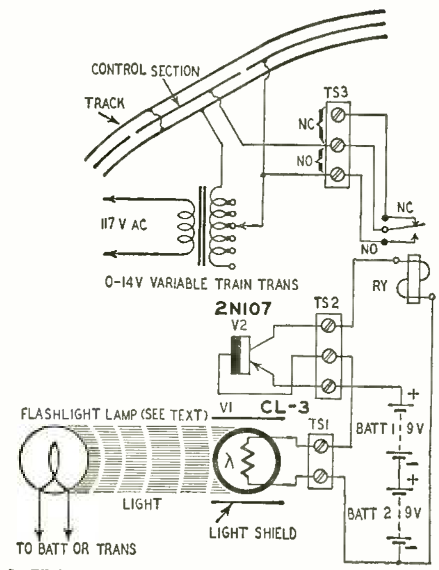
Simple photoelectric relay is an educational toy and practical robot

By JAMES A. McROBERTS





Closeup shows parts layout and wiring detail.



BATT 1, 2—9-volt battery (Burgess P-6 or equivalent)
RY—8,000-ohm coil, adjusted to operate at about 1.3 ma or less and release at around 0.7 ma (Sigma 4F-8,000-S or equivalent)
TS1—terminal strip, 2 contacts
TS2, 3—terminal strip, 3 contacts
V1—Clairex CL-3 cadmium-selenide photocell
V2—2N107
Battery harness (Lafayette MS-421)
Tool and battery clip (Lafayette 119-701)
Perforated bakelite board, 3-11/16 x 6⅞ inches (Lafayette MS-305 or equivalent)
Flashlight lamp (see text)
Miscellaneous hardware

Fig. 1—Circuit of the automatic crossing control.

NO, the toyland flyer looming out of the night on our cover photo did not hit Santa's new auto. The train was stopped short of that tragedy by an automatic crossing guard (see photo above).

As an educational toy, this device furnishes many hours of enjoyment for Junior and perhaps Papa too. It was built breadboard style for this reason. Besides cutting off power to the train when the crossing is obstructed, it can be made to ring a bell, light a block signal, stop a following train, ring a station bell, or do any one of a number of other things.

For practicality, build the unit into a metal or other sturdy container along with a self-contained power supply. The most obvious gainful use is annunciator service. Whenever light to the cell is broken, a chime rings, announcing the presence of a guest or customer. It will indicate the presence of unwanted visitors, too, such as burglars. To discourage the latter group, use the device to turn on lights automatically whenever night comes, with a second piece of apparatus for burglar or visitor alarm duty.

Fig. 1 shows the simple circuit which you can put together in an hour. And the closeup photo shows the parts layout and wiring details.

The cover picture demonstrates how a CL-3 Clairex photocell is illuminated by a small bulb whenever the crossing is not obstructed. As long as the crossing is clear, relay RY stays closed (energized), and power is supplied to the track's control section through the NO contacts. (This circuit is normally open when coil is not energized.) Interruption of the light beam reduces current through the relay, which opens, cutting the circuit from train transformer to track, and stops the train.

Two or more sections of the track's middle rail (either rail in a two-rail system) may be insulated by pulling the connecting pins. Put a piece of tape over the ends to insulate the broken connection. As the train approaches an obstructed crossing, it stops but it will run on the remainder of the track. The number of track sections controlled depends on the train's speed and length. Two or three experiments quickly determine the required distance.

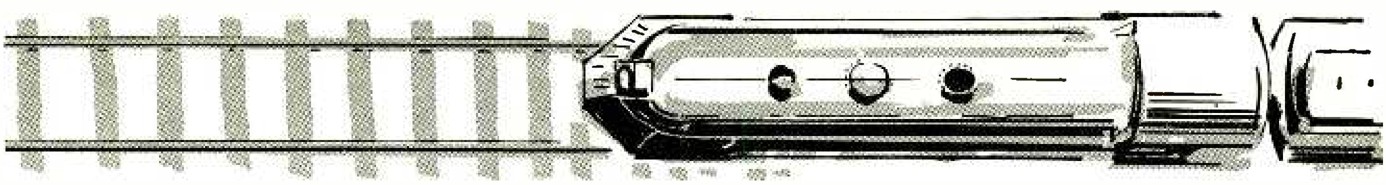
The CL-3 photocell is a conductive type whose resistance decreases in proportion to an increase in the light on it. When unilluminated, almost no current passes through the transistor's base circuit. Consequently little current flows in the collector circuit including relay RY. Increased light on the photocell increases the transistor's base and collector current. When the relay's pull-in point is reached, the relay closes, applying current to the track. Reverse action occurs as the light decreases, with the relay dropping out and opening these contacts.

For some purposes, the de-energized position activates the controlled circuit through the NC contacts. For this reason, the NC contact has been brought out to a lug on terminal strip TS3.

The light source may be a prefocused flashlight bulb operated below its voltage for the short distance by a single flashlight cell. Or it may be energized from hot contacts of the train transformer through a suitable dropping resistor. (Two flashlight cells driving a 2.8-volt bulb will pull in the relay at 8 feet. With one cell, the range is about a foot.)

Now build it

The breadboard model, most instruc-



tive for Junior, takes about an hour to assemble. Parts placement is not critical and may follow the photo. Hidden beneath the batteries are two No. 2/56 screws holding the battery clip to the board. Cut off any extra screw length and cover the end with plastic tape to prevent scratching floors and furniture.

About a ¼-inch length of a 6/32 screw is needed for the relay. Cut off the excess with a hacksaw while a nut is on the screw. Unscrew the nut to clean the threads. Install carefully, checking to prevent this screw from digging into the relay coil. An extra nut is used, with the screw and nut forming the negative tie point. For convenience you can slip a soldering lug on the screw. Position the relay for easy wiring to TS3, TS2 and the negative tie point.

Cut the fiber insulation of the battery harness in half. One polarized end fits the negative terminal of the battery and goes to the negative tiepoint. This is the black lead. The red lead runs to the transistor's emitter. *Do not reverse polarity to see if it works*—it won't! The transistor probably won't work again either!

Two 9-volt batteries snap together to form an 18-volt power source. The battery clip (a spring type clip used to hold small tools) holds them rigidly in place. Simply unsnap the batteries or either lead to cut off power.

The light source is shielded with a piece of black tape in the photo. You can use a lamp tower for a neater appearance and some type of building could be placed over the relay unit if desired. A single cell will light a 2.8-volt prefocused flashlight bulb brightly enough to operate the relay from about 6 to 10 inches. Two cells and a reflector extend this distance to about 7 or 8 feet. A lens further increases the range, and can be used on either the light or photocell.

If you want to work the bulb from the train transformer, use a locomotive headlight bulb rated about 14 volts. A 12–14 volt bulb may also be utilized with a bell transformer as the light source. Do not overexpose the photocell by bringing the source closer than about 2½ inches or excessive current may be passed to the base of the transistor. Use just enough light to hold the relay on.

Some relays have to be adjusted to increase their sensitivity. This is done by decreasing the tension on the armature spring and possibly decreasing the spacing between the contacts. The tension-adjusting screw on the Sigma type 4F relay is indicated in the photo.

Less tension lets the relay close more easily. Relay RY will not drop out if spring tension is too weak. Clockwise turning of the adjustment screw increases tension; counterclockwise turning reduces it. Turn the adjustment screw a little at a time and note results. If a voltmeter is handy, check to see that the relay pulls in with about 11 volts across its coil and drops out at about 6 volts. The circuit is designed for these normal relay operational

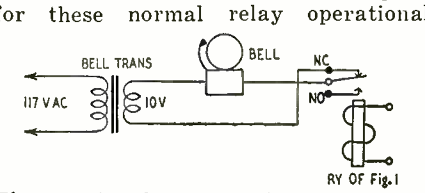


Fig. 2—Auxiliary circuit rings doorbell or chimes.

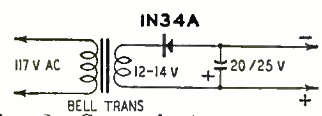


Fig. 3—Convenient power supply replaces batteries.

points with an 18-volt supply. *Do not use higher voltages.*

Other uses

The locomotive's headlight beam can energize the relay. If the light is obstructed, the relay does not go on and the train stops. Here again the number of track sections controlled is determined by the speed of the train. Also take into account the intensity of the locomotive headlight. It must be bright enough to trigger the relay.

As an annunciator, interruption of the beam de-energizes the relay. This time, you would use the NC (normally closed) contacts instead of the normally open set used at the crossing. An auxiliary power supply rings the bell or chimes with the relay circuitry acting only as an electronic switch. Fig. 2 shows this type of operation.

To turn on houselights when it gets dark, place the photocell where it will be indirectly illuminated by daylight. The relay's NC contacts are used. Dropping light values allow the relay to drop out and actuate the auxiliary circuit. Up to 200 watts may be directly controlled by a Sigma 4F relay. For heavier loads, use an auxiliary relay.

The photocell's sensitivity may be too great in some applications. Whenever this becomes a problem, connect a 1-megohm potentiometer in series with the photocell and the negative end of the power supply. The added resistance lowers the photocell's sensitivity.

A somewhat similar arrangement makes the relay an electronic counter. The relay controls a circuit containing a stepper relay or a solenoid moving a mechanical counter. Objects that interrupt the light beam cause a count for each interruption. The count will be exact if some spacing exists between the objects being counted. Should two pass at about the same time, the photocell may see them as only one.

Power supply

Although less than 2 ma is drawn from the battery supply of the crossing relay circuit, you may prefer to use a batteryless power supply for continuous operation. Fig. 3 shows the circuit of such a supply. The bell tranformer is stocked by most hardware stores. It is the higher voltage type delivering a nominal 12 – 14 volts instead of the more common 8 – 10 volts. Failing to secure such a transformer, use a low-current 12.6-volt filament transformer.

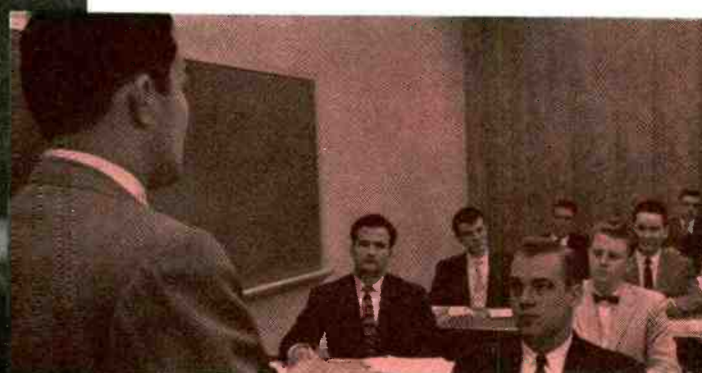
In wiring the power supply, take care that diode and electrolytic capacitor polarities are correct. Connect the negative terminal of the capacitor and diode.

If the same transformer also powers a lamp for lighting the photocell, its output voltage may be rather low due to the load. If this hinders relay action, simply adjust the relay for a lower pull-in point. Do not overdo it or the relay may not drop out. Make a check for drop-out after all such adjustments.

Caution

One side of the line may be connected to the relay frame in some of the circuit applications. Exercise care in touching the relay or allowing it to touch metal objects possibly grounded. A small plastic box placed over the relay and electrical tape over the mounting screws will offer added protection. If the unit is built on a metal chassis or into a metal box, keep the relay isolated from the box or chassis. END

How Far Can You Go in Electronics Without a Degree?



"Student" Fred Gunther in the IBM school

Fred Gunther has no degree. Yet, today, at IBM, Fred is a Technical Engineer working on America's biggest electronics project. His story is significant to every technician who feels that lack of formal training is blocking his road to the top.

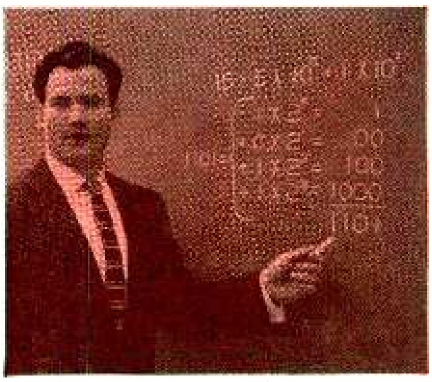
Let's go back to 1950 and watch Fred Gunther, at 18, as he goes about the business of determining his life's work. Fred spent almost a year trying his hand at various jobs. None of these turned out to be the one that Fred wanted to devote his life to. So, still undecided about his career, Fred entered the Navy for a four-year hitch.

Fred learned something very valuable in the Service, as have many other men who eventually discover the electronics field. His aptitude tests revealed him as an excellent electronics prospect, and he received ten months' training in electronics fundamentals and radar. Upon his discharge in 1955, he was an Electronics Technician, First Class.

Something even more important to Fred's career occurred during his Service hitch. He began to hear such terms as "automation" . . . "data processing" . . . "electronic computer." "Then, one evening, while glancing through the paper," he recalls, "I spotted a story about *Project SAGE*."

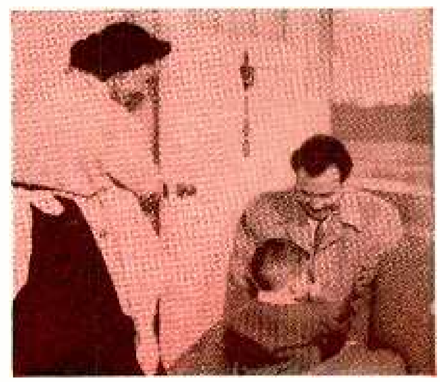
What is Project SAGE?

SAGE means Semi-Automatic Ground Environment. It is part of America's radar warning system—a chain of defense that will ultimately ring our country's entire perimeter. At the heart of this system are giant electronic computers which digest data filtered in from Texas towers, picket ships, reconnaissance planes, ground observers. The computers analyze this information for action by the Strategic Air Command and other defense units. These computers are the largest in the world. Each contains 58,500 vacuum tubes plus 170,000 diodes. They are built for the project by IBM.



Answering instructor's questions

At the operating console of the computer



Home to the family, Pemberton, N. J.

Fred joins IBM

SAGE fascinated Fred, for it embodies the most advanced electronic concepts in giant computer work. And, when he learned that IBM would train him at full salary, plus a living allowance, to become a Computer Units Field Engineer, he seized the opportunity. Fred started his new electronics career in the IBM school, with twenty other technicians. He attended classes 8 hours a day. Courses consisted of some 20 subjects—computer circuitry and units, maintenance techniques—everything he would need to become a full-fledged Computer Units Field Engineer.

Assigned to McGuire AFB

His training completed, Fred was assigned in May, 1956, to McGuire Field, where the first of the giant SAGE computers is located. Here he assisted in the cable installation for this vastly complicated electronic giant. He helped to set up the computer, interconnect its many sections, check it out and make it ready for operation. Fred spent five months at McGuire Air Force Base, but his education was not yet completed.

Becoming a Computer Systems Engineer

"I like to think it was due to my interest and grade of work," Fred says, "but at any rate, last October I was invited to return to Kingston for further training—to become, in fact, a Computer Systems Engineer. Naturally, I was proud and pleased, for this training would give me a much greater range of understanding . . . make me more valuable to the company and myself . . . and give me a chance to assume actual engineering responsibility." Fred completed the Computer Systems course. After several months of outstanding work in his new capacity, he received a *third* promotion—to Technical Engineer—in a field engineering liaison group.

What does the future hold?

What does the future hold for Fred Gunther, now that he has become a Technical Engineer? "It's hard to even set a goal in a field as rapidly moving as this," Fred says, "but with my IBM training back of me, the future sure looks good. I've advanced from Radar Technician to Computer Units Field Engineer to Computer Systems Engineer to Technical Engineer *in two years*—and received a valuable electronics education besides!"

How about YOU?

Since Fred Gunther joined IBM Military Products and the Project SAGE program, opportunities are more promising than ever. This long-range program is destined for increasing national importance, and IBM will invest thousands of dollars in the right men to insure its success.

If you have two years' education and/or experience in electronics gained through technical schooling or military service, you can become a member of this important, permanent, expanding project as a Computer Units Field Engineer.

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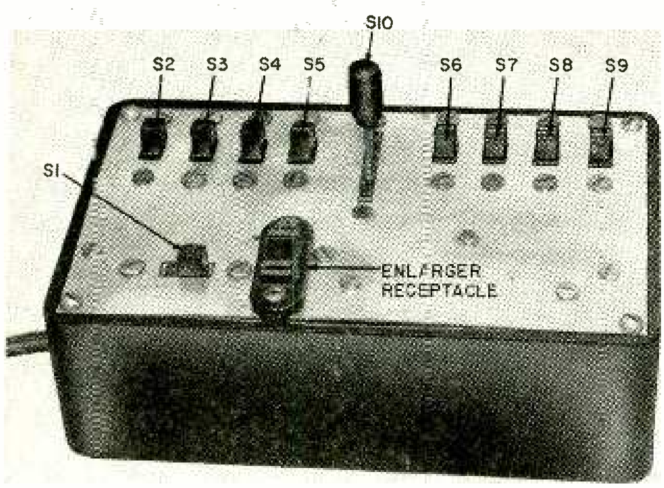
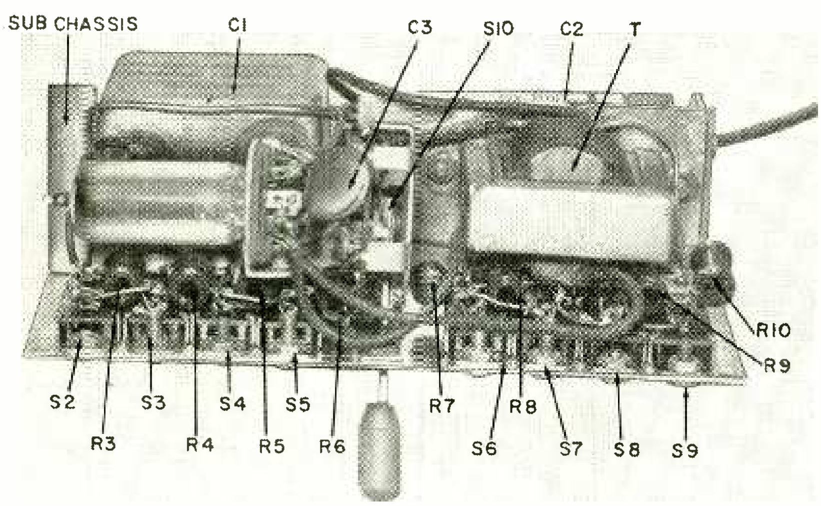


The completed timer.

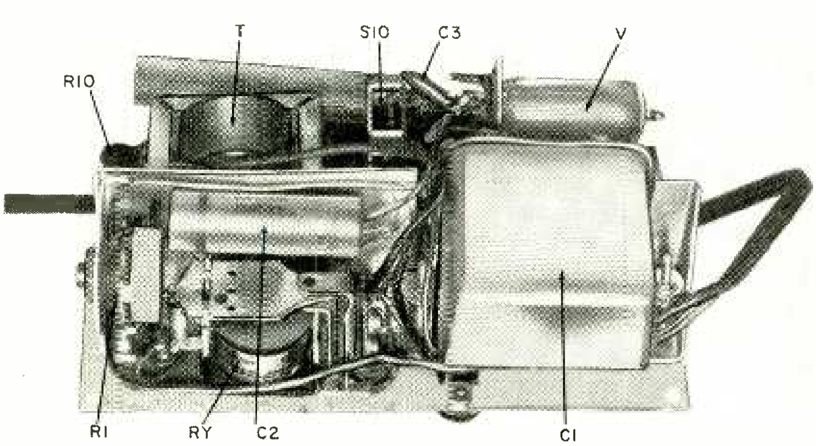
BINARY PHOTO TIMER

This timer is easy to use, even in complete darkness

By ALVIN F. RYMSHA



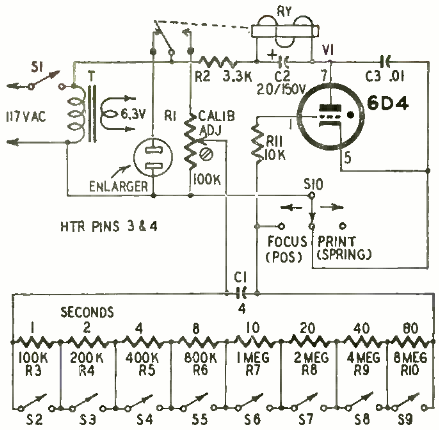
Top view of the timer chassis, showing subchassis assembly.



Rear view of the chassis. Note the compact layout.

PROBABLY hundreds of circuits have been published illustrating as many different approaches to an electronic timer. The majority have been designed for darkroom use, for timing enlargers and contact printers. As an amateur photographer, I have found one failing common to all. They cannot be seen in the dark! Unless the user has considerable dexterity, the lights must be turned on to change the time setting. The timer described in this article overcomes this fault because it doesn't require sight for its setting. Any delay from 1 to 165 seconds can be set by touch alone. The timer will repeat its setting each time it is tripped, and the setting may be "read" by the fingers in total darkness. The entire unit is encased in a plastic meter box and measures only 6¼ x 3¾ x 2 inches.

Starting with a circuit which is simple and reliable (used in the Heathkit timer), several changes are made. First, the socket for the safelight is eliminated, since there seems to be no need to turn it off in the first place. Second, the variable resistor type of control is replaced by a step-resistor bank. It is this change that increases the convenience of operation. A group of fixed resistors are connected in series across the timing capacitor to change its discharge time and thereby the "on" time of the enlarger. Each resistor is



R1—pot, 100,000 ohms, midget
R2—3,300 ohms, 1 watt
*R3—100,000 ohms
*R4—200,000 ohms
*R5—400,000 ohms or two 200,000 ohms in series
*R6—800,000 ohms or 470,000 and 330,000 ohms
*R7—1 meghom
*R8—2 megohms
*R9—4 megohms or two 2 megohm units in series
*R10—8 megohms or 4.7 and 3.3 megohms
R11—10,000 ohms, ½ watt
C1—4-µf, 200-volt bathtub
C2—20-µf, 150-volt electrolytic
C3—.01-uf ceramic
RY—5,000 ohms spdt
S1-9—spst slide switch
S10—single-pole 3-position lever switch, spring return and positive
T—filament transformer, 6.3 volt, ½ amp
V—6D4 thyratron
Miniature ac socket (1)
Miniature tube socket, 7 pins (1)
Plastic case 6¼ x 3¾ x 2 inches
Aluminum panel 6 x 3½ inches
*These resistors are 1% or 5%, ½-watt units

Circuit of the binary timer.

shorted by a slide switch, permitting any combination to be inserted.

The values of the resistors are determined by a binary series: that is, in powers of 2. The constants of the circuit are so arranged that 100,000 ohms across the 4-µf timing capacitor results in a 1-second delay. Therefore, 200,000 ohms produces a 2-second delay; 400,000 ohms, 4 seconds; 800,000 ohms, 8 seconds; 8 megohms, 80 seconds, and so forth. If all except the 100,000-ohm resistor are shorted, a 1-second delay results. By placing any other resistors in the circuits, the delay is increased by a factor of 1 second for each 100,000 ohms. To obtain a 5-second delay, the 100,000- and the 400,000-ohm resistors are inserted. One minute would be obtained by inserting the 2-megohm (for 20 seconds) and the 4-megohm (for 40 seconds) resistors. By inserting all the resistors at once, a total resistance of 16.5 megohms results in a 165-second delay.

The slide switches are connected so that in their "up" position the associated resistor is out of the circuit. Sliding it down inserts the resistor. With only eight switches, it is a simple matter to code-set the desired time and to feel the positions of the switches to read their setting.

In addition to its other advantages, the unit's calibration is extremely simple. No dial needs hand calibration. After construction an electric clock with a second hand is connected to the enlarger terminal, the switches set for 10 seconds and the timer started. The calibration control (R1) is then adjusted so the clock indicates exactly 10 seconds movement. For fine adjustment a longer time (perhaps 120 seconds) may be set up and the final "touchup" given the calibration. If the resistors are sufficiently precise, they will all fall exactly in line and no further adjustment is necessary.

For the sake of economy, 5% ½-watt carbon resistors can be used, in series combinations shown in the parts list. A more precise and reliable unit will result if 1% deposited carbon or boron-carbon resistors are used. One word of caution: use care when soldering the resistors in place. If possible, leave the leads fairly long and do not overheat the resistors as a permanent change in value may result.

Construction details

An aluminum panel cut to fit the meter case and a small subchassis support the components. If the parts are laid out beforehand, possible interference (or downright lack of space) will be avoided. The timing capacitor, filament transformer and relay are the largest components and should be selected for the smallest size available. To conserve space, timing capacitor C1 should be metallized-foil type and need not be over a 200-volt rating. For the transformer, any 6.3-volt unit rated at ½ amp will do.

Lay out the slide switches, lever switch, ac connector, timing capacitor and the relay on the front panel. The capacitor is mounted on tubular standoffs behind the power switch and connector. Bend up a subchassis shelf to support the tube socket and transformer. The calibrating potentiometer may be mounted either on a separate bracket or the bent-over end of the subchassis. This also applies to the tube. In the prototype, the slide switches were secured by machine screws but smooth-headed rivets would retain the "feel" of the unit better.

After all panel drilling, cutting and filing is complete, mount the slide switches and ac connector. Wire the switches in series and solder the resistors in proper order across the switch terminals. Keep the parts snug against the panel as other components will be mounted adjacent to them. Mount the tube socket on the subchassis and install the subchassis, timing capacitor, lever switch and transformer. Complete as much of the wiring as possible, leaving wire ends for the relay and calibrating potentiometer. Wire the potentiometer and the relay (with its capacitor) and install them, the relay going in last. The power cord is fed through a hole in the side of the plastic case.

The unit is a fairly tight squeeze into the box. Due care should be taken to insulate any parts which may touch. The relay-calibration potentiometer area should be particularly watched. You can lose a 6D4 through carelessness here. (I know!) END

more about transistor types

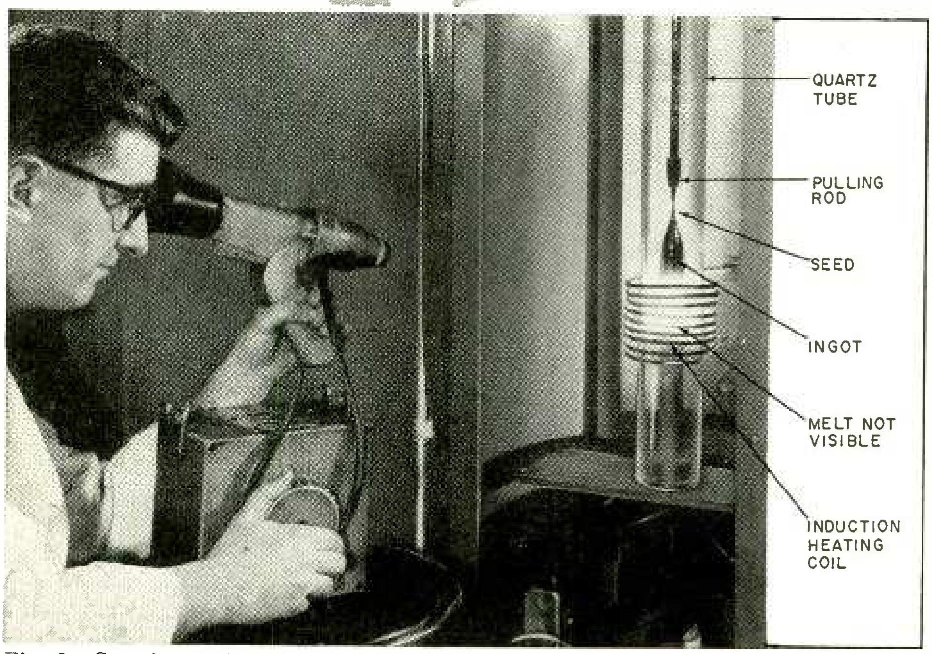


Fig. 2—Growing a single germanium crystal.

By PAUL PENFIELD, JR.

Part II—Manufacturing techniques used to make bonded, micro-alloy, grown-junction, rate-grown, grown-diffused and meltback transistors are discussed

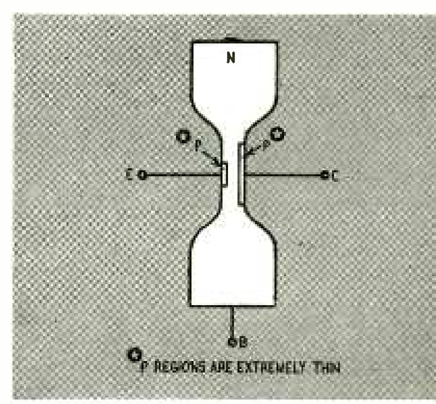


Fig. 1—Micro-alloy unit uses same shape germanium as surface barrier types.

LAST month you took a close look into the workings of drift and Unijunction transistors. You also learned how some alloy and diffusion types are made. Now, the discussion of manufacturing techniques is continued, covering additional types.

An interesting variation of alloying produces *bonded* or *bonded-barrier transistors*. Here the material to be alloyed in, instead of being in the form of a dot, is plated or otherwise attached to the end of a wire. The necessary heat is produced by passing a surge of current through the wire.

A bonded transistor looks much like a point-contact (or coaxial) unit, except that it is truly a junction transistor, the emitter and collector regions being produced by alloying, not electroforming.

Micro-alloy transistor

Here the material to be alloyed in as collector and emitter is produced by plating it directly on the surface of the germanium. The slab of germanium (see Fig. 1) is etched, with a jet spray, till very thin, just as for surface-barrier transistors. The emitter and collector are then plated on the surface, also like surface-barrier transistors. However, now the device is heated and alloying takes place, giving a very shallow alloyed region.

The only advantage of the surface-barrier transistor, remember, is that special etching techniques are used to get a very thin base. Micro-alloy transistors have the same advantage. There are also subtle advantages in micro-alloying one or both of the contacts. The disadvantage is that the base is made so very thin that maximum collector voltage is very low.

Because of the low voltages, the micro-alloy transistor is severely limited in power and its only advantage is good frequency response.

Grown transistor types

Germanium and silicon for transistors must be in the form of a single crystal—one very large array of precisely arranged atoms. About the only practical way to obtain these crystals is to grow them. The Czochralski technique, by which a small single crystal is slowly pulled out of a vat of molten germanium, is generally used. The melted germanium crystallizes in exactly the right order on the single crystal or seed. The photograph shows a germanium crystal being pulled. The coils, wrapped around the outside, are for heating the molten germanium, and only the top of the ingot is visible through the quartz tube which encloses the apparatus. The technician is using an optical pyrometer to read the temperature of the melt.

If the material in the melt is pure germanium, then intrinsic type germanium will be pulled. But if there are more donors than acceptors, the n-type will result, and vice versa.

Using this idea, *grown-junction transistors* are made by starting off with n-type material. At a certain point a small pellet of acceptor material is dropped into the melt, and p-type germanium is grown. After a short while, a pellet of donor material is added which more than balances the acceptors present.

The result is an n-p-n sandwich in the pulled crystal (see Fig. 2, which has suitable properties to be a transistor. The finished ingot is cut up after the junctions are located, and many transistors are cut from the sandwich.

Unfortunately, it is rather difficult to locate and make a connection to the p-type base. And only a limited number of transistors can be made from each pulling operation. The scrap germanium must be purified before it is used again. The base region can be made quite thin, meaning fairly good high-frequency operation. Also, the collector capacitance is rather small.

An interesting technique exists for making several grown junctions in one ingot. This is done by growing the crystal from three reservoirs of molten germanium, each doped appropriately for one of the three regions. When it is time to change the doping, one reservoir is moved away and the other shifted into place, leaving the crystal always in contact with a germanium surface. This is done by mounting the reservoirs on a turntable with narrow channels between them. The turntable is rotated while a clever gate system keeps the three melts from mixing. This technique allows many sandwiches to be made from each pulling.

Rate growing

Another way to get n-p-n sandwiches in a grown ingot is to use the rate-growing method. Here a nearly equal mixture of donors and acceptors is put into the melt. Whether we get n-type or p-type depends on the delicate balance between donors and acceptors, which is affected by the rate of pulling and the temperature. Thus slow rates of growth may yield p-type, and fast growing gives n-type.

Fig. 3 shows an ingot with n-p-n sandwiches made by merely slowing down the growth rate for a minute. This can be cut apart and each sandwich yields many transistors. Dozens of sandwiches can be obtained from each melt.

If the growth rate and temperature are adjusted correctly, the growth rate may actually be negative for a while—the crystal melts back. When the positive growth rate appears again, a very thin p-region results, and the junction formed is abrupt. Both factors help raise the frequency response.

With or without meltback, the *rate-grown transistor* compares with the grown-junction model in high-frequency response. Both types are available commercially.

It is possible to combine the effects of growing a junction with diffusion techniques to get very small base regions. If the materials and their densities are just right, it is possible to get a p-p junction in a grown bar—either by rate growing or by adding pellets. The p-p junction (one side of which has more of both acceptors and donors than the other side) is not itself useful, but, if the ingot is heated, some of the donors diffuse, giving a very small n-region right where the p-p junction was. By locating these junctions and cutting up the bar of germanium, a *grown–diffused transistor* is made.

All the grown type transistors have the advantage of a small base region, but have a rather high cost. Partly this is due to the difficulty of locating the junctions in the completed transistor, and of soldering a connection to the extremely thin base region.

Meltback types

If a piece of germanium is placed between a hot and a cold temperature, it will melt back partway, remaining partly molten, partly solid. Now if the temperature is reduced, the germanium will refreeze as a single crystal, but with a changed impurity distribution. By properly using a delicate balance of donors and acceptors, it is possible to start with a p-region, refreeze it as an n-region for a short distance, and then change over to a p-region. This produces a p-n-p sandwich (Fig. 4) which can be cut apart for *meltback* transistors.

It is difficult to control the base width accurately this way. So an improved method is used to make the *meltback–diffused transistor*. Correct doping is provided so that after meltback a p-p junction, of the type discussed in the grown–diffused transistor, is formed. The two sides of this p-p junction are p-type but have different amounts of impurities. If correct doping is used, a gentle heating of the germanium will cause a diffusion of the donors, giving a very thin n-region at the location of the junction. The p-n-p sandwich can now be cut apart to make good high-frequency transistors.

Tetrode transistors

Transistor tetrodes (which have two base connections) are customarily made from a meltback or meltback–diffused sandwich, although in principle they could be made from any of the grown types as well. Furthermore, p-n-p-n hook transistors can be made by a slight variation of the meltback–diffused technique.

By cooling a meltback sample rapidly instead of slowly, *melt–quench* transistors are formed. The original bar may be p-type, and immediately after refreezing the material may be n-type. The refreezing is allowed to proceed only a small distance, however, and then the germanium is rapidly cooled or quenched. In effect, the impurities are trapped wherever they happen to be, and the quenched region is p-type again. Thus only a small controlled n-type region is produced. Melt–quench transistors are not yet available, and it is doubtful if they ever will be, because they offer no particular advantage over other high-frequency models.

The major difficulty with transistors is poor high-frequency response. It seems probable that future high-frequency transistors will be drift units made with the special jet-etching techniques used for surface-barrier types, the diffused base region used in the alloy–diffused transistor, and microalloy emitter and collector regions. Such a transistor should not be too expensive and is expected to go beyond 1,000 mc.

Techniques for making junction transistors that have been popular in the past, specifically the grown type methods, will be less important. Meltback techniques will never amount to too much because the base region is of poor quality.

Alloy transistors will continue to be the best sellers for ordinary applications. Power transistors may be silicon diffused emitter–collector models. Diffusion techniques are just coming into their own, so expect good diffused transistors in the future. END

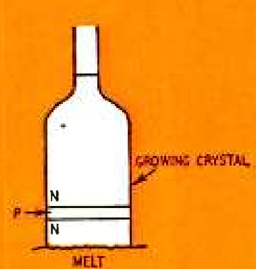


Fig. 2—A grown n-p-n sandwich suitable for transistors.

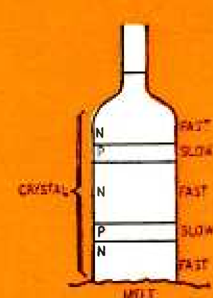


Fig. 3—Many junctions can be rate-grown in one crystal.

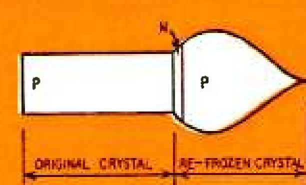


Fig. 4—A meltback p-n-p sandwich

USING neon LAMPS

They are by no means limited to indicator and pilot-light applications

By A. R. CLAWSON

THE humble neon lamp may be used in many circuit applications. Two such uses are found in the new G-E color receiver (21C700). In Fig. 1, the lamp acts as a switch in series with a resistor. In Fig. 2 it behaves like a voltage regulator. The neon may behave as a nearly perfect bypass capacitor, curing stubborn cases of unwanted feedback. To use the neon lamp in these varied applications, its unique characteristics must be understood.

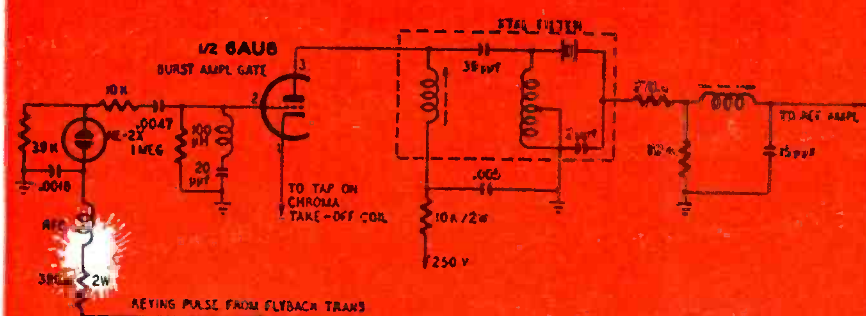


Fig. 1—Neon lamp in color-burst keyer maintains keyer-pulse amplitude constant.

Neon characteristics

A neon lamp acts like an open circuit or a switch until a certain critical striking (starting) voltage is reached. Then it conducts. Due to its internal resistance, it can be compared to a resistor in series with a switch. Once lit, the voltage must be decreased somewhat below the striking value to extinguish the lamp. Table I shows these characteristics for dc operation.

On ac, the tube is extinguished each cycle, and the values are slightly different than for dc. The maintaining voltage given in the table is just above the extinguishing point. (Individual bulbs vary considerably; these figures are an average.)

For the tube to act as a bypass it must be lit. This is also true if it is used as a voltage regulator (except for use as a surge suppressor). The bulb is used on voltages above the striking value in most instances, like the voltage regulator of Fig. 3. An external resistor (R_E) is then needed to limit current if the tube does not have an internal resistor. It may be a rheostat, a fixed resistor or both. Table I lists the minimum resistance required to drop the voltage to the maximum safe

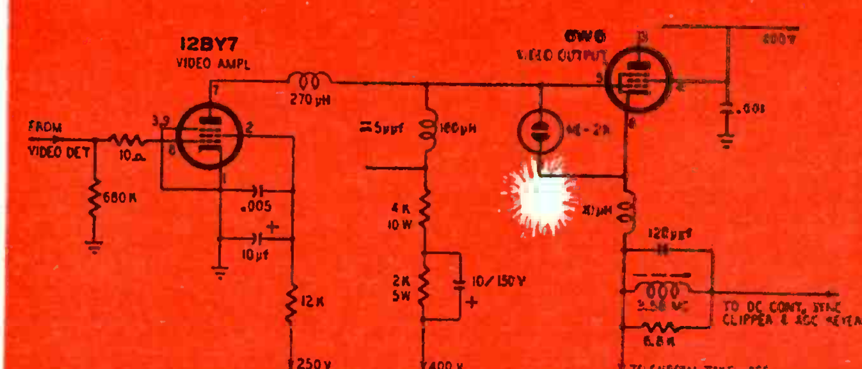


Fig. 2—A neon lamp used as an amplitude limiter and grid-bias regulator in a color set's video amplifier.

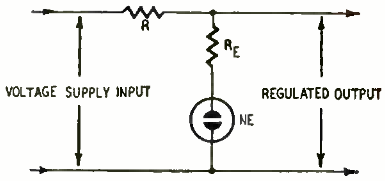


Fig. 3—Typical neon voltage-regulator circuit.

value. It is quoted in terms of ohms per volt of drop. For example, to use a 60-volt lamp on a 250-volt bus, 190 volts are dropped in the external resistor. The value of this resistor is determined by multiplying the voltage drop by the figure in the last column of the table.

The voltage output of a conventional power supply varies with the current drain. A basic voltage-regulation (stabilizing) circuit, using a neon lamp, is shown in Fig. 3. As the supply voltage increases, the voltage across the regulation network (R, NE) also increases.

The voltage across the neon lamp remains constant from the firing point to near its top current rating, so current through it goes up and the voltage drop (IR) across resistor R increases, lowering the voltage from the power supply. If the supply voltage goes down current through the neon lamp decreases, lowering the voltage drop across resistor R and increasing the output voltage.

Since putting any great amount of resistance directly in the neon-tube branch of the circuit (R_E in Fig. 3) would hamper the voltage-regulating action, it is advisable to use bulbs without internal resistors and connect

TABLE I—DC NEON CHARACTERISTICS*

Wattage	Maintaining Voltage	Starting Voltage	Current Rating (Ma)	Minimum Ex. Series Resistance (Ohms/Volt)
1/25	55	73	0.3	3200
1/4	64	83	2.0	470
1	57	65	12.0	120
2	60	74	18.0	55
3	58	78	30.0	36

Values may change slightly during first 20 hours of service, due to aging. Current is full rated current for the quoted wattage. Operating current is often below this value.

*From G-E's "Glow Lamps."

TABLE II—NEON TYPES, BASES, INTERNAL RESISTORS*

Wattage	Type	Base	Internal Resistor (Ohms) in Series with Element
1/25	NE-2	Unbased, wire leads	None
1/25	NE-51	s.c. bayonet, miniature	None
1/4	NE-45	candelabra screw	30,000
1/4	NE-48	d.c. bayonet candelabra	None
1/4	NE-16	d.c. bayonet candelabra	None
1/4	NE-57	candelabra screw	30,000
1/4	NE-17	d.c. bayonet candelabra	None
1/2	NE-58	candelabra screw	100,000
1	NE-30	medium screw	7,500
1	NE-32	d.c. bayonet candelabra	None
1	NE-56	medium screw	33,000
2	NE-34	medium screw	3,500
3	NE-40	medium screw	2,200

*From G-E's "Glow Lamps."

them in series for the voltage desired. Thus two 60-volt tubes would maintain an ouput voltage of 120.

The larger sizes of neon lamps are commonly used for this purpose (see Table II). *The greater the drain of the neon lamp as compared to the load the better the regulation.*

The lamp's current rating helps de-

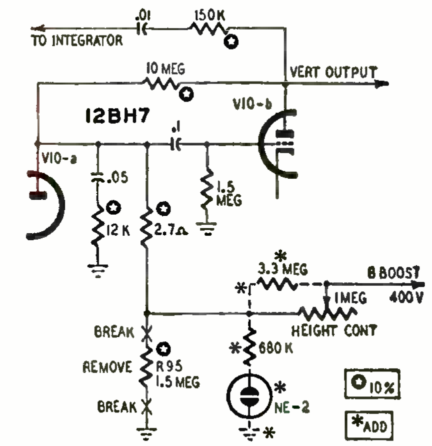


Fig. 4—Bypass action is combined with primary voltage-regulator action in this Olympic C21BD35 modification.

termine how much bypassing and regulatory action may be obtained. To maintain a relatively fixed bias on a grid the smallest lamp will do the job while for the example of Fig. 3 a larger one is needed to handle the larger current.

Most screw-base neon lamps are intended for use as dial lights or indicator duty directly from the power line. They have a built-in dropping resistor. They can be used at higher voltages by adding the necessary external resistance in series. Table II gives wattage, type number, basing and value of any internal resistance for a number of popular types. Wire lead types are intended to be soldered into the circuit directly.

Applications

Use as a combined switch and pulse-height regulator is illustrated by the circuit in Fig. 1. The tube conducts on the flyback pulse and tends to regulate the pulse's height also.

In Fig. 2, grid voltage is maintained relatively constant by the neon lamp. The circuit is direct-coupled so the lamp may be shunted from grid to cathode. The video signal will also be limited if it is excessive.

Some TV sets have critical points where 10% or better tolerance resistors are used. Fig. 4 shows such a circuit. A neon bulb was utilized to repair this set rather than experiment with precision resistors. A 1/25-watt neon lamp regulated the B-boost supply to the vertical oscillator, correcting a bad case of bounce plus height trouble with varying line voltage. Some slight changes were made in the circuit to allow for the added drain of the regulator. The lamp did another thing, too: It corrected some hook caused by blurps of the vertical pulse traveling along the B supply and being radiated into the horizontal sweep control circuit (the afc).

A neon lamp's nearly perfect bypass action is used, in Fig. 5, to eliminate pseudo-Barkhausen interference radiated by the screen-grid supply of a horizontal output tube. The screen resistor was removed first. Then its value was broken into two separate resistors whose total was a little less than the original resistor. The NE-17 neon lamp was added as shown. It bypassed the interference and regulated the screen voltage, too.

In a Du Mont RA-350 TV chassis, filter capacitor C286-B did not completely remove spurious sync pulses from the 150-volt B-plus line feeding the video if amplifiers. See Fig. 6. The neon lamp with its series resistor was added as illustrated. About 5 volts less B plus was available but this did not interfere with normal operation. If B plus is lowered unduly, the dropping resistor may be reduced in value. Here R306 is the dropping resistor.

The modification mentioned cured a bad case of horizontal jitter. Similar treatment alleviates or cures oscillation and regeneration caused by feedback along a B-plus line. A common case is that of feedback in the if stages of a car radio.

Neon lamps have other uses too. For example, they can serve as an ac voltage regulator on the input to experimental equipment. A resistor is placed in series with the line and the neon will pull more or less current in accordance with the demands of the load. END

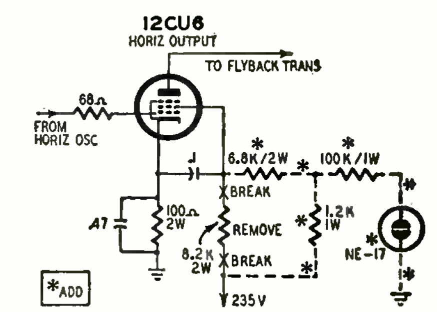


Fig. 5—Simple bypass action removes pseudo Barkhausen interference in an Emerson 120257-D.

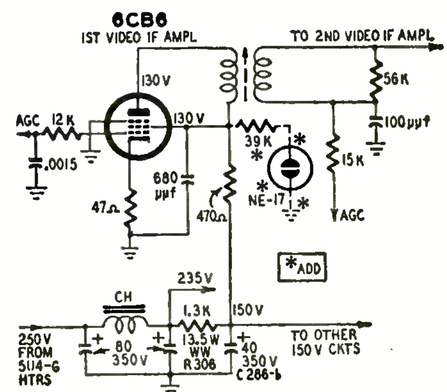


Fig. 6—Neon bulb as a glow-lamp regulator cured a case of jitter in this Dumont RA-350.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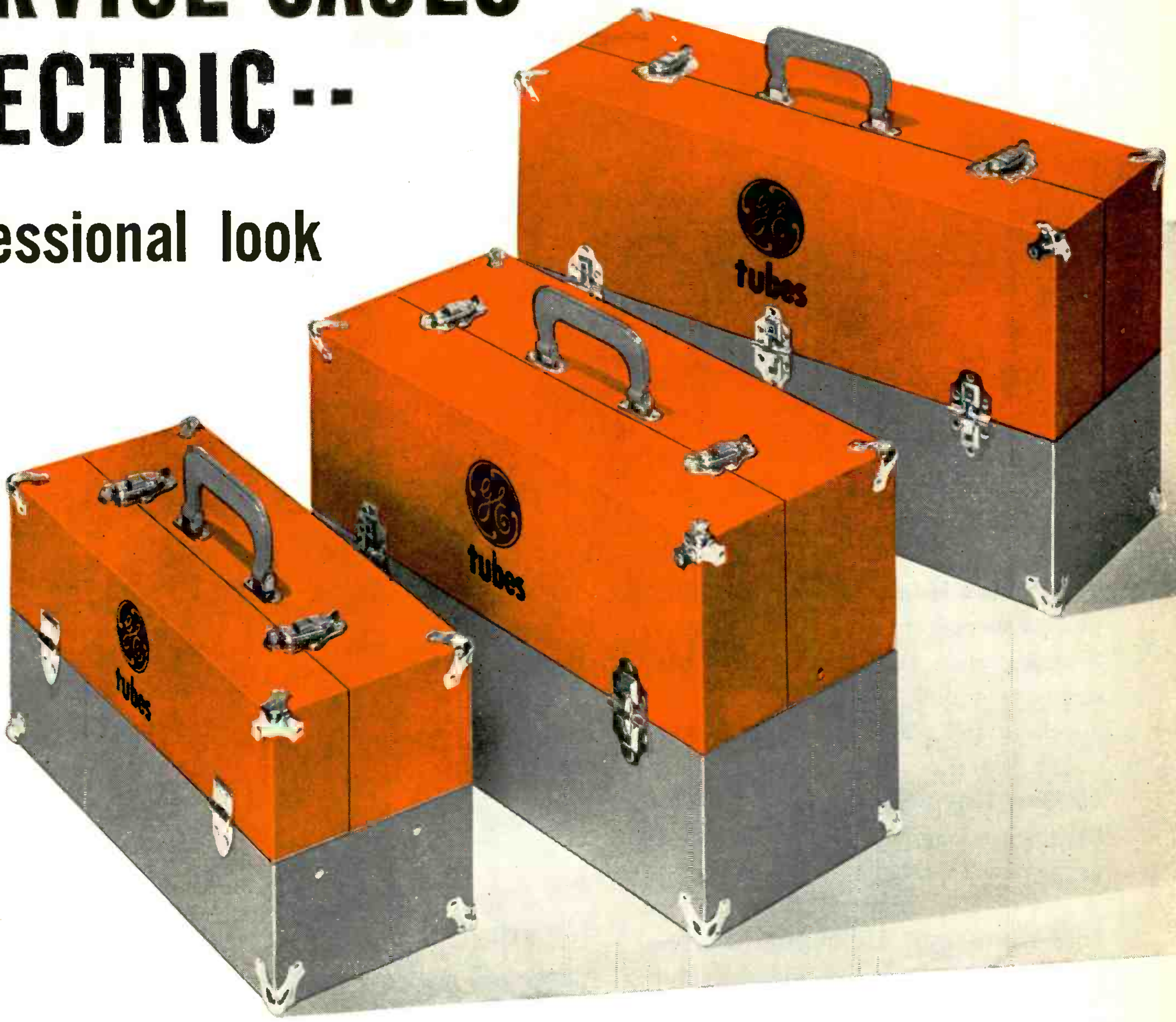

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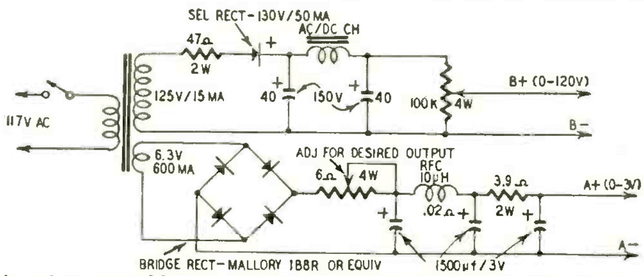
BATTERY ELIMINATOR

A line-operated battery eliminator with adjustable A and B voltages is handy when servicing portable radios. By dropping the output voltages below the levels required by the set you can spot erratic oscillator tubes and often isolate the causes of intermittent operation.



The circuit of a suitable eliminator is shown in the diagram. It can be used with most portables with parallel-connected 1.5-volt filaments. B voltage can be as high as about 120 with normal drain and A voltage can be adjusted to supply some sets requiring 3 volts. The eliminator can be improved by installing a 25-ma dc meter in the B-plus lead and 5- and 150-volt meters across the A and B output leads, respectively.

The same circuit can be used when electrifying battery radios. If you are careful when selecting parts, you may be able to construct the eliminator so it will fit in the space formerly occupied by the batteries. The power transformer may be a Stancor PS-8415 or equivalent, the B-plus rectifier a Sarkes Tarzian model 50, the low-voltage rectifier a Mallory 1B8R and the A filter capacitors a triple section unit such as the Sprague TVL-3015 or individual units with values of 1,500 μf or more.

BOOSTING 152-162-MC SIGNALS

I have a Gonset model 3012 FM tuner for the 152–162-mc band. Its sensitivity is satisfactory for powerful base stations but not for low-powered mobile transmitters. I raised the overall sensitivity of the system to an acceptable level by replacing the ground-plane antenna with a high-gain omnidirectional type and adding a booster. The antenna is a vertical collinear array like that in Fig. 1. This is a three-element array with a gain of about 3 db and a feed-point impedance that provides a good match to 300-ohm transmission lines. The antenna will cover the entire band adequately when cut for 157 mc. The dimensions shown are for this frequency.

The gain of the array can be increased about 1 db for each half-wave element added to it but it is hardly worth while to add fewer than three. The feed-point impedance will approximately 100 times the number of half-wave elements. The two outside elements remain the same length. The added elements are inserted between the end ones and are each the length of the center element. One-quarter wavelength stubs like those shown in Fig. 1, are used between each half-wave element.

The antenna and phasing stubs are made from rigid rods or tubing. The array can be mounted by fastening the cold (shorted) ends of the stubs to a metal mast. Be sure the mast is grounded to provide protection against lightning.

Fig. 2 is the diagram of a single-stage neutralized rf amplifier similar to a simple TV booster. Tuning capacitors C1 and C2 are butterfly type midget units with capacitance of about 10 μμf per section. You can use E. F.

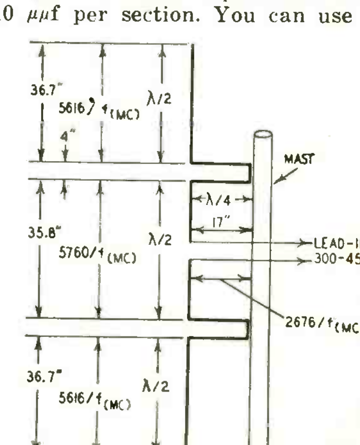
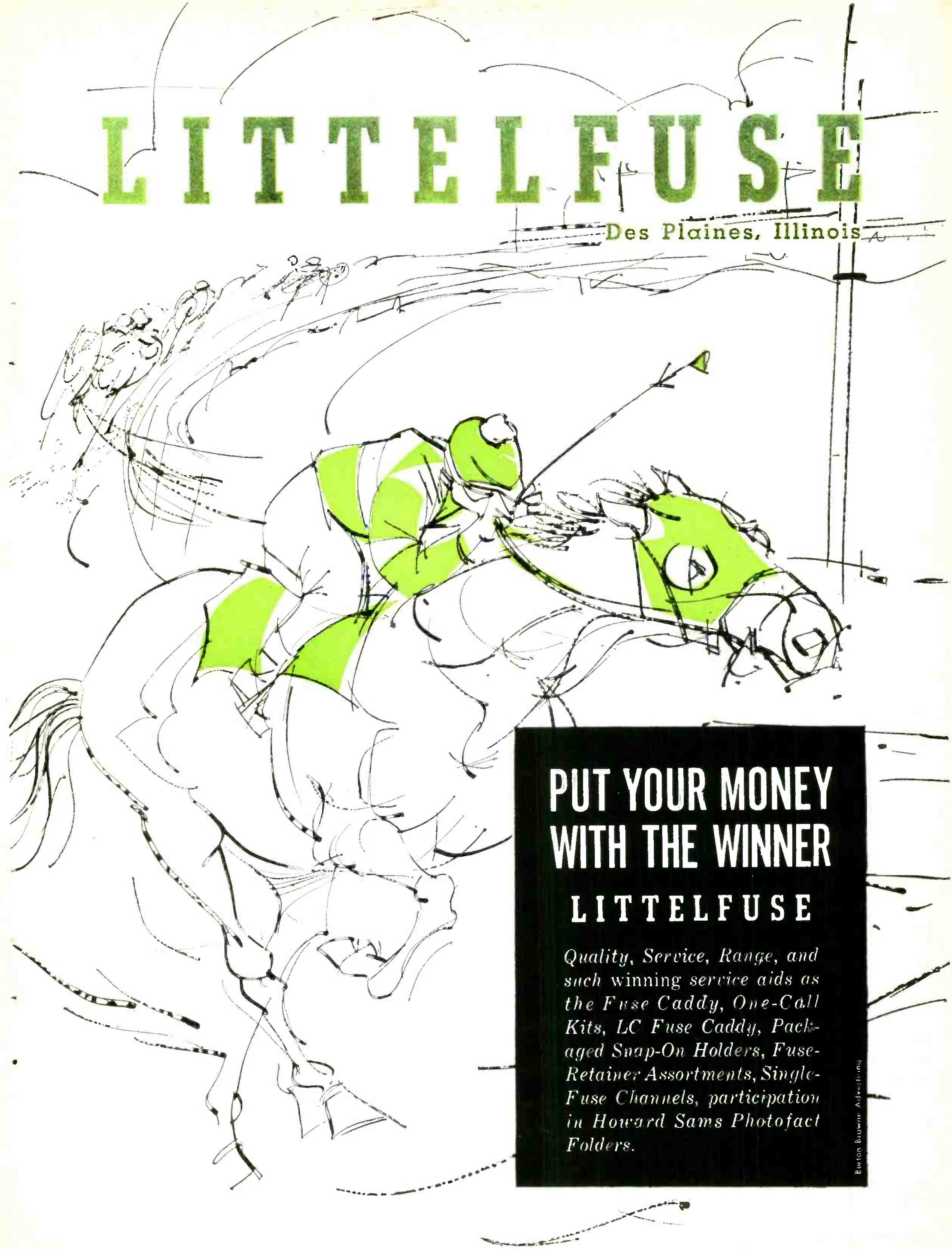


Fig. 1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Quality, Service, Range, and such winning service aids as the Fuse Caddy, One-Call Kits, LC Fuse Caddy, Packaged Snap-On Holders, Fuse-Retainer Assortments, Single-Fuse Channels, participation in Howard Sams Photofact Folders.
Burton Browne Advertising

Johnson type 11MB11 or equivalents. Neutralizing capacitors C_N are twisted-wire gimmicks or 0.5-$\mu\mu$f tubular ceramic trimmers.

L1 and L2 each consist of five turns of No. 18 enameled wire wound in two sections of 2½ turns each. The sections are ⅜ inch in diameter and ½ inch apart with a tap at the center. The antenna input and output link windings are each three turns of No. 18 wire wound ⅜ inch in diameter and ¼ inch long. These links are inserted between the halves of L1 and L2.

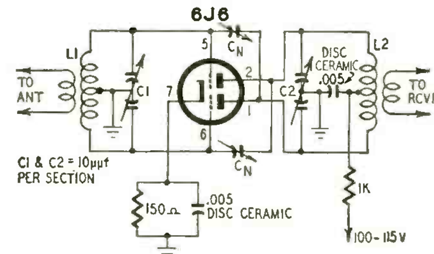


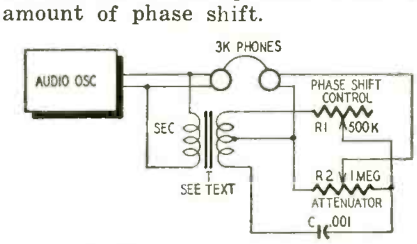
Fig. 2

To adjust the booster, connect it between the antenna and tuner—former to match the tuner's 52-ohm using a balun or TV elevator transformer to match the tuner's 52-ohm input. Tune the tuner to a frequency in the center of the band and squeeze or spread the turns of L1 and L2 so the signal comes in. To neutralize the booster, disconnect the antenna lead-in and replace it with a 300-ohm resistor. Turn up the tuner's volume control and adjust the neutralizing capacitor for minimum noise.—*Henry O. Maxwell*

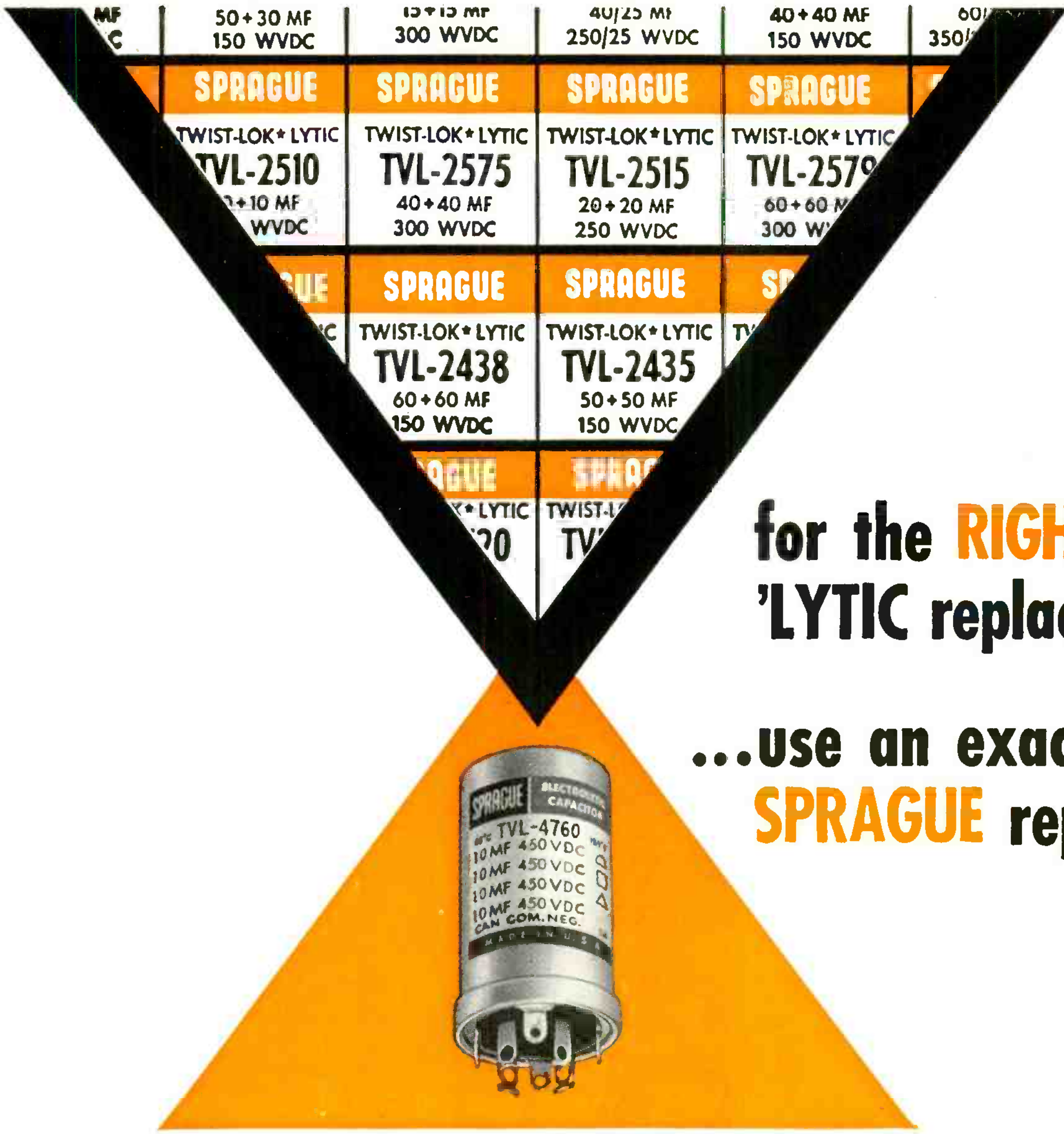
RE: PHASING EARPHONES

It is interesting to note that the technique of phasing earphones—described by Art Trauffer on page 40 of RADIO-ELECTRONICS, June, 1957—can be elaborated to reproduce direction of sound origin.

For example, if one earphone is fed a tone which is constant in phase, while the other earphone is fed the same tone which passes through a phase-shifting circuit, the apparent direction from which the tone is coming moves about the listener as the operator varies the amount of phase shift.



A suitable demonstration arrangement is shown in the diagram. T is a conventional audio output transformer with its low-impedance winding connected to the audio oscillator. R2 operates as an ATTENUATOR and should be set to provide approximately the same level of sound in the right earphone as in the left. R1 is the PHASE-SHIFT CONTROL, and causes the apparent direction of sound origin to move around the listener as its setting is varied.—*Robert G. Middleton* END



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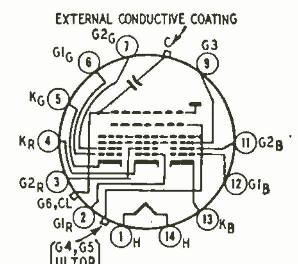
New Tubes & Semi-conductors

An all-glass color picture tube, a diode–tetrode designed for 12-volt automotive radios and some more transistor-characteristic abbreviations highlight this month's releases.

21CYP22

A directly viewed, round-glass, shadow-mask type picture tube for use in color television receivers, made by RCA. It is designed with an all-glass envelope which reduces high-voltage insulation requirements of the color receiver. It also has an external conductive coating which, with a portion of the internal conductive coating, forms a supplementary filter capacitor. This 3-gun tube has a 6.3-volt 1.8-amp filament.



21CYP22
SUBSCRIPT R,G,B REFER TO RED,GREEN & BLUE GUNS

The 21CYP22 is electrostatically focused and magnetically converged. Its maximum ratings are:

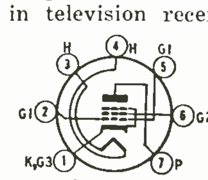
*Ultor-to-cathode voltage†	25,000
Grid 3-to-cathode voltage†	6,000
Grid 2-to-cathode voltage† (of each gun)	600
Grid 1-to-cathode voltage†	
(Neg bias value)	400
(Pos bias value)	0
(Pos peak value)	2
Peak heater–cathode voltage†	
(htr neg respect to cath)	
(during warmup, 15 seconds)	410
(after warmup)	180

**Between the ultor terminal and the high-voltage supply terminal, it is necessary to connect a 50,000 ohm resistor. The high voltage must be connected to the high-voltage supply terminal* (G6,-CL)—*never directly to the ultor.*

†Of each gun.

12R5, 17R5

These seven-pin miniatures are beam pentodes designed for use as a vertical amplifier in television receivers. Both



12R5, 17R5

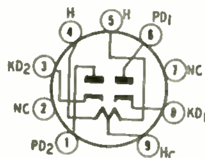
tubes are identical except for heater ratings. The 12R5 has a 12.6-volt 600-ma and the 17R5 a 16.8-volt 450-ma heater. Both have controlled-warmup characteristics for use in series-string circuits.

Manufactured by Raytheon, typical operating characteristics are:

V_p	110
V_{g2}	110
V_{g1}	− 8.5
I_p (ma)	40
I_{g2} (ma)	3.3
R_p (ohms) (approx)	13,000
g_m (μohms)	7,000

12DF5

A nine-pin miniature tube containing a cathode type, full-wave rectifier. Its center-tapped heater can be operated



12DF5

at 12.6 volts, 450 ma or 6.3 volts, 900 ma. It is manufactured by Sylvania.

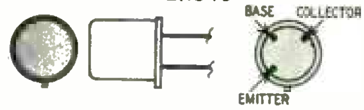
Typical operating characteristics are:

	Input to filter	
	Capacitor	*Choke*
V_P (rms ac supply to each plate)	325	450
Filter capacitor (μf)	40	
Filter choke (h)		10
Effective plate supply resistance (ohms)	82	
Dc output current at filter (ma)	100	100
Dc output voltage at filter	330	360

2N340

This grown-junction n-p-n silicon transistor is especially designed for use

2N340



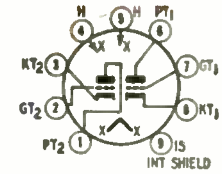
in audio or servo amplifier stages requiring medium power output. The 2N340, made by Texas Instruments, will operate over a temperature range of − 55°C to 150°C

Maximum ratings are:

V_{cb}	85
I_c (ma)	50
P_c (mw) (at 100° C)	400
(at 125° C)	200
Power gain (db)	30

6DT8, 12DT8

General-purpose high-mu twin triodes of the nine-pin miniature type intended for use as an rf amplifier and as a combined oscillator-mixer in FM tuners. The 6DT8 has a 6.3-volt 0.3-amp heater. The 12D8's heater is rated at 12.6 volts at 0.15 amp. Both are made by RCA.



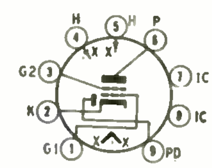
6DT8, 12DT8

The triode units are isolated by an internal shield having a separate base-pin terminal. Operating characteristics, when used in Class-A1 amplifier service are:

	Values are for each triode section	
V_p	100	250
Cathode-bias resistor (ohms)	270	200
μ	60	60
g_m (μmhos)	4,000	5,500
R_p (ohms approx)	15,000	10,900
I_p (ma)	3.7	10
V_g (for I_p of 10 μa)	− 5	− 12

12EM6

A combined detector diode and a tetrode with a common cathode. The tetrode section is intended for use as a power amplifier where heater, plate and screen grid potentials are obtained di-



12EM6

rectly from an automotive battery.

Announced by Raytheon, typical operating characteristics of the 12EM6 are:

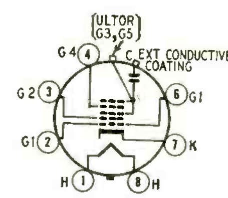
V_{htr}	12.6
I_{htr} (ma)	500
V_{PT}	12.6
V_{g2}	12.6
V_{g1} (af) (rms)	1.0
I_P (ma)	2.5
Power output (mw)	10
Total harmonic distortion (%)	10

Abbreviations

I_{CO}—Collector current when collector junction is reverse-biased and emitter is dc open-circuited.
I_{EO}—Emitter current when emitter junction is reversed-biased and collector is dc open-circuited.
I_{CEO}—Collector current with collector junction reverse-biased and base open-circuited.
NF—noise figure.
G_e—Common-emitter power gain.
G_b—Common-base power gain.
P_c—Collector power dissipation.
h_{ib}—Common-base input impedance, output ac short-circuited.

17CAP4

Another addition to 110° picture tubes, the 17CAP4 is a direct-viewed 17-inch rectangular glass type made by Sylvania. It has a spherical faceplate, aluminized screen and needs no ion trap. Its 6.3-volt 600-ma heater has a warmup time of 11 seconds.



17CAP4

Maximum voltage ratings for the 17CAP4 are:

Ultor	17,600
V_{g4} (pos value)	1,100
(neg-value	550
V_{g2}	550
V_{g1}	
(neg bias value)	154
(neg peak value)	220
(pos bias value)	0
(pos peak value)	2
Peak heater–cathode voltage (htr neg with respect to cath)	
(15-sec warmup)	450
(after warmup)	200
(htr pos with respect to cath)	200

Other types

A high-current medium-mu triode, the 6528, has been presented by the Chatham Electronics Div. of Tung-Sol Electric. It is intended for series regulator service in dc power supplies.

A 1,000-watt ceramic tetrode for single-sideband operation, the 4CX-1000A, has been announced by Eitel-McCullough. END

New Transcription-Type Tone Arm Makes *Collaro* World's First True High Fidelity Changer

The Turntable That Changes Records

From Collaro, Ltd., world's largest manufacturer of record playing equipment—comes the most significant development in the field in years—the new transcription-type tone arm.

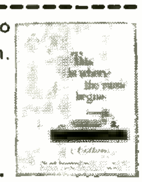
This arm, exclusive with Collaro, literally changes the conventional record changer into a brand new instrument — a TRANSCRIPTION CHANGER — with features of the finest professional equipment.

The arm is a one-piece, spring-damped, counter-balanced unit which will take any standard high fidelity cartridge. It is free of any audio spectrum resonances. It permits the last record to be played with the same low stylus pressure as the first. Between the top and bottom of a stack of records there is a difference of less than a gram in tracking pressure as compared with 4 to 8 grams on conventional changers. Vertical and horizontal friction are reduced to the lowest possible level. These qualities, found only in the Collaro Transcription Changer, insure better performance and longer life for records and styli.

In its superb performance, the new Collaro Continental, Model TC-540, meets the rigid requirements for high fidelity equipment. Here, for the first time in a changer is professional quality at a record changer price. The Continental is $46.50. Other Collaro changers are priced from $37.50 up. (Prices slightly higher west of the Mississippi.)

In addition to the new tone arm, the Collaro Continental features include: 4 speeds, manual switch for turntable operation; wow and flutter specifications — 0.25% RMS at 33⅓ RPM — superior to any changer in the world; automatic intermix; automatic shut-off after last record; heavy duty 4-pole, shaded pole induction motor; heavy rim-weighted balanced turntable; muting switch and pop-click filter for elimination of extraneous noises; jam proof machinery; pre-wiring for easy installation; attractive two-tone color scheme to fit any decor; tropicalization to operate under adverse weather and humidity conditions; easy mounting on pre-cut board or base; custom testing at the factory for wow, flutter, stylus pressure and correct set down position.

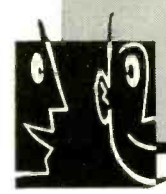
FREE: Colorful new catalog describes complete Collaro line. Includes helpful guide on building record collection.



ROCKBAR *Corporation*

WRITE TO
ROCKBAR CORPORATION
Dept. D-012
650 Halstead, Mamaroneck, N.Y.

Rockbar is the American sales agent for Collaro and other fine companies.



Technicians' News

OPPOSES PAY TV TESTS

The National Alliance of Television and Electronic Servicing Associations' (NATESA) executive secretary, Frank J. Moch, has expressed the organization's stand against any tests of pay TV "which would in any way encourage the acceptance of this system." This was in a letter to John C. Doerfer, FCC chairman.

NATESA has asked the FCC and the House Interstate Commerce Committee to get all details of the workings of pay TV before permitting tests or authorizing it in any form.

Six points are emphasized by Mr. Moch. He states that approving pay TV will be a mortal blow to the independent service industry, since pay TV promoters would demand the right to maintain the sets. He continues that we (NATESA) have not been able to get assurances to the contrary.

He also states that approval would encourage the promoters to assume a utility attitude, and like the phone company would then supply the sets on a rental basis, thus raising havoc with the entire manufacturing, distribution, retail and servicing industries.

In explaining other points of the NATESA stand, Mr. Moch wrote that pay TV is opposed to historical concepts is not in keeping with the spirit of laws, like those authorized by the FCC; that despite its weaknesses, the present system of telecasting has been accepted by the public; that pay TV cannot guarantee elimination of existing shortcomings and that pay TV does not guarantee that commercial practices now distasteful to viewers will not be continued.

TECHNICIAN'S ADVERTISING

The National Alliance of Television & Electronics Service Associations (NATESA) now offers every member of every local affiliate an opportunity to participate in the NATESA National Advertising and Publicity Program, an article in the September issue of *TESA* (Missouri) *News* proclaims.

The program calls for ads in several top magazines, newspaper ads on a local level, radio and TV spots on a national level, listing in the yellow pages of the phone directory, Operator 25 service and use of direct-mail pieces.

Individual members of local affiliates will be franchised to participate, and window valences, truck decals, letterheads, billheads, mailing pieces, etc., will be available at cost. The cost will be very low as advertising materials will be purchased in mass quantities.

The Cody Advertising Agency, Chicago, Ill., headed by Jim Cody, will handle the program and is already preparing ad copy. The yearly cost of this program, because of its size, is expected to be extremely low. Individual members can participate for a few cents a day over a period of several months.

URGES STRONG GROUP

Addressing the annual convention of the National Alliance of Television and Electronics Service Associations (NATESA), E. P. Atcherley, assistant manager of Sylvania's Electronic Products Distributor Sales Dept., said that, in his opinion, television service technicians require fewer, or one strong nationally known organization, to insure proper coordination of ideas and adequate interchange of technical information.

"To fulfill its role in electronics," Mr. Atcherley stated, "the service industry should have the equivalent of an American Medical Association or a National Association of Cost Accountants. At the present time there is no single organization equipped to fulfill the servicemen's needs and protect his interests."

HAZARDOUS ANTENNA

Those who believe TV repairing is a cinch were proved wrong again when Dr. Sidney Gaft, Bronx, N. Y., was killed while fixing a television antenna. Working on the roof of a 6-story building, Dr. Gaft slipped and fell off the roof to his death. END

Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK, *Founder*

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

In December, 1923, *Science and Invention* (formerly *Electrical Experimenter*)

Loudspeaker Without Microphone, by Dr. Alfred Gradenwitz.

Radio for the Beginner, No. 22, by Armstrong Perry.

Broadcast Stations.

A Compact "Single Six" Circuit, by H. E. Hayden.

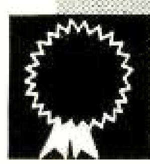
Multi-Wave Reinartz Receiver, by Kenneth Harkness.

How to Build a Rogers' Cage Loop, by Dr. James Harris Rogers.

Well Made Radio Cabinet.

Radio Oracle.

Patents

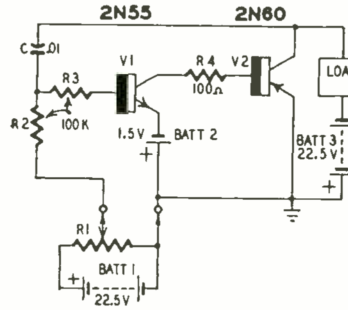


ADJUSTABLE MULTIVIBRATOR

Patent No. 2,788,449

Richard L. Bright, Adamsburg, Pa. (assigned to Westinghouse Electric Corp., E. Pittsburgh, Pa.)

When this circuit is first switched on, BATT 1 and BATT 3 act in series through the load to charge C. A rush of current through R2 produces a voltage drop that drives the junction of C, R2 and R3 negative and blocks V1. Absence of current through R4 keeps V2 nonconducting also.



As C charges, junction C-R2-R3 goes less negative. When the base voltage has dropped to about 1.5, V1 begins to conduct. Current flows through R4 to unblock V2 as well. C now discharges through R3 and saturates V1, and in turn V2. Thus, a second discharge path exists through R2 and V2.

At completion of the discharge, the cycle repeats. Voltage of BATT 1 has an important effect on the timing of the cycle, for it determines the instant V1 begins to conduct. Therefore this circuit is a pulse generator variable over a wide frequency range with but a single potentiometer control, R1.

DOG-TRAINING DEVICE

Patent No. 2,800,104

Robert C. Cameron, and John W. Hopkins, Jr., Leavenworth, Kans.

With this invention a dog's life can be made more miserable by remote control. The trainer carries an uhf portable transmitter (Fig. 1). A receiver is strapped to his dog within a

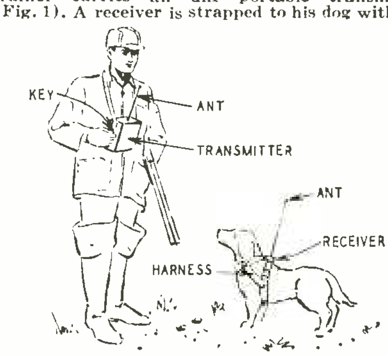


Fig. 1

harness, with a pair of electrodes touching the dog's shoulders. When the dog disobeys a command or fails to do something expected of him, the trainer presses a key to impart a "mild and unharmful, but effective" shock to his dog.

The radio detector may be superregenerative, with audio output coupled to a relay (Fig. 2). This stage is biased to cutoff, so it conducts only when modulated by a tone. Normally the relay armature touches the upper contact, allowing C to charge through R from the filament supply.

The relay is energized when the transmitter key is depressed. C discharges through the primary of stepup transformer. A high voltage

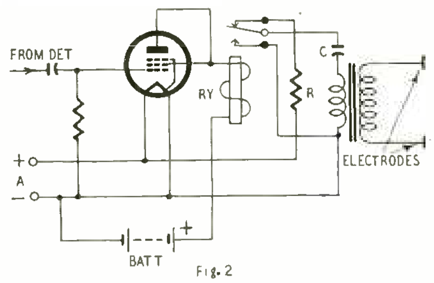


Fig. 2

appears across the scondary and the electrodes.

The inventors recommend subminiature tubes and tiny batteries. This is the least that can be done for the poor dog. Forcing him to carry heavy equipment would be adding insult to injury.

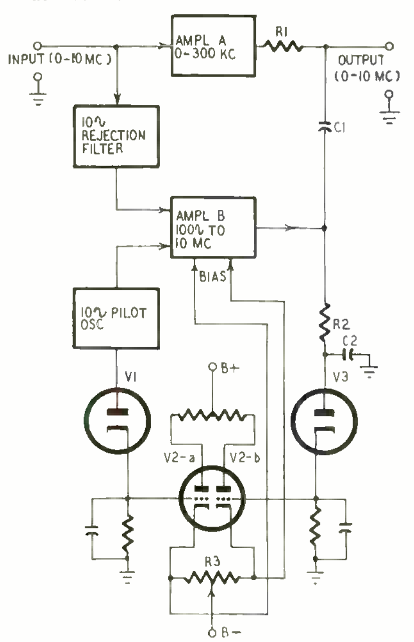
WIDE-BAND AMPLIFIER

Patent No. 2,781,423

Chester G. Kuczun, Brighton, and Paul A. Husman, Reading, Mass. (Assigned to Laboratory for Electronics, Inc., Boston, Mass.)

Two separate amplifiers team up to provide flat response from dc to 10 mc. One amplifier (A) is effective from zero to 300 kc. The other (B) responds from 100 cycles to 10 mc. A crossover network smooths the overlap range for flat transition.

It is easy to maintain a constant gain through A, but B presents more of a problem because of the high frequencies. Therefore, its gain is regulated. A standard or pilot frequency (10 cycles) is fed to B. Some transmission occurs even though this amplifier is designed for high frequency. Initially, the pilot frequency output from B is made equal to that from the pilot oscillator. Any departure from this condition is the fault of B. An automatic control corrects its gain as needed.



There must be no coupling between A and the pilot generator. Also, the pilot *frequency* must not reach B directly from the input. Both purposes are accomplished by a rejection filter.

R1, C1 is a crossover unit. It reduces high frequencies from A and also low frequencies from B. R2 and C2 form a low-pass filter that transmits only the pilot frequency to V3.

V2 is a difference amplifier that receives two signals, both of pilot frequency. One is the output of the pilot generator itself, detected by V1 and filtered. The other is the output from B, rectified by V3 and filtered. These signals appear at the grids of V2. When they are equal, there is no potential difference between the cathodes of V2. Therefore no additional *bias* voltage is fed to B at this time. Any change in the output from the pilot generator has no effect on the *bias*, since it affects the grids of V2-a and V2-b equally.

If the 10-cycle output from B changes (without corresponding change from the oscillator), it must be the fault of amplifier B. For example, if the output increases, V2-b receives a more positive signal at its grid. Its cathode also goes more positive. As a result B receives a bias voltage that reduces its gain. END

new Records — MONITOR

Note: Records below are 12-inch LP and play back with RIAA curve unless otherwise indicated.

PROKOFIEV: *Peter and the Wolf*
SAINT SAENS: *Carnival of Animals*
Rodzinski conducting Philharmonic of London
Scherchen conducting Vienna State Opera Orchestra
Westminster XWN-18525

Few combinations of music present as delightful material for testing, demonstration and show-off (as well as listening) as these two. Westminster does its wonderful best, presenting marvelous drums and solo double bass and a brilliant and clean overall sound. Unfortunately, it undoes its work by an error which I cannot forgive in a company with so much hi-fi savvy. The commentary by Garry Moore, dubbed in after the recording of the orchestras, is at a level higher than the peaks of the orchestras. It is impossible to set the volume to bring the musical portions to best effect without raising the voice to the level of a fog horn. I urge Westminster forthwith to redub the job with the voice at least 6 db, and preferably 10 db lower. If it does so, it should have a best selling hi-fi hit. The solo bass in the *Elephants* of *Carnival of Animals* alone is worth the price. Here, at last, is a double bass not as big as life but as big as many hi-fi fans would like it to be, with fearsome capacity to rattle the loose china and window panes and to find any point of resonance in the system—or the house structure. Its rosiny guttiness is entirely natural, too. The drums, too, are both prodigious and natural. Other elements contribute to its superiority. As a dividend—which may annoy some—it includes the very awesomely natural sounds of the animals. The roar of the lion will especially delight owners of really fine speaker systems. It has the genuine thunderous ominousness. But, I repeat, as long as the voice is at its present ridiculous level, these virtues will either have to be hidden or paid for with headache and family strife.

HOLST: *The Planets*
Stokowski conducting Los Angeles Philharmonic
Capitol P-8389

This second release makes plain that the new association of Capitol and Stokowski is going to be a highly rewarding one for listeners with fine hi-fi systems. This music is extraordinary in its variety of tonal effects. Requiring a very augmented orchestra, it provides opportunity for almost every instrument to show off its particular forte and in several fearsome peaks produces a concatenation of orchestral sound which is hard to match. This recording does a superb job of bringing it all to the ear, with complete freedom from distortion, great faithfulness of tone and an extremely fine definition. It will take a really fine system to do it justice, but on such a system it is hard to imagine what advantage a live performance could have. For those who can learn to like the music well enough to become familiar with the detail, this would be a superlative test recording—particularly for distortion, definition and naturalness. And it would be a fine demonstration record for musicians or sophisticated listeners. For my money, the best recording Capitol has issued so far.

DVORAK: *Slavonic Dances (Nos. 1–10)*
Malko conducting Philharmonia Orchestra of London
RCA Victor LM-2096

DVORAK:
Slavonic Dances (Nos. 11–16)
GRIEG: *Lyric Suite*
Same orchestra
RCA Victor LM-2107

Now that everybody has recorded Strauss waltzes in hi-fi, it appears that another cycle may be in the making with *The Slavonic Dances*. If so, it's a good idea, for these dances have a fine variety of music and tone coloring. This one is good enough musically, but the bass is rather vague for hi-fi demonstration. *The Lyric Suite* makes an excellent pairing. The surfaces of my copies were very noisy and nothing I could do would quiet them.

ROZSA: *Jungle Book Suite*
Thief of Bagdad Suite
Composer conducting Frankenland State Symphony Orchestra
RCA Victor LM-2118

The background music to the Alexander Korda filming of Kipling's *The Jungle Book* was recorded by RCA Victor with the voice of its hero for the narration before the war on 78's and proved very popular with the young fry. The music itself has been frequently performed in concert suite version. Here we have a new version, but with an adult voice in narration. The original was far more effective, but this should be pleasing to those who have not been conditioned by the original recording. The same composer's music to the movie, *Thief of Bagdad*, also with narration, has the flip side. The balance of voice to music is excellent. Not remarkable in hi-fi effects but pleasant and clean.

BIZET: *Carmen Suite*
L'Arlésienne Suite No. 1
Paray conducting Detroit Symphony
Mercury MDS 5-3

KODALY: *Hary Yanos Suite*
Dorati conducting Minneapolis Symphony
Mercury MDS 5-1

Mercury's entry into the stereo tape field is a welcome one. For one thing its Olympian recording technique with its great dynamic range is particularly suited for showing off the advantages of tape reproduction. Whereas on the discs the peaks are very likely to overload even the best pickups, on tape they come through with a brilliant cleanness. For another, the Mercury three-channel recording technique is a step toward but not a complete solution of the "hole-in-the-middle effect" of two-channel stereo reproduction. Finally, and perhaps best of all, the initial offerings present the spectacular type of material which makes the most vivid impression whether on stereo or single channel. This pair of tapes will present present-day stereo at its very best. The Hary Yanos, especially, has some very spectacular spots which, on the best stereo systems, will yield a most persuasive and brilliant presence. The more familiar *Carmen Suite* also has some very effective portions. The cost is high but pays for some of the very finest stereo tapes so far issued.

Dancing and Dreaming
Jay Norman Quintet
Concertapes 24-2 (stereo)
456 (monaural)

There is nothing very demanding or spectacular about the music, but this tape is capable of bringing a five-piece supper club ensemble right into your living room. The high highs and percussives of the rhythm are extremely good, and the monaural version would be excellent for demonstrating really fine single-channel systems.

Russkaya
Dragon conducting Hollywood Bowl Orchestra
Capitol P-8384

Another of the excellent combination salads in the Hollywood Bowl series which ought to find a very wide audience, especially among those who are just beginning to enjoy both classical music and high fidelity. This consists of a half dozen such proven Russian favorites as the *Overture from Russlan and Ludmila*, *Volga Boatman*, *Dance of Buffoons*, *Kamennoi-Ostrow*, Tchaikovsky's *Melody* and the folksong-based *Meadowland*. There is plenty of both hi-fi fireworks and melody. The recording is fully up to the high standards of this series—clean even in the biggest peaks, with a realistic balance of highs and lows, and a nice liveness. Nothing here to try a system severely, but much to make even a moderate system sound good; easy to listen to at low levels and respectfully impressive for demonstration at loud levels, especially *Meadowland*.

Guitariana Espagnol
Richard Pick on Solo Guitar
Concertapes 24-1 (stereo)
435 (monaural)

Recording a solo guitar in stereo looks like a silly performance and, in fact, sounds silly in spots. But few recordings communicate so high an immediacy—even in the monaural version. If you've never listened to a guitar at a distance of a few inches, this will give you the very same experience. The reproduction of the guitar transients is almost painfully real, and I recommend the monaural version as a demonstration piece with first-class single-channel systems.

Lena Horne at the Waldorf-Astoria
With Nat Brandywinne's Orchestra
RCA Victor LOC-1028

On-the-spot recording of an actual performance. The recording of Lena is extremely intimate and her breathing, etc. are very audible. There is a most strange effect, however, in the spots when she opens up double F. To prevent overloading, the engineers reduced gain of the closeup mike, which has the effect of seeming to make her move about 20 feet back during the loud spots. Exceptionally clean for a pop. The audience was well disciplined except for one table whose ebullience is plainly audible on the flip side.

TCHAIKOVSKY: *Serenade for Strings*
BARBER: *Adagio for Strings*
ELGAR: *Introduction and Allegro for Strings*
Munch conducting Boston Symphony Strings
RCA Victor LM-2105

Though we seldom pay any great attention to the quality of the strings in recordings, the fact is that it is not easy to record or reproduce massed strings with any great verisimilitude. They seem able to find any discontinuity or resonant peak in a speaker system and indeed few tweeters really come through with flying

NEW RECORDS *(Continued)*

colors when faced with the high end of the string register. Furthermore, there is a peculiar rosiny shimmer or murmur to massed strings which seldom comes through as it should in records. The string section of the Boston Orchestra, with its precision and excellent tone, is eminently suitable for an attempt at faithful reproduction and in this record RCA does a very good, though not yet perfect, job. With top-notch equipment, you should be able to reproduce it with no distortion and no wiriness, but with a plainly audible rosiny tone.

TCHAIKOVSKY: *Violin Concerto in D*
Heifetz, Soloist
Reiner conducting Chicago Symphony
RCA Victor LM 2129

The solo violin is not as easy to record and reproduce as some think, either. Tweeters have a special gift for changing its coloration, and pickups seem especially subject to becoming rattled by portions of its range. This recording of one of the most favored of all fiddle concerti by one of the masters of the instrument is perfect enough to present a completely fair test to any system. If you hear any unpleasant edge or distortion or if the color seems uncharacteristic, you can safely blame your system. This disc continues the somewhat artificial combination of closeup mike on fiddle and more remote one on orchestra which I have noted previously, but the effect is nevertheless quite impressive and the intimacy of the violin will enable any fiddler to discern (and criticize) Heifetz' technique in detail. Listen for the fingering transients in the rapid runs.

FRANCK: *Symphonic Variations*
RIMSKY-KORSAKOV: *Piano Concerto*
SCRIABIN: *Piano Concerto*
Badura-Skoda, Piano
Vienna Symphony and Philharmonic of London
Westminster XWN 18521

BEETHOVEN: *The Five Piano Concertos*
Artur Rubinstein, Piano
Krips conducting Symphony of the Air
RCA Victor LM-6702 (5 12-inch LP's)

The Victor offering is an almost monumental collection of five records of the complete Beethoven concerti at a special price and represents a bargain all the more worth while because of the excellence of the recording. Experts may prefer other pianists for some of these, but the layman can be assured of hearing these great examples of the concerto in authoritative performance and interpretation.

Paul Badura-Skoda and Westminster present the seldom heard Scriabin and Rimsky-Korsakov concerti and the more familiar Franck variations also with great competence and a possibly more stunning recording of the piano—especially its bottom end. The big, very damped tympani are a pleasant dividend.

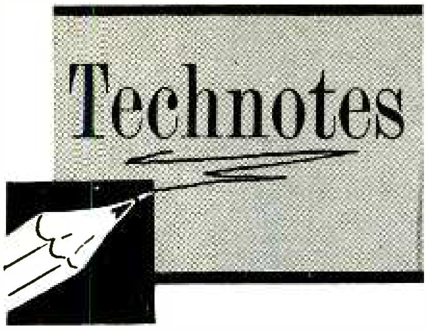
MOZART: *Symphonies Nos. 29, 30, 31 and 32*
Leinsdorf conducting Philharmonic Orchestra of London
Westminster XWN-18216

This, too, is for listening, not testing or showing off. It is part of a series which will eventually include all of Mozart's symphonies. These are not as familiar as the later ones but all have the characteristic Mozartian charm. The recordings present the music to its best advantage with fine definition and a spacious and clean sound.

Relax With Larry Ferrari
Hammond Organ and Schulmerich Harp-Celesta
RCA Victor LPM-1496

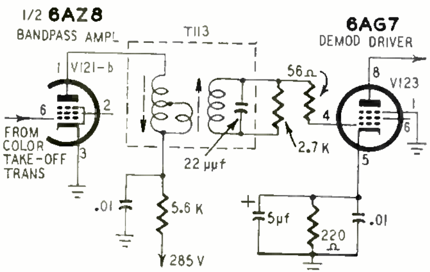
A typical restaurant type potpourri of popular tunes on a Hammond organ distinguished by the addition—for the first time, it is said, on records—of the Schulmerich harp-celesta, which offers both harp and celesta tones. Pleasant background music. END

Name and address of any manufacturer of records mentioned in this column may be obtained by writing Records, RADIO-ELECTRONICS, *154 West 14th St., New York 11, N.Y.*



WEAK COLOR

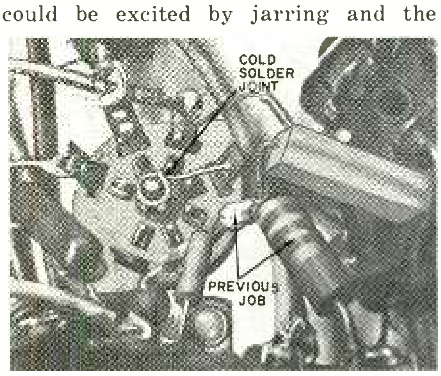
We've come across what seems to be a fairly common trouble in the RCA 21-CT-663U. The set comes in with weak color, all washed out even with the chroma control turned all the way up. Circuit checks and voltage readings



reveal low plate and screen voltage at V121-b, the bandpass amplifier. A positive voltage is found at the grid of V123, a demodulator driver. Turns out that T113, the bandpass transformer develops a high-resistance short between its primary and secondary—usually more than 1 megohm. Replacing the transformer is the only cure, and a quick one.—*Joe Shane*

INTERMITTENT OSCILLATION

An Emerson was brought into the shop with a complaint of occasional jellyfishing. The symptom would vary. Violent shaking was one type while complete loss of sync was another. A negative picture with smear was a third, even though the negative picture was not over the entire raster. The symptom could be excited by jarring and the



set's speaker did the exciting while in the customer's home. The speaker was disconnected temporarily to prove this point of a loose contact someplace.

A meter on the agc indicated a rise whenever the symptom occurred. And the same increase in voltage was noted across the detector load resistance. As a result of this check, the trouble seemed to lie ahead of the video detector.

The voltmeter was left connected to

Christmas Seals

ARE THE AMERICAN PEOPLE'S FAVORITE SYMBOLS OF CHRISTMAS GIVING the detector load and the first if's grid was grounded with a jumper. The chassis was shaken again and the rise of voltage definitely indicated oscillation in the if section. Successive grounding and many tappings with shakes localized the trouble to one stage.

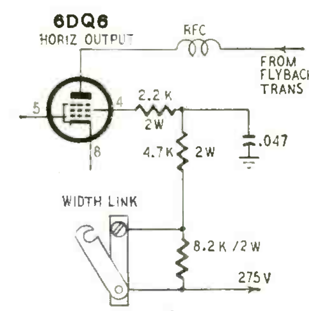
The photo shows the bottom view of this stage with a miniature tube as the amplifier. Some previous repair work had been done. Evidently a resistor had been replaced.

In so doing, the iron had heated the center contact of the tube socket. And the lead to it was probably shaken while cooling. The result was a cold soldered joint at the center contact. Resoldering cured the symptoms once and for all.

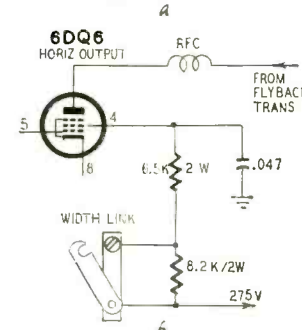
The center contact is grounded to prevent undue capacitance between the input and the output forming a small shield. Stage gain was enough on weak stations to force the set into oscillation due to this added capacitance. Most of the time the joint made good enough contact to prevent the oscillation.—*James A. McRoberts*

PHILCO CHASSIS 7L40

On these sets you will occasionally run into a horizontal drive line which cannot be eliminated. If all horizontal tubes have checked good, take a look at the 6DQ6's screen circuitry. The correct hookup should include a 2,200-ohm and a 4,700-ohm resistor as shown in *a*. On several of these models, the circuit had been changed so that a 6,500-ohm resistor replaced the two shown in *a*.



a

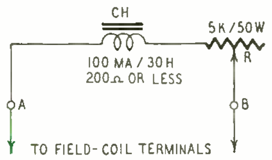


b

This circuit (*b*) supplies approximately the same screen voltage but puts the .047-μf capacitor directly between screen and ground, effectively removing the isolating or screen suppressor resistor and reducing the width. Replace the single resistor with the two proper values. The 6DQ6 socket has two spare pins which can be used as tie points.—*John B. Ledbetter*

FIELD COIL RESISTANCE?

When you run into a loudspeaker with a burned-out field coil and don't know what the coil's resistance is; relax, there is a way to find out.



Connect a 5,000-ohm variable resistor (R) in series with a filter choke (CH) across the field-coil terminals. Vary R until proper plate and screen voltages appear. Then turn the power off and measure the resistance between points A and B. Now just hook up a coil with the same value.—*Stanley Clark*

DU MONT RA-165

The complaint was no picture. I found a burntout 6BQ6 and replaced it. This restored the picture, but there was a slight horizontal displacement and critical vertical sync. I checked the sync, video, if and tuner tubes—all were very good. The customer said that the trouble had been there as long as she could remember and the chassis had received shop repairs without the difficulty being corrected.

This presented a challenge, so I convinced the customer to let me take the set to the shop. I set it up on the bench with a test tube and yoke. It performed perfectly. All waveforms and voltages were normal. After letting it cook for a few days, I returned it.

The set still had a slight horizontal displacement and critical vertical sync. I pulled the chasis again, this time with the yoke and picture tube. Set up on the bench it played perfectly. I brought the cabinet to the shop and found the trouble would appear only when the set was in its cabinet. Further checking showed that the trouble started when the chassis was about two-thirds in the cabinet.

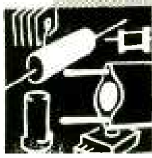
Several enjoyable minutes were spent pushing the chassis in and out of its cabinet and watching the trouble come and go. Then I checked the bottom of the chassis for parts which might be hitting the cabinet. I had absolutely no luck!

The only conclusion was that the trouble could not be happening. But it was! Then I noticed a blue lead running on top of the chassis to the local–fringe switch. The trouble would start when this lead was under the front of the picture tube. I rerouted the lead under the chassis and the trouble was permanently cured.

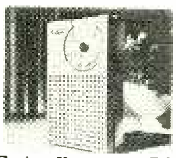
The picture tube was a glass 21-inch type with its outer coating grounded. There was only a fraction of an inch between the top of the chassis and the front bottom of the C-R tube. Evidently the capacitance between the blue lead and the grounded C-R tube coating was enough to disturb the sync pulse.—*Harry D'lott, Terrace Radio & Television* END

OPPORTUNITY ADLETS *(Continued)*

new Devices

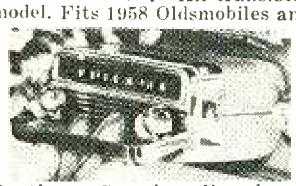


TRANSISTOR RADIO, *model TR-4.* Superhet, printed circuitry. 3 x 5 x 1¼ inches. 12 ounces.



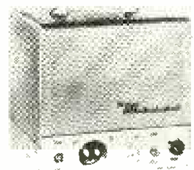
—**I. D. E. A., Regency Div.,** 7900 Pendleton Pike, Indianapolis, Ind.

AUTO RADIO. All-transistor model. Fits 1958 Oldsmobiles and

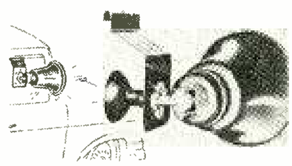


Pontiacs. Can be slipped out and used as portable radio. 9 transistors. Automatically plugs into car's electrical system. Uses car's speaker, antenna and extra transistor audio system.—**Delco Radio,** Div. General Motors, Kokomo, Ind.

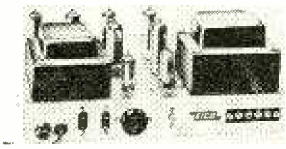
ELECTRONIC CONVERTER, *model CV-612.* 6- or 12-volt input. Delivers 117 volts at 130 watts constantly, 150 watts intermittently. 7 x 8½ x 8½ inches. 18 pounds.—**Mark Simpson Manufacturing Co. Inc.** (MASCO) 32-28 49th St., Long Island City 3, N.Y.



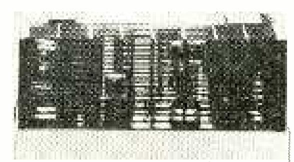
WINDOW SPEAKER SUPPORT, *WM-1.* Fastens speakers to auto window. Made from sheet steel finished in gray enamel.—**Atlas Sound Corp.,** 1451 39th St., Brooklyn 18, N.Y.



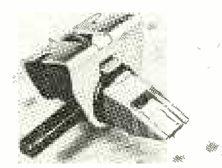
BASIC AMPLIFIER, *HF-30,* kit and wired. 30-watts. 15–50,000 cycles ± 0.5 db at rated output. Harmonic distortion less than 1%.—**Electronic Instruments Co.** (EICO), 84 Withers St., Brooklyn 11, N.Y.



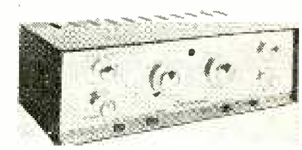
HI-FI AMPLIFIER, *Super Seventy.* 70 watts, 20–20,000 cycles at full output ± 0.1 db. IM distortion less than 1% at rated output.—**Sargent-Rayment Co.,** 4926 E. 12 St., Oakland, Calif.



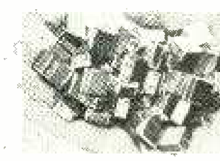
PHONO CARTRIDGE. *Ceramic V-8 line.* Sapphire-tipped needles, 1 and 3 mil. Combination of 1-mil diamond and 3-mil sapphire. 30–15,000 cycles. Tracking pressure, 8–10 grams.—**Webster Electric Co.,** 1900 Clark St., Racine, Wis.



HI-FI KITS, *Little Genie, model 207AK* (illustrated) preamp. *LJ-6K,* 10-watt amplifier; *250K,* 50-watt basic amplifier.—**Grommes, Div. of Precision Electronics Inc.,** 9101 King St., Franklin Park, Ill.



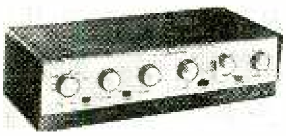
MINIATURE MICROPHONE, *MC30.* 100 fit in palm of the hand. Controlled magnetic type. 400–4,200 cycles. Output is −72 db, impedance 2,000 ohms, both measurements at 1,000 cycles.—**Shure Brothers Inc.,** 222 Hartrey Ave., Evanston, Ill.



RIBBON VELOCITY MICROPHONE *Ribbonette.* 30–14,000 cycles. For tape recorders. Replaces crystal mike without need for input transformer. Microphone output is −54.

db.—**Fentone Corp.**, 106 Fifth Ave., New York, N.Y.

STEREO - MONAURAL PRE-AMP, *Knight KN-700.* For use with stereo or monaural hi-fi system. Two equalized tape head playback preamps. Inputs for G-E and Pickering magnetic



cartridges, ceramic cartridges, microphone, tuner, tape preamp- or crystal cartridge and two auxiliary sources.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

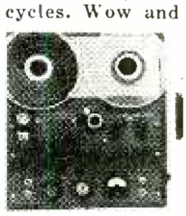
RECORD PLAYERS, portable hi-fi units. *Model CVS-12* (illustrated) permits continuous speed

variations from 25–100 rpm. *Model L-34* plays at 33⅓ and 45 rpm. Both use the *A-120* arm.—**REK-O-KUT Inc.**, 38-19 108th St., Corona 68, L.I., N.Y.

TAPE RECORDER, *Concertone Globematic 60.* Pushbutton controls. Half-track, full-track or stereophonic record and play-

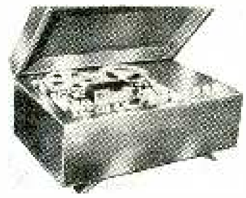
back. Takes up to 10½-inch reels. Plays at 7½ and 15 inches per second. — **American Electronics Inc.**, 655 W. Washington Blvd., Los Angeles 15, Calif.

TAPE RECORDER, *model 90*, 40–15,000 cycles. Wow and flutter



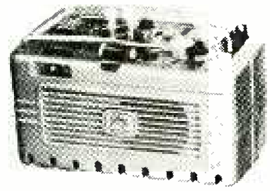
0.18%. Hysteresis synchronous motor. — **Roberts Electronics, Inc.**, 1028 N. La Brea Ave., Los Angeles 38, Calif.

STEREO TAPE RECORDER, *Tancordex.* 3 motors for drive, fast forward and rewind. 3 shielded heads for record playback and erase. 40–15,000 cycles (down 4 db at 15,000). Wow and flutter less than 0.17%. In-line heads. Self-contained binaural playback preamps.—**La-**



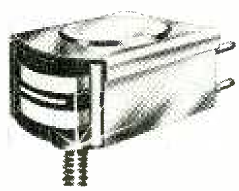
fayette Radio, 165-08 Jamaica Ave., Jamaica 33, N.Y.

PORTABLE TAPE RECORDER, *model G-255/S.* Made in Italy.



3¾ or 1⅞ ips. Dual track. Pushbutton recording. 7½ pounds.—**American Geloso Electronics, Inc.**, 312 Seventh Ave., New York, N.Y.

STEREO TAPE HEAD. Recording and playback. Interchannel magnetic shield provides cross-talk rejection. Can be compensated to provide essentially flat response from 30–10,000 cycles.

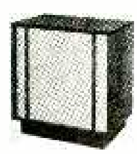


—**Nortronics Co.**, 1015 S. 6 St., Minneapolis 4, Minn.

NEW TAPE REEL. Molded with

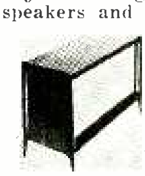
extra-heavy flanges which give a balanced flywheel-like action, minimizing wow. Molded of opaque warp-proof plastic.—**St. Cecilia Co. Ltd.**, Westwood, N.J.

SPEAKER SYSTEM, *model S-121*, 5 speakers, 4 channels,



12-inch woofer, 8-inch lower mid-range, 6-inch upper mid-range and two 3-inch tweeters. Semi-infinite baffle enclosure, treble balance control. Input impedance 8 ohms, power (max.) 25 watts. 35–20,000 cycles.—**Pilot Radio Corp.**, 37-06 36th St., Long Island City 1, N.Y.

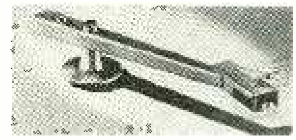
SPEAKER - AMPLIFIER SYSTEM, *Integrand.* Integrated system of speakers and transistor



NEW DEVICES *(Continued)*

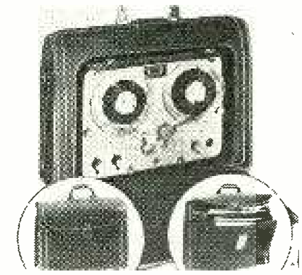
amplifiers for hi-fi sound reproduction. 15-inch woofer and mid-range ring radiators. Stereo and monaural models.—**Brand Products Inc.**, Westbury, N.Y.

TONE ARM *model 212*, Micro-



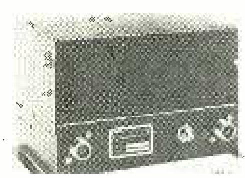
Balanced. Viscous-damped vertical and horizontal pivots.—**Gray Manufacturing Co.**, Arbor St., Hartford, Conn.

SECRET RECORDER, battery-operated. Fits in briefcase, weighs 11¾ lbs. 5 mercury bat-



teries power motor. Single-speed (1⅞ ips) and 2-speed (1⅞ and 3¾ ips) available. One 5-inch reel holds 3 hours' dual track recording. — **Amplifier Corporation of America**, 398 Broadway, New York 13, N.Y.

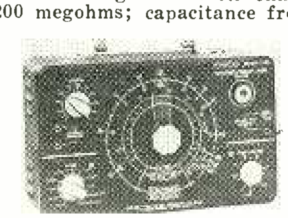
RF AMPLIFIERS, for TV signal distribution in apartment houses, hotels, motels, housing



developments, etc. *Model ABB-3* (illustrated) covers channels 2–6; *ABB-4* channels 2–13.—**Westbury Electronics Inc.**, 300 Shames Dr., Westbury, N.Y.

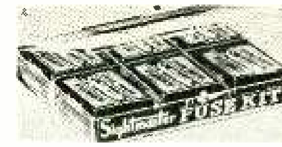
WIDE-BAND RF AMPLIFIER, *Golden Cascader*. Bandwidth: 35 mc, from 53.5–88.5 mc. Gain: 30 db minimum. Noise figure: less than 9 db. Incorporates line bridging. For closed-circuit TV or community antenna systems. —**Jerrold Electronics Corp.**, 23d and Chestnut Sts. Philadelphia 3, Pa.

BRIDGE KIT, resistance–capacitance–ratio, *model C-20*. Resistance ranges from 0.5 ohms–200 megohms; capacitance from



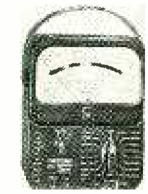
10 μμf–2,000 μf; ratio compared with an external standard from .05–20. — **Paco Electronics Co. Inc.**, 70-31 84th St., Glendale 27, N.Y.

FUSE KIT, contains 60 fuses covering most popular fuse replacements for electronic technicians. In pocket-sized case.—



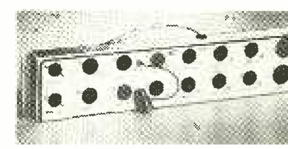
Sightmaster Corp., 85 Beechwood Ave., New Rochelle, N.Y.

MULTIMETER, *model 120-M*. 44 ranges. Sensitivity 20,000 ohms per volt dc and 5,000 ohms per volt ac. 44 ranges including ac



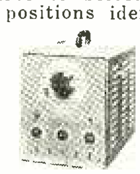
and dc volts, ohms and milliamperes. 5¼-inch meter.—**Precision Apparatus Co. Inc.**, 70-31 84th St., Glendale 27, N.Y.

SOCKET PANEL, *model 510*. Extends the use of the B & K *model 500* tube tester. Adds 50% more sockets to quick-check many more old and new tube



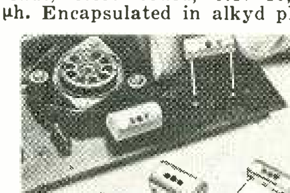
types.—**B & K Manufacturing Co.**, 3726 N. Southport Ave., Chicago 13, Ill.

COLOR BAR GENERATOR, *model 430*. All standard outputs plus G – Y at 90°. Single master control to select outputs. Control positions identified by



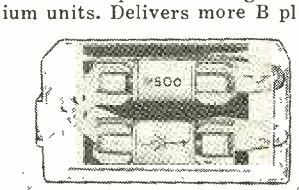
color picture of pattern which should appear on screen of properly adjusted receiver. — **Simpson Electric Co.**, 5200 W. Kinzie St., Chicago 44, Ill.

MOLDED RF CHOKES. Radial leads, color coded, 0.47–10,000 μh. Encapsulated in alkyd plas-



tic.—**Delevan Electronics,** Roycroft Campus, East Aurora, N.Y.

RECTIFIER REPLACEMENTS. *M-500 conversion kit.* Silicon rectifiers replace existing selenium units. Delivers more B plus.



—**Sarkes Tarzian Inc.**, 415 N. College Ave., Bloomington, Ind.

NEW FROM PYRAMID

DRY ELECTROLYTIC CAPACITOR FOR EXTREME TEMPERATURE RANGE REQUIREMENTS TYPE TR

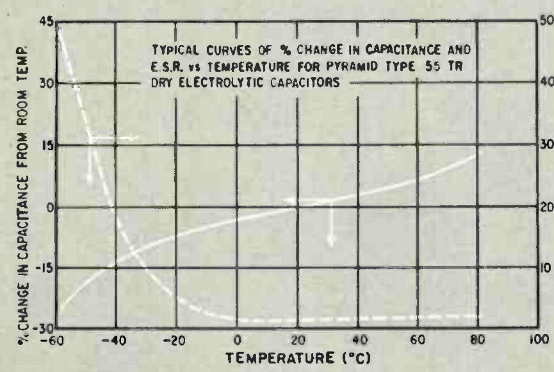
For applications previously reserved for Tantalum capacitors, Pyramid announces a new high reliability, dry electrolytic to be designated as Type TR, These are extended life capacitors using high purity aluminum foil, and can be supplied for any capacity requirements desired. Units are available in both polarized and non-polarized construction.

4 OPERATING TEMPERATURE RANGES: Type 20-85 TR –20°C to +85°C. Type 20-100 TR –20°C to +100°C. Type 40 TR –40°C to +85°C. Type 55 TR –55°C to +85°C.

CAPACITANÇE TOLERANCES: Pyramid type TR units are made with commercial capacitance tolerances.

POWER FACTOR: TR units rated less than 15 working volts have a maximum power factor of 25% at 25°C and 120 cps. Type TR units rated 15 working volts and over have a maximum power factor of 15% at 25°C and 120 cps.

D.C. LEAKAGE: Leakage current limits for Pyramid type TR capacitors measured after the working voltage has been applied for 5 minutes may be determined from the following formulas: At 25°C; $I=0.04CV$, At 85°C; $I=0.35CV$, At 100°C; $I=0.63CV$. Where: I=leakage current in microampheres, C=capacitance in microfarads, V=rated working voltage.



WORKING VOLTAGE: Pyramid type 20-85 TR can be supplied up to 450 working volts. Pyramid types 20-100 TR, 40 TR and 55 TR can be supplied up to 150 working volts.

SURGE VOLTAGE: The surge voltage rating of Pyramid type TR capacitors at 85°C and 100°C is 115% of the rated working voltage.

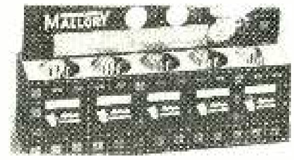
LIFE TEST: After 1000 hours at 85°C or 100°C, and working voltage applied, Pyramid type TR capacitors meet the following specifications at 25°C and 120 cps. The capacitance is within $^{+40\%}_{-20\%}$ of the capacitance measured before life test. The power factor is less than 150% of the power factor measured before the life test. The leakage current is within the limits specified above.

For circuit application information and a copy of TR Engineering Bulletin write to Industrial Division:

PYRAMID ELECTRIC COMPANY
1445 HUDSON BOULEVARD
NORTH BERGEN, NEW JERSEY

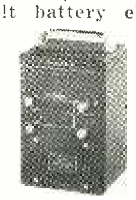
REPLACEMENT UNITS. TV power transformers. *P-2843* replaces G-E *RTP-326*; *P-2849*, Admiral 80C35-1,7; *P-2869*, Philco 32-8673 vertical output transformer *A-2816*, G-E RTO-064.—**Merit Coil & Transformer Corp.**, 4427 N. Clark St., Chicago 40, Ill.

VIBRATORS, *Highlander.* Replacement units. Packaged in 10-



pack cartons.—**P. R. Mallory & Co. Inc.**, 34 S. Gray St., Indianapolis, Ind.

BATTERY-ELIMINATOR FILTER, *model BE-4*, provides additional filtering of output of 6- or 12-volt battery eliminators



for use with transistor equipment, 5 amps maximum current output.—**Heath Co.**, 305 Territorial Ave., Benton Harbor, Mich.

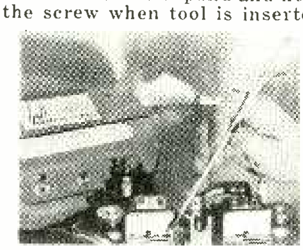
LOCTITE, for securing nuts to bolts. Prevents loosening.

Locked nuts can be removed with ordinary tools, retreated and reused.—**American Sealants Co.**, 103 Woodbine Ave., Hartford 6, Conn.

MAST GRIPPERS. Lightweight clamps for antenna installa-

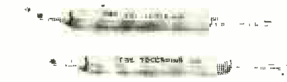
tions. Pair converts 1¼-inch tubing into slidable trombone mast. Weather-resistant, cast aluminum alloy.—**Helix Rotor Co.**, Marlin, Tex.

SCREW-HOLDING DRIVER. Small twin bits expand and hold the screw when tool is inserted



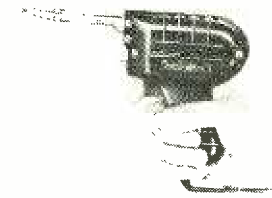
into screw-head slot. Aids in reaching hard-to-get-at spots. Variety of lengths and sizes.—**H. J. J. Co.**, 268 Marlow Dr., Oakland, Calif.

SOLDERING AIDS, miniaturized. Two types. Specially de-



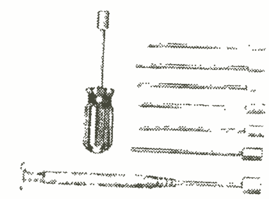
signed for printed-circuit applications.—Available from **CBS tube distributors.**

SOLDERING GUN, *model 100.*



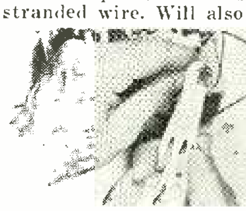
Heats in 2.5 seconds. Rated at 100 watts. Replaceable tips.—**Wen Products Inc.**, 5806 Northwest Highway, Chicago 31, Ill.

SOCKET WRENCHES, subminiature. 1½ inches long. 7 sizes: 5/64, 3/32, 7/64, ⅛, 5/32, 3/16 and ¼ inch.—**Desco Manufac-**



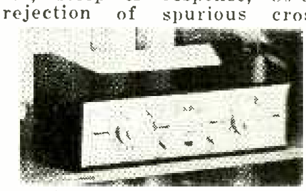
turing Co., 551 W. Glenoaks Blvd., Glendale 2, Calif.

WIRE STRIPPER. *Strip-It.* Adjusts to strip size 10-20 single or stranded wire. Will also snip



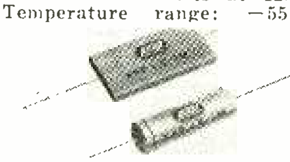
wire.—**Hunter Tool Co.**, Box 584, Whittier, Calif.

AM-FM STEREO TUNER, *model 330.* FM section includes a 150-kc bandpass, 2-mc detector, steep if response, 80-db rejection of spurious cross



modulation and automatic gain control. FM sensitivity, 2 µv for 20 db of quieting. AM section has 1 µv sensitivity, 3-position adjustable if bandwidth and 10-kc whistle filter.—**H. H. Scott Inc.**, Dept. P, Powdermill Rd., Maynard, Mass.

MYLAR CAPACITORS, type *XPR* (round) and *XPF* (flat). Voltage rating: 150 volts at 85°C and 100 volts at 125°C. Temperature range: −55°C–



125°C. — **Astron Corporation**, 255 Grant Ave., E. Newark, N. J.

END

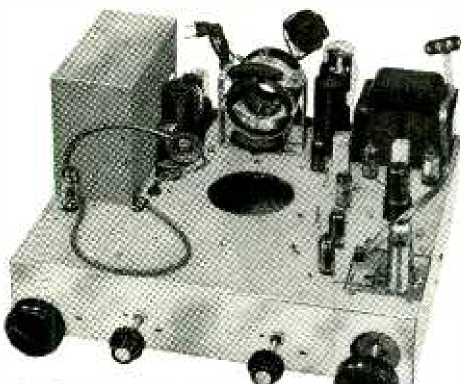
All specifications given are from manufacturers' data.

FREE CHRISTMAS GIFTS on all sales of $5 or over.
RADIOS — TOOLS — PENS — ETC. (depending on size of order)

Excitingly new! DX-16 Super Deluxe TV KIT

70° or 90° — operating all 21", 24" and 27" PICTURE TUBES

The **DX-16 SUPER DELUXE TV KIT** is a worthy successor to the famous **#630 TV KIT** . . . a product in which we took a leading role. In designing and engineering this NEW KIT, we used the #630 as a standard of comparison for POWER, STABILITY and FRINGE AREA RECEPTION . . . resulting in a NEW TV CHASSIS *equal in performance* and with *even greater versatility.*



Dimensions 17½"W x 16"D
Shipping weight 40 lbs.

NEW IN DESIGN — *Mounts Horizontally, Vertically or Sideways.*

★ Produces a Superior 16-Tube Chassis with 30-Tube performance.
★ Latest advanced Intercarrier Circuitry and Multi-section Tubes.
★ Standard Cascode Tuner for Selectivity and Fine Definition.
★ 5 Microvolts Video Sensitivity (20 volts peak to peak at CRT grid).
★ Fast Action AGC for Drift Free, Steady and Clear Pictures.
★ 3 Hi-gain Video I.F. Stages for excellent Contrast and Details.
★ AGC Level and Area Control, for adjusting reception to signal area.
★ All Video and I.F. Coils factory pre-aligned and tuned.
★ Horizontal Sweep Circuit is the famous RCA Synchroguide Network.
★ Large 250 ma Power Transformer—not a hot chassis.
★ Large 12" Concert-tone Speaker.

ALL COMPLETE with **LIFE-SIZE** step-by-step Building Instructions (less tubes & CRT) . . **$69.97**

ALL COMPLETE with SET of **WESTINGHOUSE TUBES** (less CRT) **$79.97**

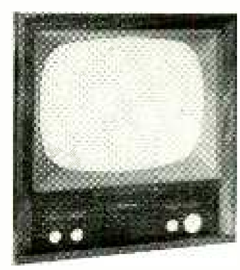
ALL COMPLETE with SET of **WESTINGHOUSE TUBES** and **WESTINGHOUSE 21" 70° or 90° Alumnized CRT**. . . **$99.97**

WESTINGHOUSE OR CBS PICTURE TUBES

BRAND NEW in Factory Sealed Cartons—With a Full Year Guarantee

17" 70° #17BP4A, 90° #17AVP4A Aluminized $22.66	21" 70° #21YP4A Aluminized, 90° #21ALP4A Aluminized $32.21	24" 90° #24CP4A Aluminized $48.99	27" 90° #27EP4A Aluminized $74.31

BUILD YOUR TV CABINET



Comparable to the type that Top Mfrs. use on their finest TV Sets.

You receive–The **FRONT PANEL ASSEMBLY** complete as pictured in genuine Mahogany, Walnut or Blond Korina in a beautiful hand-rubbed finish with **MASK, SAFETY GLASS, DECALS** and undrilled **KNOB PANEL.** You also receive–the **TOP & SIDES** finished in matching color, the perforated **BACK** with **CRT CUP, GLUE, SCREWS, BRADS** and amazing **Easy-To-Follow Instructions.** 90% of the job is done for you . . . All you add are the BOTTOM & simple 1" connecting STRIPS.

21" CABINET . . . H-26" W-25" D-22" . . . **$24.95**

"ONE DOLLAR" buys as much as $15 worth

Deduct 10% ON ANY ORDER of $10 or over (on items listed below)

100 – ASSORTED FUSES popular sizes $1
100 – ASSORTED ½ WATT RESISTORS. $1
70 – ASSORTED 1 WATT RESISTORS. $1
35 – ASSORTED 2 WATT RESISTORS. $1
10 – 6' ELECTRIC LINE CORDS with plugs $1
5 – TV CHEATER CORDS with both plugs $1
4 – 50' SPOOLS HOOK-UP WIRE 4 colors. $1
100' – TWIN LEAD-IN WIRE 300Ω heavy duty . . . $1
50' – FLAT 4-CONDUCT. WIRE, many purposes . . $1
1 – $7 INDOOR TV ANTENNA hi-gain 3 section . . $1
20 – ASST. TV KNOBS. ESCUTCHEONS, Etc. . . $1
15 – ASSORTED ROTARY SWITCHES $15 worth . $1
100' – FINEST NYLON DIAL CORD best size . . . $1
200 – SELF TAPPING SCREWS #8 x ½" $1
50 — ASST. TUBULAR CONDENSERS. $1
5 – ELECTROLYTIC COND. 100/50 - 50/25v $1
35 – ASST. RADIO KNOBS screw and push-on $1
100 – KNOB SPRINGS standard size ⅜" x ½". . . . $1
100 – ASSORTED KNOB SET-SCREWS. $1
25 – ASSORTED CLOCK RADIO KNOBS. $1
400 – ASST. H'DWARE, screws, nuts, rivets, etc. . $1
50 – ASST. SOCKETS octal, noval and miniature . . . $1
50 – ASST. MICA CONDENSERS some in 5% . . . $1
50 – ASST. CERAMIC CONDENSERS. $1
10 – ASST. VOLUME CONTROLS less switch $1
5 – ASST. VOLUME CONTROLS with switch $1
20 – ASST. PILOT LIGHTS popular types $1
10 – PILOT LIGHT SKTS. bayonet type, wired $1
50 – ASST. TERMINAL STRIPS 1, 2, 3, 4 lug . . . $1
10 – ASST. RADIO ELECTRO. CONDENSERS. . . $1
5 – ASST. TV ELECTROLYTIC CONDENSERS. . . $1
15 – ASST. TV COILS sync, peaking, width, etc. . . $1
25 – ASST. MICA TRIMMER CONDENSERS. . . . $1
50 – TUBULAR CONDENSERS .02-400v $1
50 – TUBULAR CONDENSERS .001-600v $1
20 – TUBULAR CONDENSERS .047-600v $1
50 – TUBULAR CONDENSERS .01-400v $1
3 – ELECTROLYTIC COND. 40/40—450v $1
3 – ELECTROLYTIC COND. 80—450v $1
3 – ELECTROLYTIC COND. 50/30 - 150v $1
3 – ELECTROLYTIC COND. 40/10/10 - 450v $1
3 – ELECTROLYTIC COND. 50/25/10-150v. $1
10 – HV TUBULAR CONDENSERS .03-2000v . . . $1
10 – HV TUBULAR CONDENSERS.005-6000v $1

35 – MICA COND. 20 – 100 mmf & 15 – 250 mmf $1
35 – MICA COND. 20 – 470 mmf & 15 – 1000 mmf $1
35 – MICA COND. 20 – 680 mmf & 15 – 10K mmf . $1
35 – CERAMIC COND. 20–25 mmf. & 15–47 mmf. . $1
35 – CERAMIC COND. 20–68 mmf & 15–1500 mmf . $1
35 – CERAMIC COND. 20-250 mmf and 15-680 mmf $1
50 – 100Ω ½ WATT RESISTORS 5%. $1
75 – 680Ω ½ WATT RESISTORS 10%. $1
75 – 470KΩ ½ WATT RESISTORS 10%. $1
50 – 3.3Ω 1 WATT RESISTORS 10%. $1
50 – 15KΩ 1 WATT RESISTORS 10%. $1
50 – 470KΩ 1 WATT RESISTORS 10%. $1
25 – 2.2Ω 2 WATT RESISTORS 5%. $1
25 – 3.3Ω 2 WATT RESISTORS 5%. $1
25 – 100KΩ 2 WATT RESISTORS 10%. $1
10 – ASST. WIREWOUND RES. 5, 10, 20 watts . . $1
3 – AUDIO OUTPUT TRANSFORMERS 50L6 type . $1
3 – AUDIO OUTPUT TRANS. 6K6 or 6V6 type . . . $1
3 – I.F. COIL TRANSFORMERS 456kc $1
3 – I.F. COIL TRANSFORMERS 10.7 mc FM $1
4 – OVAL LOOP ANTENNAS ass't. hi-gain types. . $1
3 – LOOPSTICK ANT. new fernite, adjustable $1
12 – RADIO OSCILLATOR COILS 456kc $1
3 – ½ MEG VOLUME CONTROLS with switch . . . $1
1 – 5" PM SPEAKER alnico #5 magnet $1
5 – SETS SPEAKER PLUGS, wired $1
10 – SETS PHONO PLUGS and PIN JACKS. . . $1
2 – $2.50 SAPPHIRE NEEDLES 4000 playings $1
5 – DIODE CRYSTALS 2-IN21 2-IN23 1-IN64 . . . . $1
1 – TV VERT. OUTPUT TRANS. 10 to 1 ratio $1
5 – TV CRT. SOCKETS with 18" leads $1
5 – HI-VOLT. ANODE LEADS with 18" leads $1
1 – TV SYNCHROGUIDE TRANSFORMER #205R1 $1
1 – TV SYNCHROLOC TRANSFORMER #208T8 . $1
1 – TV RATIO DETECTOR TRANS. 4.5mc $1
1 – SET TV KNOBS standard type incl. decals $1
1 – LB SPOOL ROSIN CORE SOLDER 40/60 . . . $1
6 – SPIN TIGHT SOCKET SET 3/16" to 7/16". . . $1
3 – TV ALIGNMENT TOOLS 5", 7", 12". $1

HANDY WAY TO ORDER—Simply tear out advertisement and pencil mark items wanted, enclose with money order or check. You will receive a new copy of this ad for re-orders.

ON SMALL ORDERS—Include stamps for postage, excess will be refunded. Larger orders shipped express collect.

EICO . . . World's Largest Selling KITS & Instruments

See EICO ad pages 29-30

HF12 HI-FI AMPLIFIER 12-watt (kit) . . . . $ 34.95
HF12 HI-FI AMPLIFIER 12-watt (wired) 57.95
HF50 HI-FI AMPLIFIER 50-watt (kit) 57.95
HF50 HI-FI AMPLIFIER 50-watt (wired) 87.95
HF52 HI-FI AMPLIFIER 50-watt (kit) 69.95
HF52 HI-FI AMPLIFIER 50-watt (wired) 109.95
HF61A HI-FI PREAMPLIFIER (kit) 24.95
HF61A HI-FI PREAMPLIFIER (wired) 37.95
HF61 HI-FI PREAMP. w/power supply (kit) . . 29.95
HF61 HI-FI PREAMP. w/power supply (wired) 44.95
HF60 HI-FI AMPLIFIER 60-watt (kit) 72.95
HF60 HI-FI AMPLIFIER 60-watt (wired) 99.95
HF20 HI-FI AMPLIFIER 20-watt (kit) 49.95
HF20 HI-FI AMPLIFIER 20-watt (wired) 79.95
HFS1 2-WAY HI-FI SPEAKER SYSTEM. . . . 39.95
666 TUBE & TRANSISTOR TESTER (kit) . . . 69.95
666 TUBE & TRANSISTOR TESTER (wired) . . 109.95
368 TV-FM SWEEP GEN. & MARKER (kit) . . 69.95
368 TV-FM SWEEP GEN. & MARKER (wired) 119.95
460 COLOR & MONO. 5" SCOPE (kit) 79.95
460 COLOR & MONO. 5" SCOPE (wired) . . 129.50
324 RF SIGNAL GENERATOR (kit). 26.95
324 RF SIGNAL GENERATOR (wired) 39.95
232 PEAK to PEAK VTVM w/probe (kit) 29.95
232 PEAK to PEAK VTVM w/probe (wired) . . . 49.95

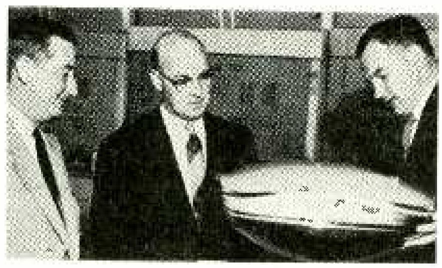
EICO CATALOG mailed on request

BROOKS RADIO & TV CORP., 84 Vesey St., New York 7, N.Y.

TELEPHONE
COrtland 7-2359

Business and People

Sylvania Electric Products, Seneca Falls, N. Y., recently produced its 15 millionth TV picture tube. Shown on hand for this production milestone are,



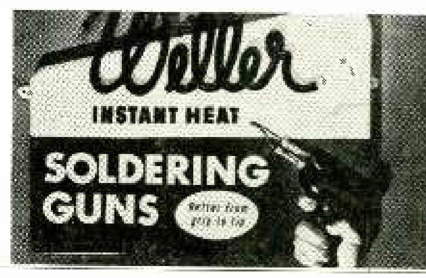
left to right, Donald W. Gunn, general manager of the Electronic Products Sales Department; Matthew D. Burns, vice president electronic tube operations, and W. Herbert Lamb, general manager of the Television Picture-Tube Division.

Pyramid Electric Co., North Bergen, N. J., held an engineering symposium on "Long Shelf Life of Capacitors in Relationship to Low Temperature Characteristics" in Los Angeles. Karl Moeglisch, Pyramid's director of re-

search and development, conducted the meeting and Jack Berm^n, California representative, acted as host. Thirty people from 14 different firms attended.

Cleveland Institute of Radio-Electronics, Cleveland, Ohio developed an Employers' Plan for training technical personnel while on the job. The plan helps employers relieve the two-way radio-microwave technician shortage without hiring new personnel. A booklet describing the service has been prepared by the school.

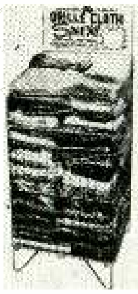
Weller Electric Corp., Easton, Pa.,



BUSINESS AND PEOPLE *(Continued)*

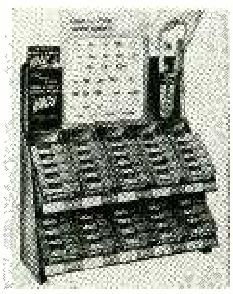
is offering electronic distributors a four-color three-dimensional sign featuring its soldering gun.

General Cement Manufacturing Co., Rockford, Ill., made a special price offer



on its grille cloth. In addition, a wire display rack is offered with 100 packages.

Vaco Products, Chicago, created a new display featuring its solderless



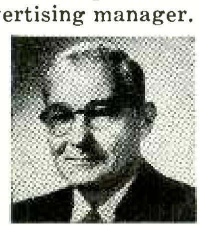
terminals. The display also has slots for exhibiting the Vaco crimping tool and for holding descriptive literature.

Electronic Chemical Corp., Jersey City, N. J., is offering dealers two

two-color single can displays for its volume control and contact restorer, and Tuner-Tonic products.

George Gemberling, former general district manager of Alliance Manufacturing Co., Alliance, Ohio, has been promoted to sales manager of the Con-

sumer Products Division. Ray Buhrman (right), advertising manager, was appointed assistant sales manager of the division as well as advertising manager.



H. F. Randolph continues as manager, receiving tube operations, of the RCA Electron Tube Division, Harrison, N.J., in a realignment of the staff of

PHOTOGRAPHS

RADIO-ELECTRONICS can use good photographs of service benches, service shops, high-fidelity audio layouts, and any other interesting and original radio-electronic devices.

We will pay $6.00 each for good professional photos or equivalent, suitable for reproduction.

Full information on subject photographed will increase their acceptability.

The Editor, RADIO-ELECTRONICS
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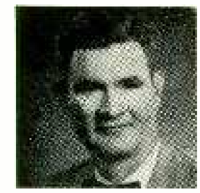
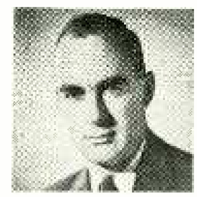


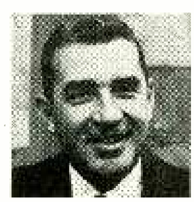
entertainment tube products. **H. R. Seelen,** manager, color kinescope operations, is now manager, kinescope operations. Right, **M. J. Carroll** former manager, cathode-ray and power-tube marketing, becomes manager, marketing.

Roy A. Juusola joined CBS-Hytron, Danvers, Mass, as manager, marketing administration. He has over 15 years experience in electronics and comes to the company from Sylvania, where he was a plant manager.



John Prutton joined the capacitor sales section of Centralab Division of Globe-Union, Milwaukee, Wis. He has wide experience in the industry and was formerly associated with the P. R. Mallory Co. and Westinghouse Corp.

Frank Hadrick joined the engineering staff of Simpson Electric Co., Chicago, as chief field engineer—test equipment. He comes to Simpson from Admiral Corp. where he had been chief television field engineer.



George I. Long, Jr., president of Ampex Corp., Redwood City, Calif., was elected to the board of directors of Orradio Industries, Opelika, Ala.

Obituary

Robert Lee Stephens, a pioneer in electronics and high fidelity, recently in Iowa City, Iowa, following surgery for a chronic hip ailment. He founded Stephens Tru-Sonic Co., Los Angeles. Although he sold his interest in 1956, he was a consultant to the firm. END

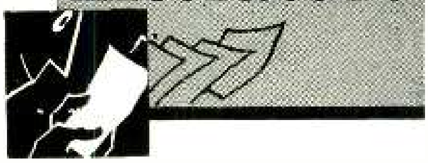
TV TINKERER

By Jeanne DeGood

He knows exactly what is wrong
And says repairmen take too long
And so he grabs a tool and starts
To pull out tubes and scatter parts.

It doesn't take him very long
To find exactly what is wrong—
It's really simple to explain
A screw is loose—up in his brain.

technical Literature



Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

ELECTRONIC PARTS, *Catalog No. 68*. A grouping of many types of electronic parts with brief descriptions and illustrations fill its 156 pages.—**Newark Electric Co., 223 W. Madison St., Chicago 6, Ill.**

ELECTRONIC COMPONENTS, *General Catalog 305*. Complete listing of electronic components from resistors to elaborate high-fidelity units. Among the 180 illustrated pages are sections on transistors and subminiature components, stereophonic equipment, amateur items and tools.—**Lafayette Radio, 165-08 Liberty Ave., Jamaica 33, N. Y.**

TV TUNERS, *Catalog 201*. Pocket-sized, 28-page booklet contains the latest listing of this manufacturer's tuners and shows exploded views of each type. A replacement guide covering TV sets made between 1948 and 1957 is also available.—**Standard Coil Products Co. Inc., 2085 Hawthorne Ave., Melrose Park, Ill.**

COIL AND TRANSFORMER CATALOG, *1957*. Filters, high-Q coils, toroids variable inductors and power, pulse, audio and miniature transformers are described and illustrated in this 34-page booklet.—**United Transformer Corp., 150 Varick St., New York 13, N. Y.**

TUBE TESTER, *model 107Q* is described and illustrated in a colorful folder. Operating intructions, circuitry and other important features of the tester are presented. — **Seco Manufacturing Co., 5015 Penn Ave. South, Minneapolis 19, Minn.**

ELECTRICAL CATALOG of 78 pages lists over 1,500 electrical wiring devices, lamps and specialty products.—**Eagle Electric Manufacturing Co., Inc., 23-10 Bridge Plaza South, Long Island City 1, N. Y.**

MAGNETIC FILMS and Magna-Strips are described in a full color brochure.—**Reeves Soundcraft Corp., 10 E. 52 St., New York 22, N. Y.**

INDUSTRIAL TUBES provides source material on the general characteristics of power tubes, beam-power tubes, thyratrons and other industrial types. Also lists maximum ratings of these tubes.

A second booklet, *Guide to Replacement*, lists basic designation, tube class and various manufacturers' type numbers of many industrial tubes.—**Sylvania Electric Products Inc.**, 1740 Broadway, New York 19, N. Y.

REPLACEMENT CHART shows part of manufacturer's line of exact replacement power transformers, yokes, flybacks and vertical output transformers.—**Merit Coil & Transformer Corp.**, 4427 N. Clark St., Chicago 40, Ill.

SPEAKER ENCLOSURES, ready-to-use cabinets and prefinished types. A complete line is shown in this 1958 catalog.—**Cabinart**, 99 N. 11 St., Brooklyn 11, N. Y.

ELECTRONIC COURSES are outlined and employment opportunities with their requirements are presented in this handy brochure.—**Cleveland Institute of Radio Electronics**, 4900 Euclid Ave., Cleveland 3, Ohio.

EIA (RETMA) STANDARDS. *RA-196: Fixed Film Resistors* (High Stability), from *Standards Proposal 507*. *RS-197: Power Filter Inductors for Electronic Equipment*, from *Standards Proposal 511 and 526*, a revision of *TR-110-B*.—EIA (Formerly RETMA), Engineering Dept., 650 Salmon Tower, 11 W. 42 St., New York 36, N. Y. RA-196, 60c. RS-197, 50c.

LINEARITY IN TRANSMITTER TUBES is stressed in a 9-page bulletin entitled "Transmitting Tubes for Linear Amplifier Service."—**Penta Laboratories, Inc.**, 312 N. Nopal St., Santa Barbara, Calif.

CONTROL GUIDE, *No. 5*, makes control replacement information available. Covers replacements for radio, TV, auto sets as well as audio equipment.—**Centralab**, Div. of Globe Union Inc., 900 E. Keefe Ave., Milwaukee 1, Wis. 20c.

ELECTRONIC PHONO FACTS is a 21-page booklet by Maxmilian Weil which answers many questions about high-fidelity equipment. It covers subjects like stylus alignment, peaks and dips, turntable and record care.—**Rek-O-Kut Inc.**, 38-19 108th St., Corona, 68, L. I., N. Y. 25c.

FIXED COMPOSITION RESISTORS, *type BT*. Construction, characteristics, terminations, heat dissipation, color coding, power and voltage ratings are found in *Catalog Data Bulletin B-1C*.—**International Resistance Co.**, 401 North Broad St., Philadelphia 8, Pa.

NEW BOOK CIRCULAR describes Beitman's *Additional 1957 TV Servicing Information Manual*. Also lists other helpful servicing literature.—**Supreme Publications**, 1760 Balsam Rd., Highland Park, Ill.

CRYSTAL-FILTER SPECIFICATIONS, outline drawings, typical characteristic curve and circuit diagram are set forth in this 4-page catalog.—**Hycon Eastern Inc.**, 75 Cambridge Parkway, Cambridge 42, Mass.

ELECTRONICS CATALOG, *No. 170*, lists over 27,000 items in its 404 pages. A complete line of hi-fi components and Knight kits are included. Industrial equipment is also shown.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

HIGH-FIDELITY CATALOG contains a listing of this manufacturer's line of hi-fi equipment in kit and factory-wired form. — **Electronic Instruments Co.** (EICO), 84 Whithers St., Brooklyn 11, N. Y.

MAGNETIC TAPES for instrumentation recording are the subject of this illustrated booklet. Six tape types used in telemetering, computers and other instruments are detailed. — **Minnesota Mining & Manufacturing Co.**, 900 Bush St., St. Paul 6, Minn.

CONSTANT-VOLTAGE TRANSFORMERS for 6.3-volt filament supplies are offered in circular *CVF-269*. Four informative pages describe the operation of these units.—**Sola Electric Co.**, 4633 W. 16 St., Chicago 50, Ill.

AUDIO-FREQUENCY AMPLIFIERS are detailed in *Catalog No. 16-C* which stresses laboratory type units for scientific laboratories, tape or disc recording equipment and other purposes. —**Cimena Engineering**, Div. of Aerovox, 1100 Chestnut St., Burbank, Calif.

TRANSISTOR SPECIFICATIONS of this manufacturer's line of alloy-junction types and an interchangeability guide are offered in a 4-page pamphlet.—**Industro Transistor Corp.**, 649 Broadway, New York 12, N. Y.

PRECISION WIREWOUND RESISTORS are presented in this illustrated 2-color catalog. Axial, lug, printed-circuit and radial-lead versions are described.—**General Resistance Inc.**, 557 E. 156 St., New York 55, N. Y.

MINIATURE PAN-I-LITES and Pan-I-Lite switches are shown in two illustrated spec sheets.—**Alden Products Co.**, 117 N. Main St., Brockton 64, Mass. END

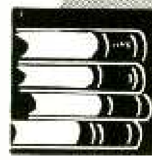
CORRECTION

There is an error in the text of the article "Hi-Fi Twin-Coupled Amplifier" in the November issue. In the second paragraph on page 44 the text states that R5 and C1 should be removed when using an electrostatic tweeter. The reference should be to R6 instead of R5.

Our thanks to Mr. L. R. Cartwright of Unionville, Mich., for reporting the error.

The author of "Build This Amplifier–Rectifier Vtvm for Audio Testing" (October, page 59) points out that capacitor C7 was erroneously listed as an electrolytic in parts list. C7 should be a paper type capacitor to minimize leakage and erroneous meter readings. A bath tub type capacitor was used in the original instrument.

Books



TV REPAIR QUESTIONS AND ANSWERS, Vol. 5 (Sound and Low-Voltage Circuits), by Sidney Platt. John F. Rider Publisher, Inc., 480 Canal St., New York 13, N.Y. 5½ x 8½ inches, 120 pages. $2.10

Many of us find it easier to absorb and retain information that is presented in question-and-answer form. This book, written that way, is for practical technicians. Theory is held to a minimum. Questions and answers are followed by a discussion which explains the procedure. Where adjustment or alignment is outlined, it is given step by step. To save time and effort, separate chapters are written for the if stages, detector, amplifier, speaker and power supply.

TV TUBE LOCATOR, Vol. 2. Harry G. Cisin, Amagansett, N. Y. 8½ x 11 inches, 32 pages. $1.50.

This newest volume of the TV Tube Locator starts where Vol. I stopped. Shows tube layouts of recent TV sets from 1955 models up to and including the newest 1957 sets. Each diagram gives the location and exact type number for every tube in the receiver and its function. A handy feature of the book is a table listing 135 common TV troubles caused by defective tubes. Series-string heaters and selenium rectifiers are indicated. If you've ever wondered which tube is the video output, this book can save you time.—*LS*

THE GRAMOPHONE HANDBOOK, by Percy Wilson. Metheun and Co., Ltd., 36 Essex St., London W. C. 2, England. 5 x 8 inches. 227 pages text, 42 pages advertiser's announcements, 15 shillings.

This work by the technical editor of the British periodical *The Gramophone* is billed on the jacket as "intended for the ordinary man of an inquiring turn of mind who wants to know something of the ideas behind this modern development of high-fidelity reproduction of sound." Mr. Williams presents the basic purposes of high fidelity, the conditions for achieving it and a summary of the means of arriving at it, clearly and free from personal prejudice or enthusiasm. The first four chapters comprise an excellent presentation of the ideas behind high fidelity. The several chapters on pickups, styli, arms and turntables, record wear, etc., are a little more advanced than the rest and should be of value to a somewhat more technical reader. Though specific references are to British equipment, this does not take away from the usefulness of the book to American readers.—*JM*

SERVICING AND CALIBRATING TEST EQUIPMENT, by Milton S. Kiver. Howard W. Sams & Co., Inc., Indianapolis 5, Ind. 5½ x 8½ inches, 184 pages. $2.75.

A successful service technician really has two jobs: He must keep his own test equipment in good operating condition as well as keep his customers' sets in good repair. Unless the first requirement is satisfied, there is not much likelihood that his customers will be. Even the highest-quality meters, generators, scopes and probes do not remain reliable unless they are properly maintained and regularly checked.

This book shows how to take care of, calibrate and repair various test instruments. It tells how to keep test records and the best methods of preventive maintenance. Typical service instruments are described with photos and schematics.—*IQ*

FM LIMITERS AND DETECTORS, edited by Alexander Schure, John F. Rider Publisher, Inc., 116 W. 14 St., New York 11, N. Y. 5½ x 8½ inches, 44 pages. 90c.

Four basic FM circuits are described in detail. They are the limiter, Foster-Seeley discriminator, ratio detector and gated-beam tube circuit. Theory and operation are covered in each case, together with information for adjustment for optimum results.—*IQ*

RESONANT CIRCUITS, Edited by Alexander Schure. John F. Rider Publisher, Inc., 116 W. 14th St., New York 11, N. Y. (No. 166-16). 5½ x 8½ inches, 72 pages. $1.25.

Resonant circuits; combinations of L, C and R are found in many types of electronic instruments and radio devices. Presuming little previous knowledge, this booklet starts with basic concepts. It clearly describes such topics as impedance, Q. power factor and coupling. Distributed as well as lumped constants are covered.—*IQ*

INVENTORS AND INVENTIONS, by C. D. Tuska. McGraw-Hill Book Co., Inc., 330 W. 42 St., New York, N.Y. 6 x 9 inches, 174 pages. $3.75.

Whether you admire the inventive genius in others or you yourself have a creative spirit, this book will be interesting. The author describes effects of environment, education and age on patent productivity. Case histories of many important patents such as the superheterodyne radio, telephone and X-rays show how inventions may result from inspiration, curiosity, accident or sheer necessity.

Inventors will find suggestions for protecting, patenting and marketing their brain-children—*IQ* END

CORRECTION

The author of "Build This Amplifier-Rectifier VTVM for Audio Testing" (October, page 59) points out that capacitor C7 was erroneously listed as an electrolytic in the parts list. C7 should be a paper type capacitor to minimize leakage and erroneous meter readings. A bathtub-type capacitor was used in the original instrument.

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M. Harvey Gernsback
Publisher and Editor

Sworn to and subscribed before me this 10th day of September, 1957.

[Seal]

Viola H. Scherer
(My commission expires March 30, 1958)

ANNUAL INDEX

Vol XXVIII

RADIO-ELECTRONICS

KEY TO SYMBOLS AND ABBREVIATIONS
* Construction Articles
† Section of full-length article
Clinic .... Television Clinic
Corres .... Correspondence
NB .... News Briefs
Pat .... Patents
QB .... Question Box
REC .... Radio-Electronic Circuits
TTO .... Try This One

Regular departments not indexed are Business, Technicians' News, New Devices, People, Technical Literature, Books.

"The hearing aid works all right but the radio is noisy around 7 mc."

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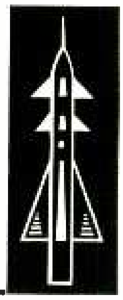

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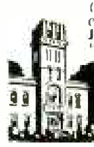

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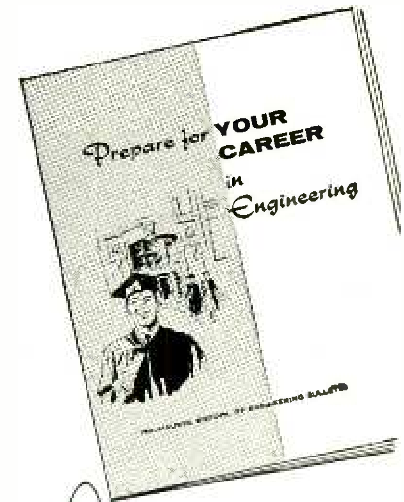

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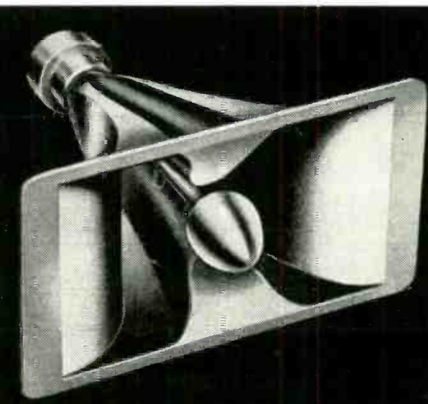
Smooth, **distortion-free sound reproduction from 600 cps to inaudibility!**



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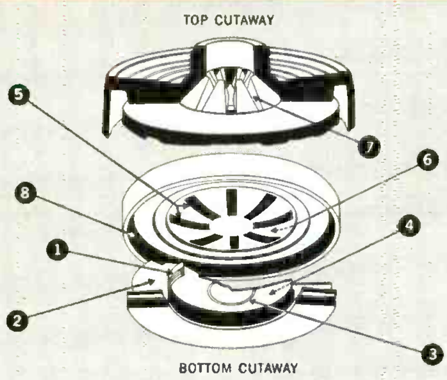

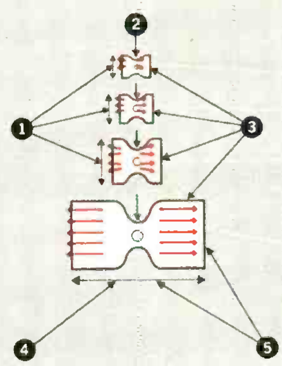

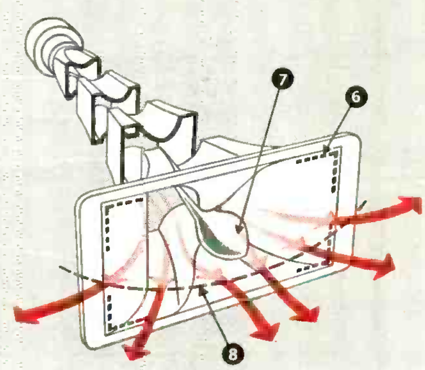

Exclusive features of the T-50

1 Individually-wound aluminum voice coil has maximum high frequency efficiency. 2 Placed at the rear, enclosed side of diaphragm protects it against external damage and foreign matter. 3 Diaphragm is zonally re-enforced with concentric rib for maximum piston action. 4 and has convex radiating surface that achieves maximum uniformity of high frequency path lengths into mixing chamber. 5 Radial apertures in new phase-matching mixing chamber transmit all path lengths equally, 6 and reduce radial transmission impedance between diaphragm and mixing chamber surface, permitting tight spacing of diaphragm to mixing chamber surface for high frequency extension. 7 Constant cross-sectional area of die-cast mixing chamber apertures provides perfect acoustic match from diaphragm to throat of horn. 8 Diaphragm and mixing chamber are rim-centered on magnetic pot structure for optimum voice coil and gap alignment.

SPECIFICATIONS: Response: 600 cps to inaudibility; Recommended crossover: 700 cps; Power capacity: 50 watts, integrated program; Diameter: 4¼"; Depth: 4⅛"; Throat: 1⅜"—18 thread; $49.50 net

**Patent pending*

Exclusive features of the H-600

1 Initial expansion of precision die-cast aluminum horn grows larger and larger in vertical direction 2 while central contouring profiles get deeper and deeper 3 building up sound pressure more and more into the horizontal direction 4 and when contoured sound has been fully developed within horn, horn expansion in the horizontal direction† takes over 5 until both ultimate expansion of horn and sound pressure are coordinated in the horizontal plane at the mouth 6 which is designed large enough to present a smooth radiation characteristic down to the lowest wave lengths 7 and where a radiating plane wave front equalizer 8 smoothens out the wave front to give an even, wide horizontal sound pattern.

SPECIFICATIONS: Air column: 7¾"; Horn Cut-off: 600 cps; Recommended crossover: 700 cps; Dispersion: 125° horiz. x 55° vert.; Bell mouth: 8¾" x 4¾" over-all; Depth (less driver): 7¾"; Throat: 1⅜"—18 thread; $18.00 net

† U.S. patent #2,690,231

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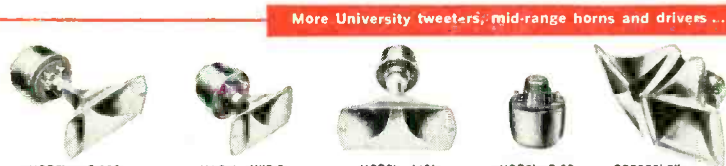

HF-206 Hypersonic Tweeter. Response to inaudibility. Crossover 5000 cps. Wide angle "reciprocating flare" die-cast aluminum horn. 8 ohms $33.00 net.

UXT-5 Super Tweeter. Crossover 5000 cps up. Wide-angle response to 17,500 cps. 8 ohms. $21.00 net.

4401 Tweeter. Crossover 2500 cps up. Wide-angle response to 15,000 cps. 8 ohms. $18.00 net.

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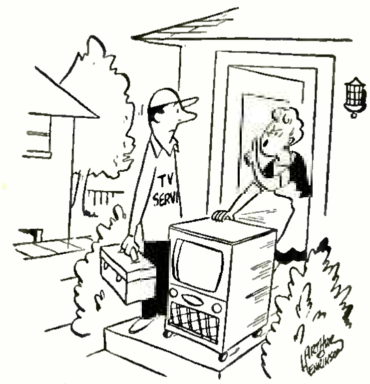
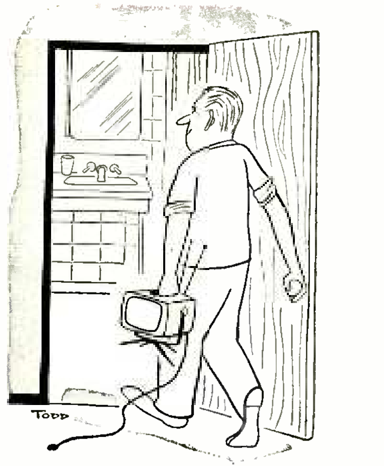


"The baby's asleep! Fix it out here!"

"Give me a .01 tubular, Joe, and plug this in, will you?"



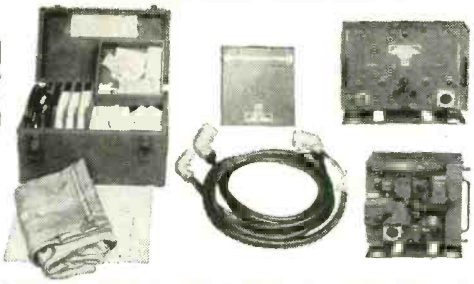
"First high-fidelity hearing aid on the market!"

"HUNTERS & SPORTS HEATERS"

Kerosene or Gasoline Heater Reduced to $4.95

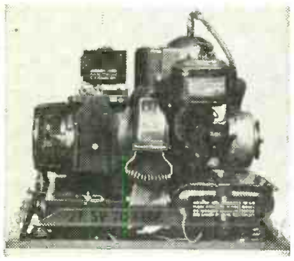
Brand new. Evans blue flame heater. Output approx. 50,000 BTU. Ideal for garage or shack where not confined. Size: 10" dia. x 12" high. Cost Govmt. many times our low price. Shipped in orig. packing; wt. 47 lbs. $4.95

RC-58-B FACSIMILE SET—$59.50 ea.



Brand new, complete, ready to operate by connecting to 12 V. DC source. Spare parts included with ample supply of ink and paper. Transmits and receives and prints, signatures and copy. Ideal for loan offices, banks or other businesses where signatures must be verified, etc. Use two sets together with 2 wires telephone line or radio carrier between. Cost Gvmt. approx. $6000. Your price, in original packing, only $59.50 ea. Ship. wt. approx 300 lbs.

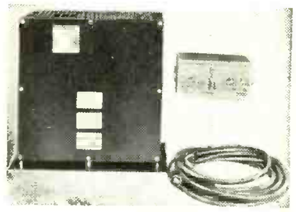
HRU-28A GENERATOR—$79.50



Homelite gasoline generator 28.5 V. DC at 2 KW. 3400 RPM motor speed. Electric or rope start. Use to power surplus aircraft radio equipment, cabin or marine power, aircraft starting, etc. These units rebuilt like new by the U.S. Air Force and have not been run since. Size 21½" x 24⅝" x 17½". Wt. 115 lbs. Original AF boxed. Guaranteed. Ship. wt. 210 lbs. "Instruction book included."

30 AMP. BATTERY CHARGER WHILE SUPPLY LASTS—$12.50 ea.

Cost Government $300 ea. Our purchase of large quantity allows this bargain. Ward-Leonard Mfgd. Type EO 33510. Charging rates up to 30 amps. on 12-30 volt battery combinations (6-15 cells). Operates from 110 V.D.C. Size 20" wide x 20" high x 10" deep. Shipped in original overseas pack with spares and cord. Wt. 65 lbs. Ship. wt. 145 lbs.

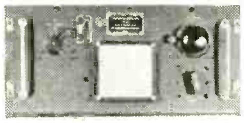


Receiver R-1/ARR-1—$1.95

A two-stage RF superhet converter in range of 234-258 Mc. Ideal for conversion to various preselectors, ham 220 Mc. converter, or other uses. Uses 4—954 acorn tubes supplied. In compact aluminum case 10" x 3½" x 3". Filaments operate from 12 or 24 V. by merely throwing switch contained in unit. Complete with conversion article as in Jan. 1949 "Radio-TV News." Brand new demilitarized units (input coil insulation broken—easily repaired). Used units that are not demilitarized also available—specify new or used. Ship wt. 4 lbs. Price $1.95 ea.

12 or 24 V. co-axial antenna relay for above or other mobile transmitter-receiver equip. New .... $1.25 ea.

TU-10B TUNING UNITS $2.50 ea.



Brand New TU-10B tuning units for the BC-191 or 375 transmitter. The popular one for parts and case. Size 16½" x 7⅝" x 7½". Ship. wt. 15 lbs.

M-1 Odograph, over $5,000 value—$89.50

See Nov. 1944 Electronics for Full Description

This is a survey instrument for automatically drawing a map of the terrain over which the jeep or other vehicle to which it is attached traverses. These instruments mfgd. currently by Monroe Calculating Machine Co. and sold in excess of $5,000. Our surplus purchase allows passing on these machines at this value. Order early, only 200 in stock. Units have been rebuilt by Corp of Engineers, U.S. Army and guaranteed good condition. Ideal for prospectors, oil companies, power line and farm use. Nothing else needed for operation except vehicle. Many are using the compass unit for automatic pilots on boats—many, many applications. A real machine. Ship. wt. approx. 300 lbs. .... Our Price $89.50 ea.

LEEDS & NORTHRUP MICROMAX RECORDERS

Strip type recorder used for controlling and recording wide variety of processes. Used originally for temp. range of 350-550° C. but may be changed for other applications. Operates on Wheatstone bridge principle using AC galvanometer movement. Original cost several times our low price. Removed from demilitarized equipment which in many cases was new. Sold as used but guaranteed, or money back if not satisfied. Ship. wt. approx. 165 lbs. $179.50 ea.

SEXTANT $254 value $17.95

Air Force Bubble type sextant at a price to move quickly a large quantity surplus purchase. These instruments come in original carrying case complete with telescope but less battery case used for artificial light source (this can be made from 2-cell flashlight). Mfg. by Ansco or Fairchild. Optics alone worth this price if you have no need for sextant. Ship. wt. approx. 10 lbs.

Freq. Crystals. . .Less Than 5c Ea.

Imagine crystals costing Govmnt. $3.50 to $12.50 ea. in this assortment. 100 brand new; various freqs.; plenty in ham bands. Practically all types of holders; all mounted; guaranteed to oscillate.

Assortment of 100. Ship. wt. 4 lbs. $4.95

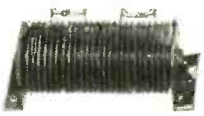
Andover Power Plants $185 ea.

This is the D2 plant that has been always in such great demand for use as portable welders and auxiliary power. Delivers 28.5 V. DC up to 200 amps. continuous. The lightweight aircraft type motor on these plants had a Gvmnt. acquisition cost of $2937.00 ea. Motor is 2 cylinder 4 cycle aircooled with hi-tension magneto type shielded ignition rated at 10 HP at 3200 RPM. Entire unit weighs approx. 125 lbs. Guaranteed good condition. Ship. wt. 300 lbs. Price $185

Engines only from above plant for only $125 ea. Ship. wt. 250 lbs.

110 V. RECTIFIER SPECIAL—$2.85

New G.E. dry disc rectifiers for changing 115 V. AC to DC. Has one amp. rating-more intermittant or with forced air cooling. Size approx. 9" 3½" x 3½". Ship. wt. 10 lbs.



GOLF CAR MOTOR $12.50

Brand New 6 V. DC motor with separate terminals for armature & field to allow connection in series, shunt, or easy reversing. Approx. 5" dia. 10" length including 1-⅞" shaft extension. Shaft is ⅝" dia. Mounts by four ⅝" threaded studs ⅞" long on shaft end of motor.

Mobile Hams Attention!

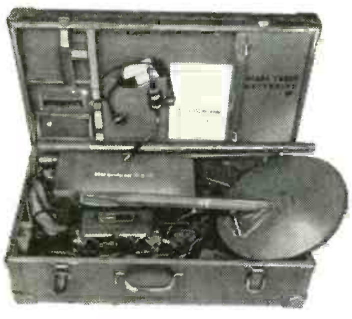
6-12-24 V. VIBRATOR POWER SUPPLY $9.95

PE-237 Non-synchronous vibrator type. Input: 6 V. 36 amp., 12 V. 17 amp., or 24 V. 9.5 amp. DC. Output: 525 V. DC .095 amp., 1105 V. DC 4.2 Ma., 6.5 V. DC 2 amp., 6 V. DC ½ amp., 1.35 V. DC 450 Ma. Higher current drain may be obtained with no ill effect. This power supply has been successfully used for powering the BC 604 Xmtr. below. Steel brown crackle case size 20¼" x 11" x 10". Ship. wt. 119 lbs. ea. Excellent to new condition. Price $9.95 ea.

TS-9 Handset—$1.99

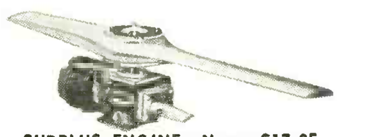
Ideal for your mobile rig. Contains 250 ohm rec. element and single button carbon mike transmitter unit. Will replace your T-17 handmike or other SB mike. Excellent to new condition. Ship. wt. 5 lbs. Price .... $1.99 ea.

Metal Locators—$39.50



The famous SCR-625 mine detector which has been found to be unexcelled for locating hidden metallic objects such as pipes, treasure, etc. Hundreds in use by prospectors, mining companies, plumbers, veneer mills, etc. Comes complete in carrying case and checked ready for operation with addition of batteries below. Case size 28¼" x 16" x 8¼". Operating carrying wt. approx. 15 lbs. Ship. wt. 55 lbs. Price $39.50 ea.

Batteries for above SCR-625 $4.25 set.



SURPLUS ENGINE—New—$17.95

2.3 H.P. 2 cy. horizontal engine manufactured by or for Jacobsen. Ball bearing crankshaft. Weighs only 8½ lbs. Attach your own coil and battery. Ideal for air-propelled boats, ice sleds, models, etc. .... $17.95 Shipped as shown with propeller but less hub for attachment.

Storage Battery Pack—BB-208 $3.50 ea.

Contains three 36 V. 18 cell lead acid batteries size 4⅛" x 1-7/16" x 15/16". Wt. approx. 5 oz. ea. and one 6 v. 3 cell lead acid battery size 4-3/16" x 1¼" x 15/16" wt. 5 oz. All batteries dry charged and must be filled with 1.265 sp.g. sulphuric acid before use. (Acid not incl.) Ideal for models, vest packet transmitters and other compact service requirements. All new in vacuum sealed can. Ship. wt. of all 4 batteries 2 lbs.

SYNCHRO MOTORS $2.95 ea. 110 V. 60 cycle

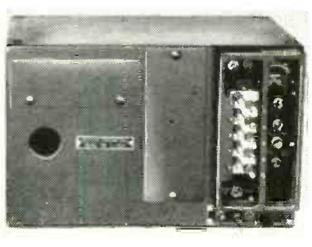
Purchase of a large quantity of these motors allows this special price. Navy type 5 synchros motors that cost the Gvmnt. $80 ea. Apply to many uses such as beam rotation and indication, weather vanes, etc., etc. By merely hooking like wires of a pair of these together and applying 110 V. 60 cy. to the junction of the two Rotor wires, any movement applied to either shaft is repeated on the other unit which may be 100's of feet away. Units are used but guaranteed not burned out. Ship. wgt. 7½ lbs. ea. Order a pair for $5.75.

BC-604 Transmitter—$9.95 ea.

30 watt crystal controlled on 10 preselected channels in range of 20-27.9 Mc. F3 emission. Operates from 12 V. or 24 V. DC (dynamotor not supplied). Tubes and meter supplied worth the price of entire unit. Size 18" x 10" x 12". Excellent to new condition. Ship. wt. approx. 100 lbs. ea. Price $9.95 each.

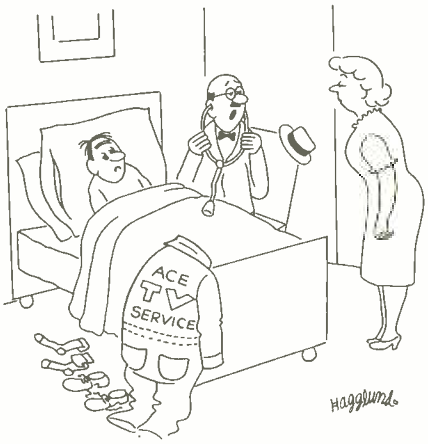
Receiver and Transmitter combination .... $25.00 set

Order a receiver and transmitter combination for mobile or fixed station or for wireless intercom.



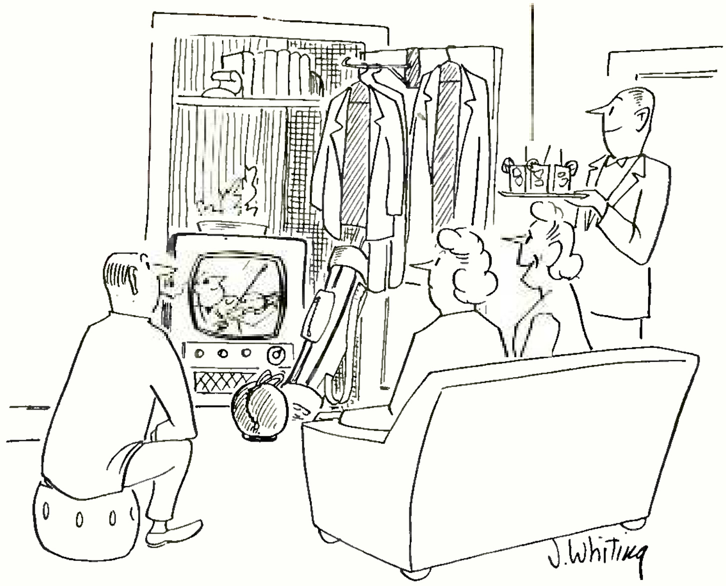
ESSE RADIO CO. 42 WEST SOUTH ST. INDIANAPOLIS 25, IND.

REMIT SHIPPING CHARGE AND INSTRUCTIONS WITH ALL ORDERS. OTHERWISE ORDER WILL BE SHIPPED EXPRESS COLLECT. ALL ITEMS GUARANTEED TO YOUR SATISFACTION OR MONEY REFUNDED IF RETURNED PREPAID WITHIN 10 DAYS OF RECEIPT

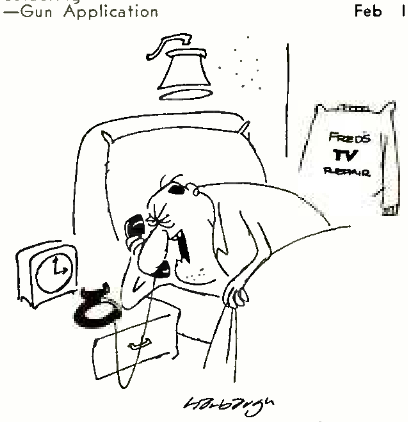


"I'm afraid I'm going to have to take him into the shop."

"Most severe case of corono I ever saw. Turn the light back on."



"We like the idea of having it built in but it leaves us a little short of closet space."



"That's right . . . now grab the terminal marked 500 volts."

END

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MAYBE YOU'RE THE MAN TO WRITE THEM. ASK FOR AN AUTHOR'S GUIDE.

RADIO-ELECTRONICS
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Exclusive Lafayette Money-Saving Values

PROFESSIONAL TURNTABLE WITH HYSTERESIS-SYNCHRONOUS MOTOR

The **Lafayette Model PK-225** is a *true* hysteresis-synchronous motor and is free from speed variations due to fluctuations in line voltage, load and temperature. It is the smoothest type known, completely free from "cogging" (the minute variations of speed which show up as wow and flutter)!

ONLY LAFAYETTE'S HYSTERESIS—SYNCHRONOUS MOTOR, in its price class, is made to extremely fine tolerances (on the order of .00001 inches)! Only Lafayette's motor has 16 cores; a high permeability rotor magnet, ball thrust bearings, oilite sleeve bearings plus felt oil reservoir, cooling fins as an integral part of the rotor and a hollow rotor core for maximum efficiency and minimum heat. Only Lafayette's motor can be oiled from above, without disassembly, through a unique oil feed system. Only Lafayette's motor has a self-aligning armature.

Here's THE turntable—the last word in professional high-fidelity performance! A fine precision instrument in every sense. Just look at some of these *OUTSTANDING FEATURES:*- **WOW AND FLUTTER:** Less than 0.2% • **TURNTABLE:** Heavy, diecast aluminum. Lathe-turned for perfect balance and concentricity. 12" diameter—weighs approx. 4 lbs. and provides amazingly constant speed; the extra-heavy rim acts just like a flywheel to prevent speed variations • **TRUE-HYSTERESIS-SYNCHRONOUS MOTOR:** For smooth, low-noise, wow- and flutter-free operation • **RUMBLE: AND NOISE:** 50db below average recorded level • **INTEGRATED SPEED CONTROL:** For all 3 speeds—78, 45 and 33⅓ rpm • **2 OVERSIZE, HEAVY DUTY IDLERS:** Precision-ground; provide positive constant-speed rim drive • **SINGLE BALL THRUST BEARING:** Turntable rides smoothly over ball bearing floating on thin film of oil • **FREE FLOATING, SHOCK-MOUNTED MOTOR** • **RUBBER CUSHION SHOCKMOUNTS** • **AUTOMATIC IDLER DISENGAGEMENT** • **CORK AND RUBBER MAT** • **STAINLESS STEEL PRECISION SPINDLE** • **POWER REQUIREMENTS:** For 105-130 volts, 60 cps AC; draws 16 V.A. • **ACCESSORIES SUPPLIED:** 45 RPM adapter, Strope disc • **SIZE:** 2⅛" above and 4" below motor board; 14¾" deep x 12¼" wide • **SHIPPING WEIGHT:** 16 lbs.

Deluxe Woodbase for PK-225 and 12" Tone Arm (Specify Finish). Shpg. wt., 13 lbs. .... Net **14.95**
Deluxe Woodbase for PK-225 and 16" Tone Arm (Specify Finish). Shpg. wt., 15 lbs. .... Net **15.95**
LAFAYETTE MODEL PK-225 .... Net **64.50**

SPECIAL MONEY-SAVER COMBINATION

PK-225 Turntable, PK-90 12" Tone Arm, New GE VRII Series Triple-Play Cartridge Model 4G-052 with Genuine GE Diamond and Sapphire Styli. **SPECIAL!** .... Net **81.50**

VISCOUS DAMPED TRANSCRIPTION TONE ARMS

12" VISCOUS DAMPED ARM
PK-90— 11.95

LICENSED UNDER CBS U. S. PATENT NO. 2676806

16" VISCOUS DAMPED ARM
PK-170— 17.95

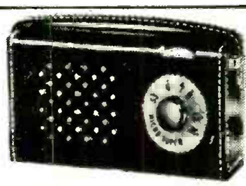
LAFAYETTE MATCHED HIGH-FIDELITY PHONO SYSTEM

NOBODY BUT LAFAYETTE can bring you a phono system of this quality—and at this price. Indeed a Lafayette "best buy" system designed around the new **Lafayette LA-69 20 watt amplifier.** The performance of this phono system surpasses the most critical requirements of music lovers at a price below that of commercial phonographs. Twenty-four combinations of record equalization provide an almost endless variety of tone compensation to match varying recording characteristics. In addition to the LA-69 this system includes the famous **Garrard RC-121 4-speed Record Changer** featuring full automatic and manual positions and Simple-mix operation; the new improved **VRII Variable Reluctance GE Triple Play Turnover Cartridge Model 4G-052** with **genuine GE** diamond and sapphire styli, and the celebrated **Lafayette SK-58 12" Coaxial Hi-Fi Speaker.** All units are supplied with plugs, jacks and prepared coded interconnecting cables for quick easy installation. For 110-125 volt, 60 cycle AC. Shpg. wt., 50 lbs.

HF-179—Complete Phono System .... Net **119.50**

Reg. Value ~~158.55~~ SALE! 119.50

6 TRANSISTOR SUPERHET RECEIVER KIT

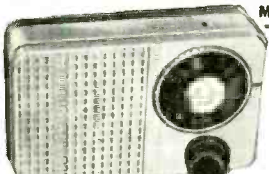


- 100% SUBMINIATURIZED
- SENSITIVE, SELECTIVE, STABLE
- PUSH-PULL OUTPUT — PLENTY OF POWER
- AN INCOMPARABLE VALUE

The Lafayette KT-119 6 Transistor Superhet Transistor Kit provides superior commercial quality with maximum sensitivity, selectivity and stability. The circuit features 6 selected transistors and crystal diode, a specially matched set of 3 IF's, Oscillator coil, high Q loop, and audio transformer coupling. Has efficient 2¾" speaker and earphone jack for private listening. Complete with all parts, transistors, prepunched chassis and easy to follow step-by-step instructions. 6½" x 3½" x 1½". Shpg. wt., 3 lbs.

KT-119—Complete Kit—Less Case & Battery .... Net **29.95**
BATTERY RCA VS300 ...... Net **1.23** **BURGESS P6** .... Net **.77**
MS-339—Sturdy, attractive brown leather case with carrying strap for KT-119. Shpg. wt., 1 lb. .... Net **2.95**
MS-366—Sensitive matching earphone Net **1.29**

3 TRANSISTOR SUPERHET POCKET RADIO KIT



- A TRUE POCKET SUPERHET RECEIVER
- NO EXTERNAL ANTENNA
- NO EXTERNAL GROUND

A remarkable sensitive, super-selective pocket superhet receiver with astonishing performance over the complete broadcast band. Uses 2 high-frequency and one audio transistor plus efficient diode detector and features 2 specially matched IF transformers for maximum power transfer. The components are housed in a professional looking beige plastic case. The receiver's appearance enhanced by attractive maroon and silver station dial. Sensitive built-in ferrite antenna eliminates need for external antenna. A designer's dream in a true pocket superhet receiver! Complete with all parts, transistors battery, case, dial and easy to follow step-by-step instructions. 4⅛" x 2⅝" x 1-1/16". Shpg. wt., 1 lb.

KT-116—Complete Kit, less earphone .... Net **16.95**
MS-260—Super Power Dynamic Earphone .... Net **3.95**

NEW POCKET AC-DC VOM MULTITESTER

2,000 ohm per volt sensitivity on both DC and AC
160 ua 3" METER 1% PRECISION RESISTORS
SILVER CONTACT SELECTOR SWITCH
FULL SCALE RANGES

D.C. Volts: 0-10; 0-50; 0-500; 0-1000 Volts—**A.C. Volts:** 0-10; 0-50; 0-500; 0-1000 volts—**D.C. Current:** 500 ua and 500 ma—**Resistance:** 0-10K; 0-1 Meg—**Decibels:** —20 to +22; +20 to 36 db (0 db—0.775 V)—**Capacity:** 250 mmfd. to .2 mfd—.005 mfd to 1 mfd—**Output Ranges:** 0-10; 0-50; 0-500; 0-1000 volts.

Best Buy in America! A very accurate and sensitive VOM. This Multitester is a complete instrument (not a kit) with high quality and sensitive 160 microamp meter; 2000 ohm per volt on both AC and DC. Single selector switch, 1% precision resistors, 3" meter. Features extreme versatility, accuracy and ruggedness. In attractive plastic front panel, with metal bottom for ruggedness and shielding. First capacity range requires 50 volt AC source. Second capacity range requires 10 volt AC source. Size 4¼" x 3½" x 1⅝". Complete with test leads and batteries. Shipping weight 4 lbs.

RW-27A .... Complete **8.95**

HIGH SENSITIVITY 20,000 OHM PER VOLT DC 10,000 OHM PER VOLT AC MULTITESTER

LOOK AT THESE FULL SCALE RANGES!

D.C. Volts: 0-6; 0-30; 0-120; 0-600; 0-1200; 0-6000 Volts—**A.C. Volts:** 0-6; 0-30; 0-120; 0-600; 0-1200 Volts—**Resistance:** 0-10K; 0-100K; 0-1 Meg; 0-10 Megohms—**D.C. Current:** 0.60 Microamp; 0-6; 0-60; 0-600 Milliamps—**Decibel:** —20 to +17 db (0db—0.774V)—**Capacity:** .0001-.01; .005-.15 mfd—**Inductance:** 20-2000 millihenry—**Output Ranges:** 0-6; 0-30; 0-120; 0-600; 0-1200 Volts.

The new Lafayette high sensitivity Multitester is a complete instrument (not a kit). In addition to its unusual sensitivity of 20,000 OHMS PER VOLT ON D.C. AND 10,000 OHMS PER VOLT ON A.C., and the extraordinary number and scope of its ranges, it is packed with features that would make it cost at least twice as much if made in this country. Uses 1% precision resistors, silver contacts on selector switch, 35 ua 3" meter. Dependable, rugged and accurate. Even the test leads are heavy duty with high voltage insulation. Voltage source required for low capacity range is 120V for high range capacity and inductance scale is 6V A.C. Attractive plastic front with metal botton. Size 6¼" x 4¼" x 2½". Complete with batteries and leads. Shipping weight 4½ lbs.

RW-30A .... Singly, Each **19.95**
in lots of 3, Each **19.25**

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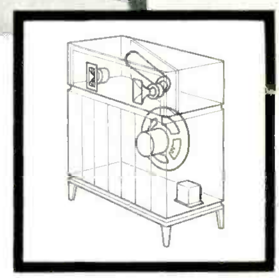
Electro-Voice®



Here is Why Electro-Voice Phase Loading Improves Along-the-Wall High-Fidelity Reproduction

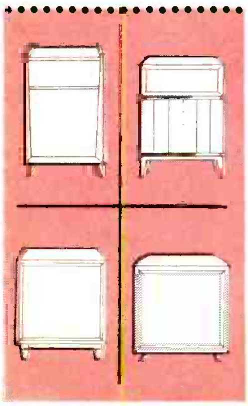
Phase Loading—a great Electro-Voice development—gives you performance from along-the-wall speaker enclosures that approaches the performance of a corner horn! Specifically designed for use along-the-wall, phase-loaded cabinets give you almost a full added octave of smooth, augmented bass. The bass driver unit is placed low and close to the rear reflecting wall so that the direct sound from the cone and the reflected sound reach the listener's ears from very nearly the same source. This prevents phase cancellations, gives smooth, augmented bass range.

Phase Loading also permits a sealed cavity behind the driver cone of precise volume. The compliance of this cavity is made to react with the mass of the cone and the outside air throughout the second octave, adding this range to the response not otherwise attainable. This is *why* Phase Loading is demonstrably superior. Hear it today!

NEW ELECTRO-VOICE PHASE LOADED ENCLOSURES

The Carlton IV. Smart, handsome low-boy design using acoustically correct "Tapatex" grille cloth for accent. It harmonizes gracefully with modern furnishings. Employs a complete *phase loaded* system affording extended bass response range with smooth, resonance-free characteristics. Includes Model 105E deluxe 15-inch, 4-way components completely wired and installed. Size: 33½" high, 26¼" wide, 19½" deep. Mahogany Complete — Net each $359.00

The Sheraton. Complements the Carlton phase loaded speaker enclosure, affording extensive facilities for amplifier, tuner, turntable or record changer, tape deck plus record and tape storage. Compartment dimensions: Record Player, 18" long x 17¼" wide x 9½" overall depth (adjustable mounting board raises for manual player); Amplifier-tuner, 18" long x 17¼" deep; Storage, 13" high x 19" wide x 17¼" deep. Overall size: 33½" high x 37½" wide x 19½" deep. Mahogany Cabinet Only—Net each $173.00



THERE'S AN ELECTRO-VOICE PHASE LOADED ENCLOSURE FOR EVERY APPLICATION

The Suzerain IV. With phose loaded Model 105E 15-inch deluxe speoker system, wired ond installed, Size: 36½" high x 26" wide x 19¾" deep. Mahogany Complete—Net each..... $395.00

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