APRIL

Radio-Electronics

TELEVISION • SERVICING • HIGH FIDELITY

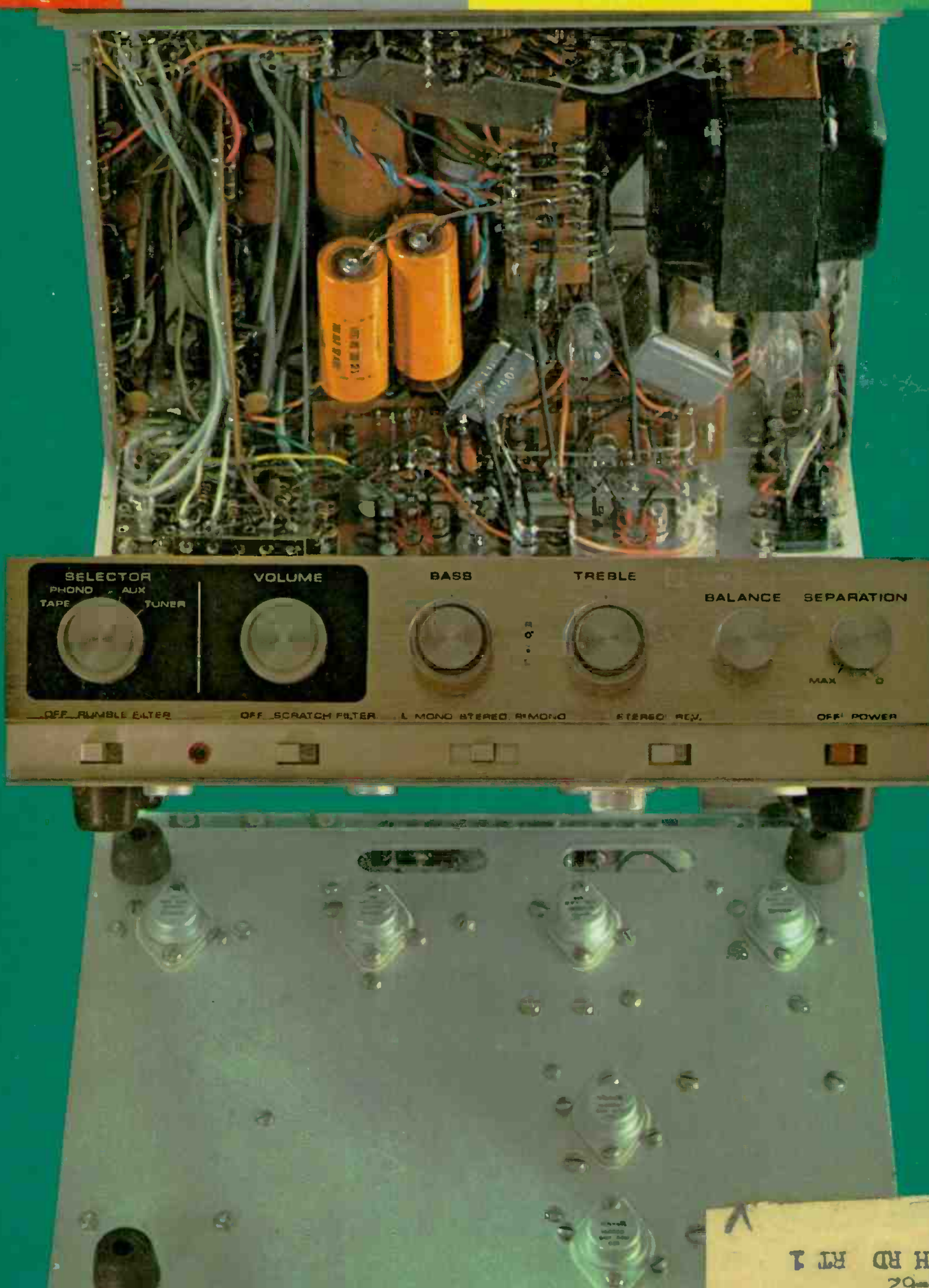
Setting Up the Zenith and RCA Color TV Sets

Versatile Transistor Tester

More Stereo Multiplex Listings

Electroluminescent Flashlight

HUGO GERNSBACK, Editor-in-chief



New 50-Watt Stereo Amplifier is All-Transistor

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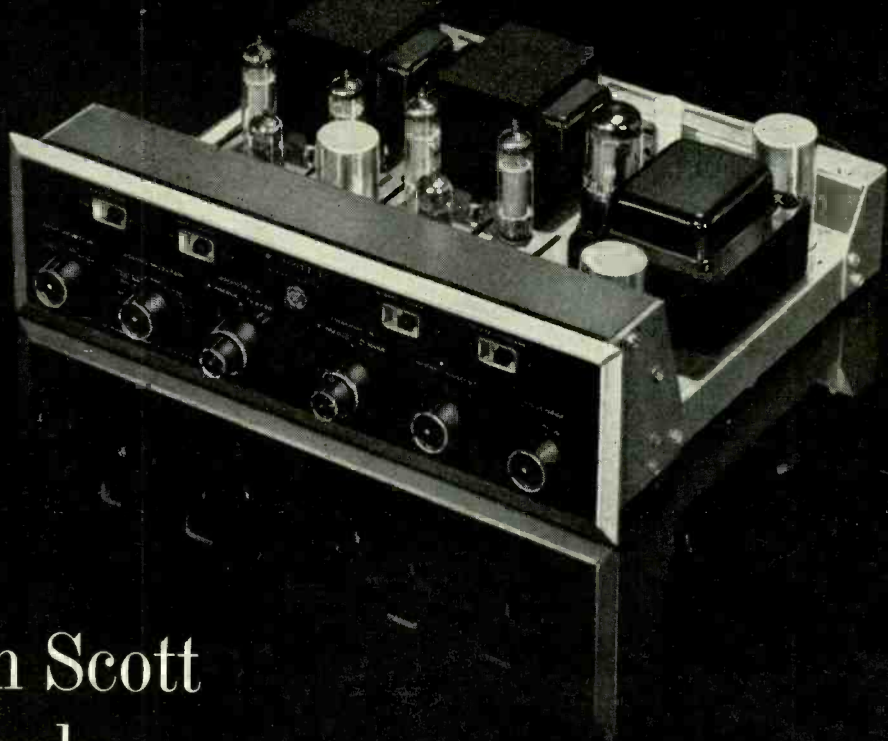
50c



Hermon Scott could make this new kit for $30 less, If...

Hermon Scott faced a basic choice . . . bring out his new LK-48 amplifier kit at $124.95 or make it to sell for $30 less like many other amplifier kits. All his engineering department had to do was make a few compromises.

The LK-48 is rated at 48 watts. By using a smaller power supply, ordinary output transformers, and pushing the output tubes to their limits, the amplifier might still produce 48 watts at 1000 cycles where many amplifier kits are rated. But measured at 20 cycles, where Scott engineers feel power is really important, output would be down considerably. No compromise was made. The LK-48 *actually* produces 28 watts per channel at 20 cycles, and delivers full power throughout the audio range.

Many kits use a one color instruction book. Hermon Scott decided to continue to use full color to insure factory-built performance, even at the hands of a novice.

Important Scott engineering extras like the all-aluminum chassis, DC operated preamp heaters and unique hum-null balancing could have been eliminated. Hum would have been audibly higher and distortion at levels normal to many kits, but Hermon Scott felt that the kit builder was entitled to the same performance he has come to expect from Scott factory-wired units.

Yes . . . Hermon Scott could have made the LK-48 to sell for $30 less . . . but it would have meant compromising life-long standards. This is something he would never do. You can choose any Scott kit with complete confidence — the LK-48, the LK-72 80 watt complete stereo amplifier, the LK-150 130 watt stereo power amplifier, the LC-21 professional preamplifier, the LT-110 multiplex tuner, LT-10 FM tuner or the LM-35 multiplex adaptor. These superb kits have all the features and performance you've come to expect from the world's leader in audio engineering.

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Radio-Electronics

Formerly RADIO CRAFT — Incorporating SHORT WAVE CRAFT—TELEVISION NEWS—RADIO & TELEVISION*

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Over 50 Years of Electronic Publishing

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Average Paid Circulation Over 155,000

—on the cover—

(Story on page 35)

This one's done with mirrors. The real Knight-Kit stereo amplifier is in the middle. It delivers 25 watts per channel and uses a total of 20 transistors.

Color original by Irving Kaufman

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News Briefs

Citizens Banders React

A federation of volunteer Citizens-band radio operators has been organized to provide aid to the authorities and their communities under local emergency conditions. The objectives of the organization are:

1—To provide a round-the-clock radio communications system, effectively supplementing police, fire, ambulance, hospital and civil defense efforts.

2—To promote correct and efficient use of Citizens-band radio.

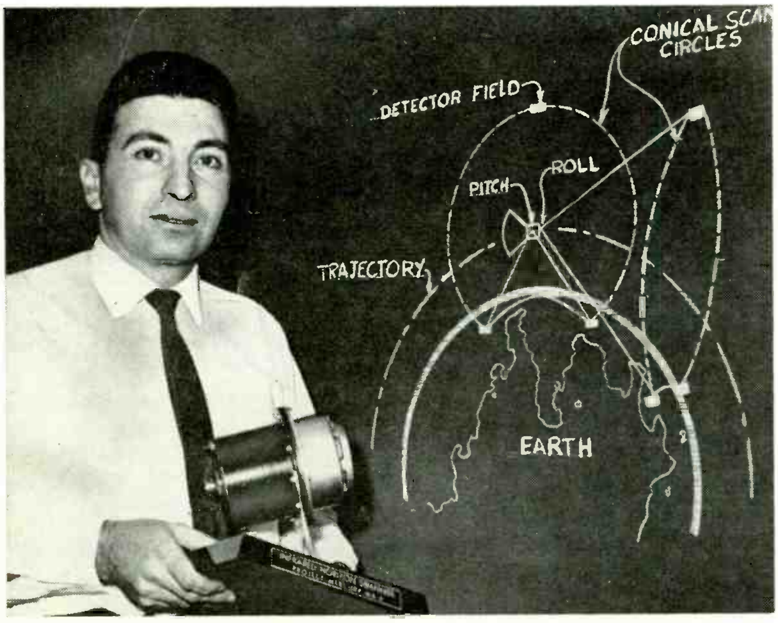
The organization is known as the Radio Emergency Associated Citizens Teams (REACT), and is already functioning in Wisconsin. Membership is free, REACT being sponsored and supported by the Hallicrafters Co., Chicago communications equipment manufacturers. Since Citizens banders now number more than a quarter-million, it is felt the organization can become a valuable emergency service, especially in areas where existing communications facilities are limited.

Infrared Stabilizes Satellites

A "horizon sensor" that works with infrared, and therefore operates as well in darkness as in daylight, has been patented by Monty M. Merlen of Barnes Engineering Co. The device has been used in the US Air Force's Midas and Discoverer programs, and in other NASA earth-orbiting and far-space projects. Two of them are used in the Project Mercury spacecraft. They detect pitch and roll and produce corrective signals that keep these space craft stable in flight.

The horizon sensor takes advantage of the fact that every object emits infrared energy, the amount being proportional to the fourth power of its absolute temperature (T^4). Thus, the earth, which has an average temperature of 280°K (45°F) in moderate zones, radiates far more energy than does outer space, which is approximately at absolute zero. To the thermistor infrared detector which forms the heart of the horizon sensor, the earth appears as a hot sphere whose edges are easily detected.

The horizon sensor described in the patent generates a conical scan by rotating a tilted mirror or prism some 1,800 times a minute. As the line of sight from the instrument cuts across the edge of the earth, the sudden change from the cold of outer space to the warm earth is sensed by the thermistor infrared detector and causes a change in voltage across this temperature-sensitive element. This signal, after amplification and processing, may provide corrective commands to an automatic stabilization system. The signal also may be telemetered to ground or used to operate a position indicator in the vehicle. Two horizon sensors are normally installed in a spacecraft, their combined operation being used to correct both pitch and roll.



Monty Merlen, the inventor, with "horizon sensor" recovered after Project Mercury mission. Diagram shows how two of them control satellite's pitch and roll.

Machine Reads Script

Handwriting can be read electronically with 90% accuracy, the Symposium on Optical Character Recognition was told recently in Washington, D. C.

L. D. Harmon, Bell Telephone Laboratories, Inc. (Murray Hill, N.J., described the process this way:

The writer is asked to observe base and guidelines, use no capitals and write legibly. Real-time signals giving stylus position are obtained from a transducer and recorded on magnetic tape, providing input data for a computer-simulated recognition system.

Most of the machine's errors are on the letters M, N, R, U, V and W—the same characters that humans have trouble identifying because of the importance of context.

Meanwhile, electronic reading of typewritten and special characters is continuing to progress rapidly. Farrington Electronics delivered to the Post Office a new experimental mail sorter that reads typed addresses photoelectronically at 9,300 letters an hour. They also announced a contract for a larger and faster machine. The ultimate objective is equipment that will read 36,000 addresses an hour.

"New Color Tube" a Fraud

Tokyo police raided the head office of the Toyo Electric Manufacturing Co., that recently announced and "demonstrated" a sensational new color TV tube supposed to produce colors with layers of gases trapped in silicone grease (RADIO-ELECTRONICS Nov. 1961, page 10). The homes of the former president of the company and an engineer were also raided. The police were apparently searching for evidence that the company had manipulated the market to push up the price of

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their stocks, which soared from 130 yen a share in January 1961 to 505 in July. Technical persons who saw the original demonstration believed it to be a fake product, and that the new set was a Toshiba receiver modified to make it look sufficiently different. The president attacked such statements as slander, but changed his attitude in October and discharged the engineer who, he said, had cheated the company.

Subs to Eavesdrop on Whales

Darts, wired for sound and shot into the back of a baleen whale, may produce electronic data useful to the new Polaris submarines. Each small dart will carry a sound transmitting device. An oceanographic vessel, the Sea Quest, will follow the whale and record electronic data from the sound transmitter in the whale's back.

William V. Kielhorn, Lockheed-California Co.'s oceanographer engaged in anti-submarine warfare research, hopes to learn more about the whale's diving track and underwater habits, as well as build up a "library of sea noises" to prevent sonar recording of false contacts.

The experiment will take place sometime in 1962.

Home TV Tapes

Video tape recorders for home entertainment are being planned by Sony Corp., Tokyo, states Kazuo Iwama, the firm's director of research and development. He is uncertain how soon circuitry can be simplified and production cost reduced enough for large-scale production.

Sony is now improving its transistorized video tape recorder for industrial use, says Mr. Iwama. To date, there are no definite marketing plans for this model.

IRE Meets March 26-29

The 1962 50th Anniversary IRE International Convention is expected to draw more than 70,000 engineers and scientists from 40 countries to the Waldorf-Astoria Hotel and the Coliseum in New York City; dates are March 26 through March 29. A program of 240 papers is being presented in 54 sessions. The IRE Electronics Show held in conjunction with the convention includes 850 exhibitors and some $15,000,000 worth of electronic equipment.

ETV To Pay Own Way

Airborne educational television has been operating regularly since Sept. 11, with regular instruction for students from the first grade to college levels. Up to the present, it has been experimental, with costs shared among various sponsors. Now a plan has been announced by Dr. John E. Ivey, Jr., former University of Michigan administrator, which would put the new Midwest Program

(*Continued on page* 12)

50,000,000 tube hours... an unusual electron tube still keeps undersea voice signals strong

Deep on ocean floors, from North America to Europe, between Key West and Havana, Florida and Puerto Rico, under the Pacific to Hawaii and Alaska—in 20,000 miles of undersea telephone cable—a special kind of electron tube is setting a remarkable record for reliability.

This four-inch-long electron tube was designed, developed and fabricated at Bell Telephone Laboratories to operate with no attention for 20 years or more. It is part of the submarine cable repeater manufactured by Western Electric which faithfully and reliably amplifies voice signals transmitted along undersea coaxial cables.

All of the 1608 tubes built into the repeaters have operated to date without failure for a total of over 50,000,000 tube hours, or an average of three-and-a-half years. The oldest have been in service since the first deep-sea repeatered telephone cable was laid 12 years ago.

Years before it was put to use, Bell Laboratories scientists and engineers began developing this undersea tube, another example of forward-looking technology that has made the Bell Telephone Laboratories the world center of communications research and development.

BELL TELEPHONE LABORATORIES

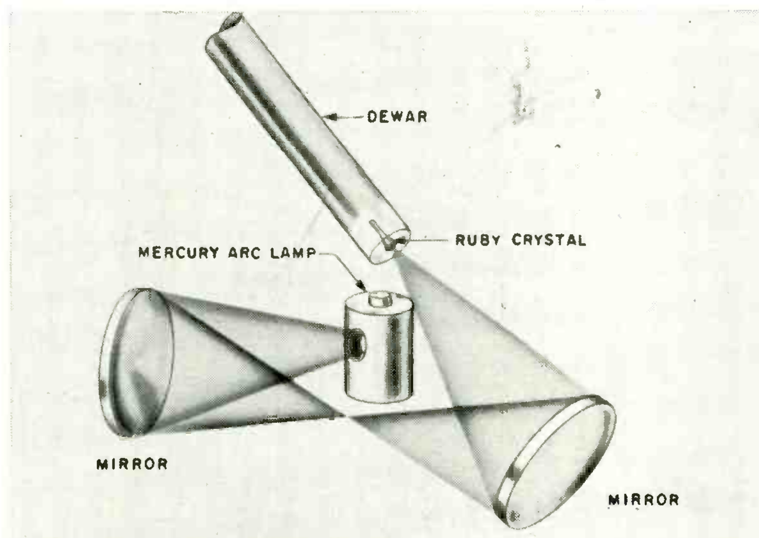
(*Continued from page 8*)

on Airborne Television Instruction (MPATI) on a pay-as-you-go basis.

Under Dr. Ivey's plan, fees from participating schools would be pooled to build up an annual budget of a little less than $4,000,000. The basic rate would be $1 per pupil, with a minimum charge of $200 for a participating school, and a reduction for schools with enrollments above 1,000. If put on a self-supporting basis, Dr. Ivey says, the system could be expanded by 1965 to cover an area of 172,000 square miles with a potential enrollment of 9,400,000 students.

Ruby Maser Works Continuously

The first solid-state optical maser to operate continuously has been announced by Bell Laboratories. A radical new way of exciting the maser crystal delivers five times the intensity that has been possible from previous continuous optical maser pumps. Instead of using a spiral xenon flash lamp, a mercury arc lamp is used, with a pair of concave spherical mirrors, to focus practically the whole of the light onto the face of the maser crystal. This reduces the power requirements from the more than 1,000 kw originally needed for pulsed operation to less than 1 kw for continuous operation.



Co-eds Enter Electronics

Young women college graduates this spring will find more jobs to choose from than did their sisters last year, according to a recent *Wall Street Journal* survey, and the barriers are more likely to be down in the electronics field than in others.

Litton Industries states: "We are stepping up our recruiting of women, especially those with electronic engineering and physics degrees. When we find a woman in one of those fields, we snap her up." Raytheon plans to hire about 10 scientifically oriented girls this year, compared with only 3 last year, and would hire more, excepting that the colleges "just don't have many girls who specialize in the fields we are interested in."

There is a tendency to feel that women are better suited than men for some finicky lab jobs. "Women are more patient and painstaking," according to one research lab head.

University spokesmen agree that women's greatest opportunities lie in the engineering, math and science fields. Mildred Webber, placement official at the University of Michigan, maintains that "women have just as good a chance as men in any science field, and can earn comparable salaries."

CBS Backs All-Channel TV

CBS President Frank Stanton pledged the network's full support to the Federal Communications Commission's drive toward vhf–uhf TV sets, at the FCC's Washington hearings on TV programming. Dr. Stanton said ". . . We support the FCC in its effort to persuade the Congress to enact legislation which would result in the manufacture of only all-channel receivers."

The statement made CBS the first major network to officially take this position.

The switch to all-channel TV would provide 80 channels instead of the 12 now found on vhf receivers.

Sniperscope Has New Use

A Navy infrared sniperscope promises to aid doctors in diagnosing and treating blindness of certain types, according to the *Naval Research Reviews*. When the cornea (transparent part of the outer covering of the eyeball) becomes opaque, the patient not only cannot see out, but the examining doctor cannot see the condition of the structures in the eye. By placing the sniperscope between the observer and the regular ophthalmic instrument used for examination, the observer can see what is not visible with ordinary light, since infrared penetrates many tissues that are quite opaque to the rest of the spectrum. There is a further

(*Continued on page 16*)

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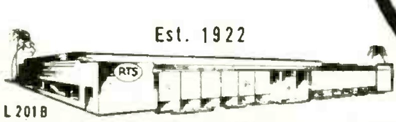

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DISTRIBUTOR SALES DIVISION

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CLAROSTAT MFG. CO., INC. DOVER, NEW HAMPSHIRE

The Fort Dix Advent antenna as it approached completion.

(*Continued from page* 12)

advantage if infrared light only is applied to the eye. Since it is invisible to the patient, his pupil dilates as if in total darkness, giving the doctor further opportunities for observation.

Calendar of Events

IHFM High Fidelity Show, Mar. 20–25, Ambassador Hotel, Los Angeles, Calif.

IRE International Convention, Mar. 26–29, Coliseum, New York, N. Y.

Southwest IRE Conference and Electronics Show, April 11–13, Rice Hotel, Houston, Tex.

IRE-AIEE Symposium on Mathematical Theory of Automata, April 24–26, United Engineering Center, New York, N. Y.

SMPTE 91st Convention, April 29–May 4, Ambassador Hotel, Los Angeles, Calif.

IRE, AIEE Spring Joint Computer Conference, May 1–3, Fairmont Hotel, San Francisco, Calif.

IRE International Congress on Human Factors in Electronics, May 3–4, Lafayette Hotel, Long Beach, Calif.

IRE, AIEE, EIA Electronic Components Conference, May 8–10, Marriott Twin Bridges Hotel, Washington, D. C.

IRE National Aerospace Electronics Conference, May 14–16, Biltmore Hotel, Dayton, Ohio.

Institute for Advancement of Medical Communication Council on Medical TV, May 15–16, National Institutes of Health, Bethesda, Md.

Navy Medical Dental TV Workshop, May 16–17, National Naval Medical Center, Bethesda, Md.

1962 Electronic Parts Distributors Show, May 21–24, Conrad Hilton Hotel, Chicago. Attendance limited to manufacturers, distributors, representatives and their advertising agencies. RADIO-ELECTRONICS will exhibit in Room 610.

ISA National Aero-space Instrumentation Symposium, May 21–23, Marriott Twin Bridges, Motor Hotel, Washington, D. C.

IRE, AIEE, ASME, ISA National Telemetering Conference, May 23–25, Sheraton Park Hotel, Washington, D. C.

EIA Annual Convention, May 23–25, Pick-Congress Hotel, Chicago, Ill.

IRE Seventh Region Space Communications Conference, May 24-26, Seattle, Wash.

Advent Antenna Up

World's most accurate space communications antenna has been installed at the Project Advent ground station at Fort Dix, N. J. The 60-foot parabolic reflector weighs 9 tons. Standing 102 feet overall, the antenna will track and will handle vital communications with military Advent satellites. (Project Advent is a Department of Defense research and development program to determine the feasibility of a reliable military communications system for relaying messages anywhere in the world through active-repeater satellites hovering in a 22,300-mile-high stationary orbit above the equator.)

Brief Briefs

The first completely solid-state microwave communications equipment, according to the Radio Corporation of America, was demonstrated to Pennsylvania Electric Association members, who held conversations over the laboratory equivalent of a 60-mile microwave system, with what was described as "excellent results". The new equipment is crystal-controlled and operates with transistors and varactor diodes.

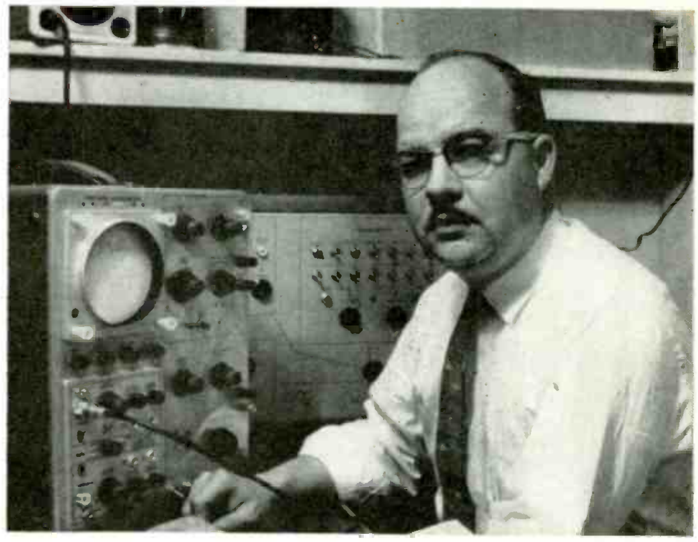
The term "compactron" is now a standard English word. The General Electric Co. has taken steps to abandon its trademark on the word as applied to multi-function electronic devices developed by the company.

The single-gun Chromatron color tube will be manufactured by Sony Corp. in Japan, under a license agreement with the American patent owners. Sony states that it believes the one-gun Chromatron has inherent properties that will enable Sony to make a color TV set that will be "brighter, less bulky, have less service problems, and cost less than current sets."

A 3-megawatt laser has been announced by the U. S. Army Signal Research and Development Lab, Fort Monmouth, N. J. This is 300 times as powerful as lasers in general laboratory use. END

are you standing still in electronics while this man advances?

Find out why—and do something about it—if you have the ambition to want a career instead of just a job.



CREI graduate Mearl Martin, Jr. has progressed from Junior Technician to licensed Senior Engineer. He is now Field Support Manager, Marketing Division of Tektronix, Inc., Portland, Oregon.

LET'S LOOK AT THE FACTS. There's something wonderful about knowing how a circuit works or what a filter capacitor does. If you've ever fixed a TV set, built a radio or used a voltmeter, you've tasted the thrills of electronics.

This excitement may have led you to a job in electronics. But the glamour fades if you are stuck in the same job year after year. You'll be bored with routine and unhappy about prospects for future earnings. You'll discover, as have many men, that simply working in electronics does not assure a good future.

If electronics is the "field of opportunity," how is this possible? No question about it, electronics offers many opportunities, *but only to qualified men*. In any career field, it is how much you know that counts. This is particularly true in the fast moving field of electronics. The man without thorough technical education doesn't advance. Even men with intensive military technical training find their careers can be limited in civilian electronics.

ADVANCED TECHNICAL KNOWLEDGE IS THE KEY to success in electronics. If you have a practical knowledge of current engineering developments, if you understand "why" as well as "how," you have what employers want and pay for. With such qualifications, you can expect to move ahead.

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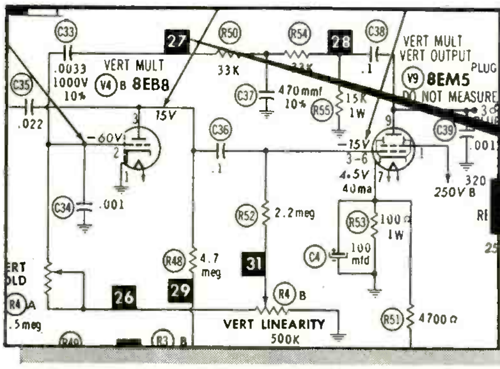

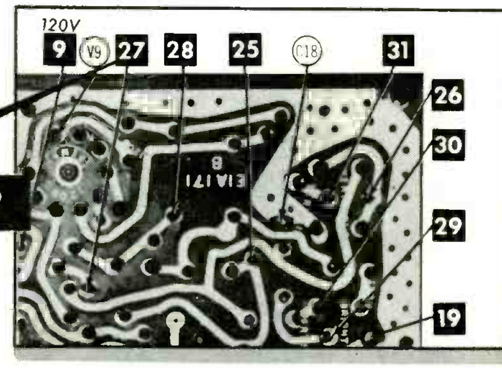

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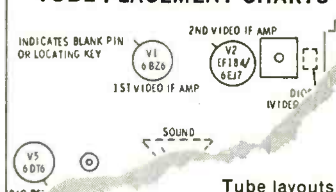
TV: Sweep - ½ Amp. (M1) Radio
LV Supply - Fuse Wire (M2)
Filament - Fuse Wir...
See "Tub...

Valuable instructions for making all necessary adjustments in the home, locating fuses, removing safety glass, etc.

TUBE PLACEMENT CHARTS



Tube layouts of top and bottom of chassis show sync and sound paths, tube keyways, fuses, rectifiers, etc. Helps you trace signal path to localize the trouble.

TUBE FAILURE CHECK CHART

POWER SUPPLY FAILURE
No raster, no sound Fuse Wire (LV Power), Fuse ...

SWEEP FAILURE
No raster, has sound Fuse (Sweep), V8, V9, V10, ...
No vertical deflection V7
Poor vert. linearity or foldover V7
Poor horiz. linearity or foldover ...
Narrow picture V8, ...

Points out probable causes of common troubles, tells you which tubes to replace to correct the symptom. Also shows series-string filament connections.

DISASSEMBLY INSTRUCTIONS

TV CHASSIS REMOVAL

1. Remove 10 push-on type knobs
2. Remove 12 wood screws in...

You get step-by-step procedure for removing chassis, CRT, speakers, knobs, hidden bolts and connections. Avoids parts damage—saves valuable time.

HORIZONTAL SWEEP CIRCUIT ADJUSTMENTS

Set the Horizontal Hold Control to... Horizontal Frequency Slug (B1) ... tally. Keep turning B1 in the ... out of sync. Reverse t...

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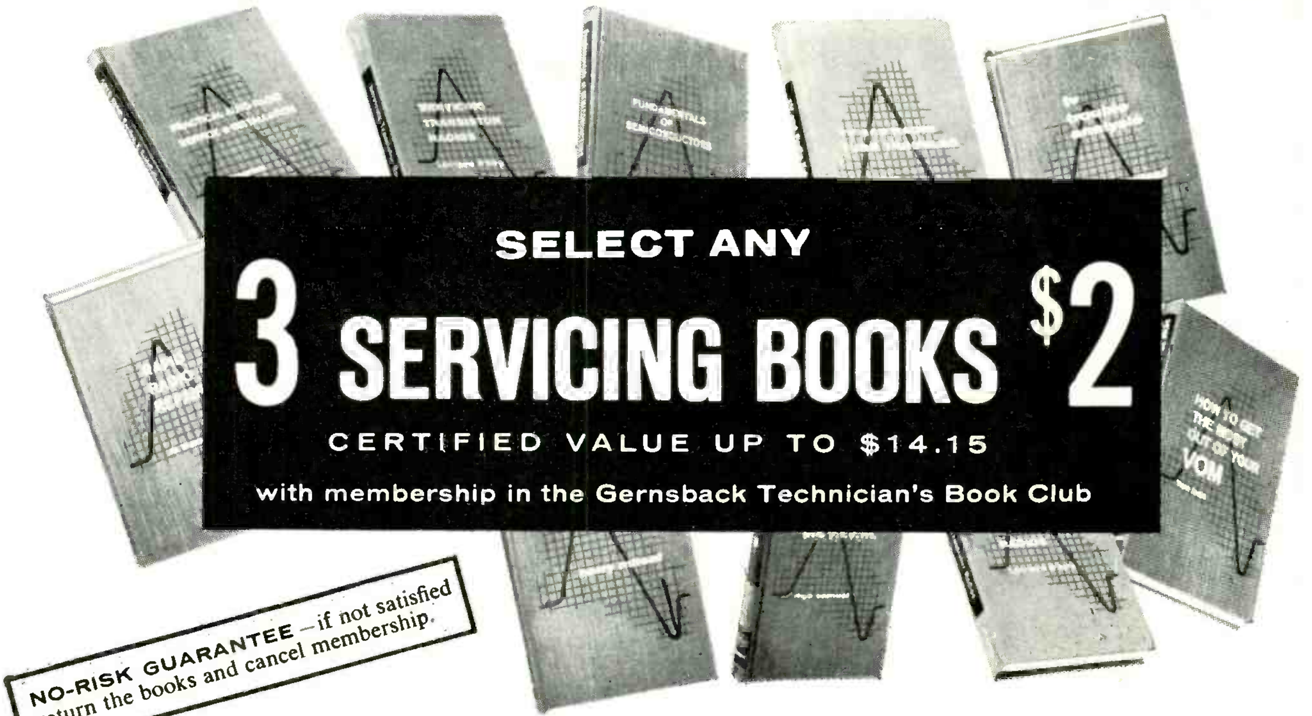

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FINE POINTS OF FILTER THEORY

Dear Editor:

Apparently in his week of intensive work on stereo (see "Does FM Stereo Follow Its Own Theory," RADIO-ELECTRONICS, October 1961, page 59), Mr. Crowhurst missed some of the fine points of modern filter theory. It is true that a linear phase (the designation "constant delay" is more descriptive) high-pass filter can be realized only with an infinitely long network. However, as Bode and Dietzold pointed out in the Bell System *Technical Journal* for April 1935, it is possible to approximate the constant-delay characteristic to an arbitrarily high frequency with arbitrary accuracy by using a suitably large number of critical frequencies. No filter, high pass or otherwise, has ever had a phase "advance." Furthermore, low- and high-pass Bode filters are not complementary networks. It is true that minimum-phase high-pass filters have a decreasing frequency, but a fundamental characteristic of the class of networks investigated by Bode is that they are not minimum phase. In any case, it is possible to synthesize the bandpass filter with other combinations, i.e., two low-pass filters of equal delay but differing cutoff frequencies. In fact, a direct design approach which includes no assumptions about percentage bandwidth was demonstrated by Bode. Thus the comments of Mr. Crowhurst on high-pass filters and low passband pass analogies are at best irrelevant.

ROBERT G. HUENEMANN
Zenith Radio Corp.
Chicago, Ill.

Dear Editor:

Mr. Huenemann's letter raises several points which would require quite an engineering treatise to answer in full. I must content myself with answering those things which are more basic to the concepts involved.

Agreed that *constant delay* is more descriptive than *linear phase;* I also realize a signal cannot arrive at the output of a filter before it is presented at the input. This does not preclude the possibility—in fact the inherent nature of high-pass filters—of producing *phase* advance, which is a different thing.

A transmission analogy will illustrate this distinction: A coax cable has a high-frequency cutoff, determined by its physical constants. On the other hand, a waveguide has a low cutoff

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City_______________Zone_____State_______________ frequency and is thus comparable to a high-pass filter.

Three velocities are associated with a waveguide—group velocity, *phase* velocity and free transmission velocity. The last-named is the velocity of propagation of electromagnetic waves in the medium contained in the guide—normally the velocity of light. Group velocity is lower and phase velocity *higher* than free transmission velocity.

A given bunch of energy transmitted by the frequency in question in this waveguide is delayed, but the phase of waves transmitting the energy is progressively advanced, relative to transmission in free space. Waveguide lenses utilize this fact. The waves do not leave before they enter, but they do appear to travel faster than their *normal* velocity.

A similar thing happens in a high-pass filter and equivalent actions. Take a simple crossover. If an input sine wave of crossover frequency is divided across an inductance and a capacitance with resistance terminations, the voltage across the capacitance is behind the input voltage in phase, while that across the inductance is correspondingly advanced. Successively more complicated crossovers increase the amount of delay *and advance* in complementary fashion.

We are quite aware of the varied approaches to filter design. We have also examined many multiplex adapter circuits, using filters which, from the values shown, were obviously designed from classic transmission-line-derived data which assume matching termination at input and output. These filters are then fed from a cathode follower and loaded with almost open circuit, which completely invalidates their predicted performance, in both magnitude *and phase*. Small wonder they don't perform to spec!

May I emphasize what the original article pointed out—the Bode filter in the Zenith publication is a *low-pass* configuration, not bandpass. My criticism was directed at high-pass and bandpass types, within practically realizable possibilities. The simple low-pass configurations come close to phase-linear, and the Zenith circuit, critically adjusted, should come very close indeed.

NORMAN H. CROWHURST
Audio Design Service
New York, N. Y.

ABOUT THAT MIXER

Dear Editor:

I wish to protest an absurdity in an article by James A. Fred, "Spice-Can Audio Mixer," which appeared in the February issue.

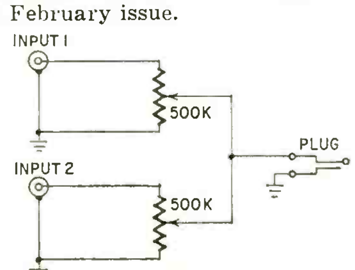

Fig.1

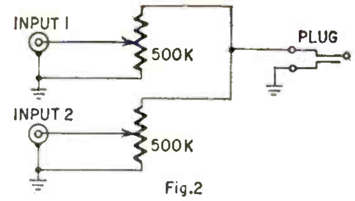

Fig.2

The circuit he shows (Fig. 1) does not work! When the wiper on either pot is turned to its grounded position, the output plug is shorted to ground, effectively killing the other channel too.

I propose an alternate circuit which I have tested, and which does work (Fig. 2). ROBERT SNAPP
Berea, Ohio

[When reading Mr. Fred's article you will notice he specifies the operating conditions. He uses the device to mix two signals and to increase the level of one of them when necessary. He never uses the mixer to cut off any one channel completely. Your circuit (Fig. 2), while effective, has disadvantages too. Let's say you were feeding input 1 with a crystal phono cartridge. As you varied the mixer pot for this channel, you would vary the impedance the crystal cartridge sees and would, in turn, change its frequency characteristics. This is certainly undesirable. Perhaps the most effective yet simple mixer circuit is the one in Fig. 3. Here the input

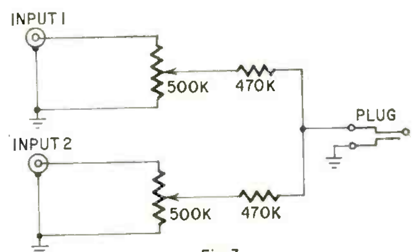

Fig.3

impedance is fixed, yet both channels are isolated. If you wanted to cut one channel off, you could without affecting the other.—*Editor*

FM ANTENNA STORY—THE VERY BEST

Dear Editor:

Edward M. Noll's article, "FM Antennas for Better Listening," February 1961, is one of the best I have seen on this subject. I would like to add some information.

In designing broad-band antennas, the center frequency *is not taken as the arithmetic mean of the two end frequencies, but as the geometric mean.* The arithmetic mean is computed by taking half the sum of the two end frequencies. The geometric mean frequency is found by taking the square root of the product of the two end frequencies. While the error here is slight, it is appreciable in other applications. Arithmetic mean frequency:

$$\frac{108 + 88}{2} = 98 \text{ mc}$$

Geometric mean frequency:

$$\sqrt{108 \times 88} = 97.5 \text{ mc}$$

WILLIAM F. DOHERTY
Sacramento, Calif.
END

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Tips for Technicians

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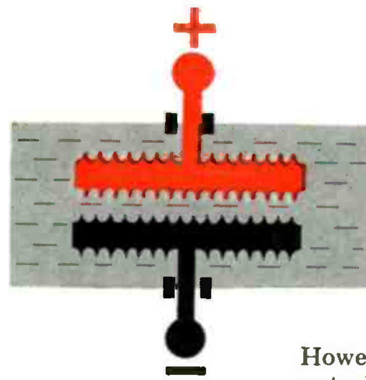
Why some filter capacitors develop hum... and some don't



Aluminum electrolytic capacitors are widely used as filters in DC Power Supplies. This is because of their large capacitance in relatively small size. All in all, they do an efficient job of reducing ripple (hum) to acceptable levels.

However, all electrolytic capacitors are not alike. This is often why some types seem to allow hum to rise to objectionable levels more quickly than do others. In order to understand why, we must investigate actual construction methods.

As you know, electrolytics are basically made by depositing a film of aluminum oxide on aluminum foil to form the positive anode. The oxide is the dielectric. A semi-liquid electrolyte surrounds the anode and is actually the negative cathode. In order to connect this semi-liquid cathode to a terminal, a second piece of aluminum foil is used. This is often *called* the cathode, but it is not. It is actually only the *cathodic connection*. (The preceding describes a "polarized" electrolytic capacitor.)

When high ripple currents are applied to polarized electrolytics, a thin oxide film forms on the so-called "cathode". It begins to assume the characteristics of a second anode. This in turn, has the same effect as placing two capacitors in series. Consequently, overall capacitance is reduced. Inevitably hum increases.

This action is especially noticeable in electrolytics which use plain foil as the "cathode". This is simply because the oxide builds up over a relatively small area.

Mallory avoids this problem by etching the "cathode" on electrolytics. As a result, oxide build-up is spread over a vastly increased area. Therefore, ripple currents are maintained at very low levels for very long time periods.

Of course etched "cathodes" cost a lot more to make. But you get them from Mallory at *no extra cost*. There's much more to the Mallory capacitor story, but we'll leave that to another TIP.

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On streets, subways and buses, in crowded offices, motion picture houses, theaters and all other places where humans come into close contact with each other, germs are constantly transferred from man to man—often with epidemic results.

Unfortunately, against this constant transference of disease-bearing organisms, man so far has had practically no defense. It is true that during epidemics some people have worn masks covering nose and mouth, but such masks have been practically worthless, because the germs penetrate the poorly designed gauze masks easily. Even the finest porous porcelain filters would be useless, because, first, they would not allow a human to breathe, and, second, many micro-organisms of the virus type pass readily through even porcelain.

One of the most dangerous micro-organisms that plague mankind today is the gram-positive bacterium—the *staphylococcus*, the cause of pus formation throughout the body, in boils, abscesses, etc. These germs are found in various internal human organs; they cling to the skin, to bedsheets, beds, walls, and are widespread in practically all hospitals. So far few chemicals or medicines are potent enough to eradicate "staph" efficiently.

It would seem to us that so far science and medicine have attacked the problem from the wrong end. We try to kill off the micro-organisms with medicines, when we should try to attack them in their habitat—*the air in which most of them live.*

Many years ago, when the present writer was a manufacturer of storage batteries, he noted that few of the workers ever were affected by colds or respiratory diseases. The reasons for this are simple. When storage batteries are "formed," the negative plates, after many charges and discharges, change inside and out into sponge lead. At the same time, the positive plate and its interstices turn into peroxide of lead. During the "forming" stage, all plates are immersed in dilute sulphuric acid. Routinely during the forming stage, the charging of the storage batteries goes on for many days, day and night.

When the workers come on in the morning, a thick fog or mist permeates the entire charging room—unless ventilators dissipate the sulphuric acid mist during the night. This mist is not harmful to humans who breathe it, often for years without discomfort. On the other hand, it is invigorating, and evidently serves as a most efficient bactericide, particularly against respiratory germs. Storage battery manufacturers have long known these facts, but as far as we know, the idea of using sulphuric acid mist for therapeutic purposes has not been exploited. We have given this example only to show what can be done in this direction.

In our opinion, *all* indoor spaces where humans congregate should, as soon as possible, be equipped with well-engineered and medically researched electronic germ eradicators. Hospitals, subways, buses, offices, churches, theaters of every kind can in time be made reasonably germ-proof.

The first onslaught should be made as quickly as possible on that mass distributor of germs—our modern air conditioner. This new health menace admittedly *cools*, but it also stirs up all the germ-laden air in a closed room so efficiently that the micro-organisms soon find a good home in human noses and lungs. Probably most of the so-called summer colds can be traced directly to the efficient churning of germ-laden air onto healthy humans, who soon become infected. It should be noted, too, that most window air conditioners *merely recirculate the stale air*—no fresh air is admitted. (Central air-conditioning systems do add fresh air, routinely, at present.) Admittedly, the air conditioner extracts moisture and filters dust from the air, BUT THE GERMS *are never filtered out; they stay right in the room.*

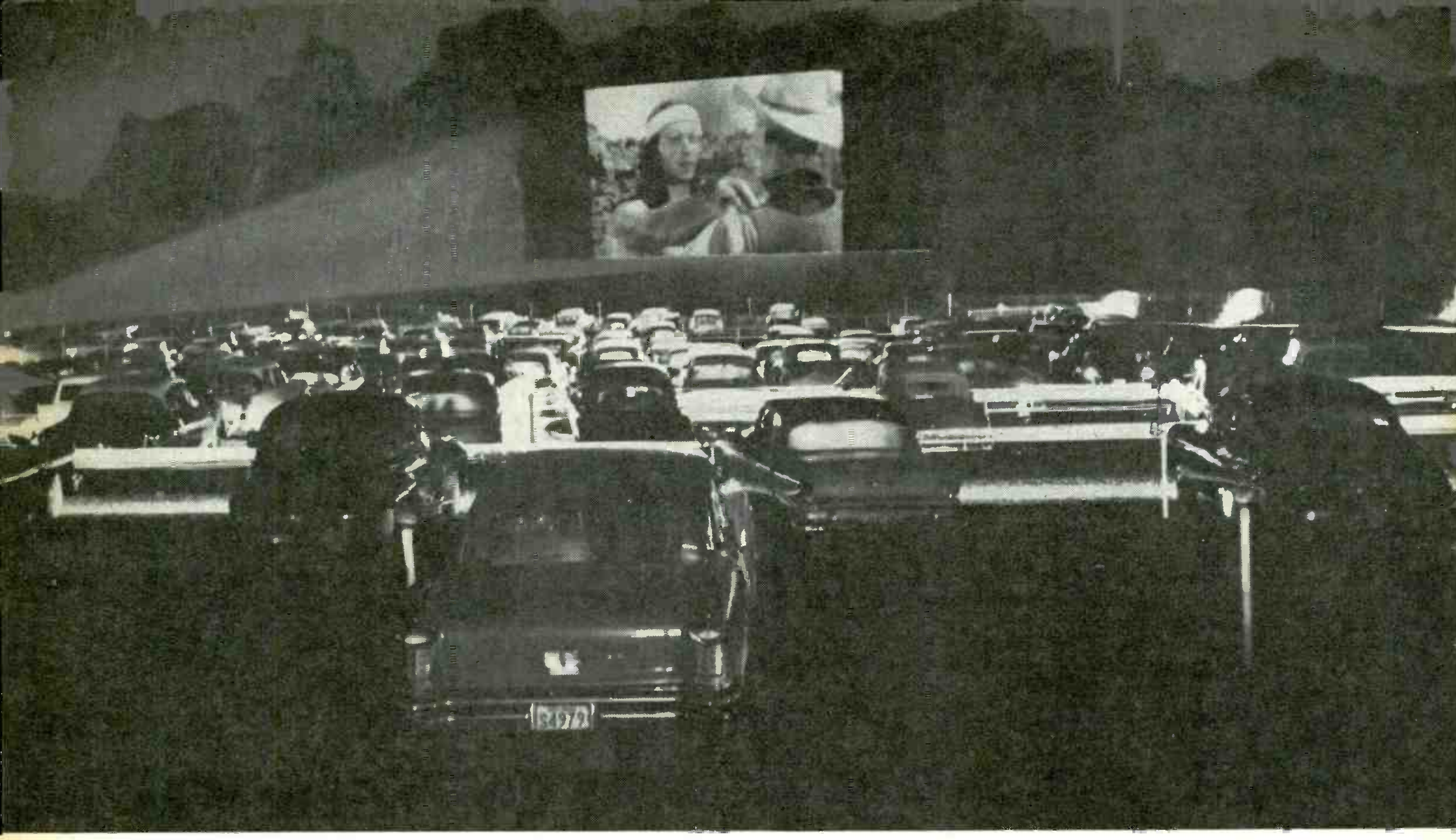
Rest assured that future air-conditioner units will be equipped with efficient electronic bactericides. Indeed, we can readily foresee a boom of such machines in the near future because of the great need for them. It should be noted that, for efficient health purposes, *all* types of air conditioners should operate in all seasons, not only during the hot spells. Thus, during the cool seasons, the electronic germ-eradicator air conditioner should run, too—just the fan, not the cooling part.

Curiously enough, we have all—or most—of the means today to create efficient electronic germ killers. Let us mention only one.

Draw all air ejected into the room from the air conditioner through a special chamber which has a number of high-voltage *quenched* air gaps. The high heat and high voltage (50,000 to 100,000 volts) will kill any germ life. Of interest here is the fact that a high-energy quenched spark gap also generates ozone, which then would be discharged into the atmosphere. The percentage of ozone liberated by the spark gaps should be sufficiently low that it would be harmless to man. This system can be elaborated into many directions.

In the future, new *plasma* electronic applications can serve the same purpose, so can mass ionic discharge applications.

Once our medico-electronic engineers gain sufficient experience in the new art, much of our present-day germ infestation will be a thing of the past. —*H.G.*



THE DRIVE-IN —electronic maze

Five miles of wiring plus a heap of amplifiers and speakers make up the audio system

By DANIEL M. COSTIGAN

Fig. 1—Audio corner of a drive-in's projection booth.

A DRIVE-IN MOVIE THEATER IS THE SITE of a rather unique audio installation. In place of the relatively few centrally or strategically located speakers at the business end of the conventional PA system, the drive-in dissects its audience into hundreds of isolated segments and provides each with its own individually controllable speaker. In a sense, it's a PA system that speaks privately to its public.

The number of speaker positions in a drive-in theater ranges from about 150 in a small installation to 2,000 or more in a large one. With the introduction, in the 1950's, of multi-channel sound, use of dual speakers brought the total to a possible 4,000 in a typical large-size drive-in featuring stereophonic sound. The average drive-in accommodates from 800 to 1,000 cars.

Ever wonder how you'd go about connecting 1,000 speakers to a single amplifier? Let's take a look at how this impedance-matching feat is handled.

Amplifiers

A visit to the projection booths of three or four drive-in theaters is likely to reveal a wide range of amplifier setups. The differences may be due to variations in car capacity, make of equipment, or age of installation—or a combination of all these factors. In some installations, a single amplifier feeds the theater's entire speaker "field". In others, as many as a dozen separate amplifiers may be used.

Besides names like Motiograph, Simplex and Ballantyne (specialists in theater equipment), the visitor to the drive-in booth is just as likely to find sound equipment bearing names more familiar to hi-fi fans, such as Altec, RCA and Bogen.

Fig. 1 shows the sound section of a Simplex (National Theatre Supply Co.) installation at a 1,250-car drive-in. The four stacked amplifiers are Bogen 100-watters, designed specially for theater use. Three of them each feed one-third —about 416—of the drive-in's total speakers, while the fourth stands by, preheated, as a spare. In this particular installation, the spare is switched in by turning a knob to the number representing the amplifier that's in trouble.

As a rule, there are four speakers to every watt of amplifier output. The accepted standard is 1/6 to ¼ watt per speaker.

Another Simplex installation, this one in a 900-car drive-in, is shown in Fig. 2. Here a driver amplifier is used in combination with a single Altec A-287 power amplifier (now obsolete) to feed all 900 speakers. The driver amplifier delivers 15 watts and the power amplifier 250 watts.

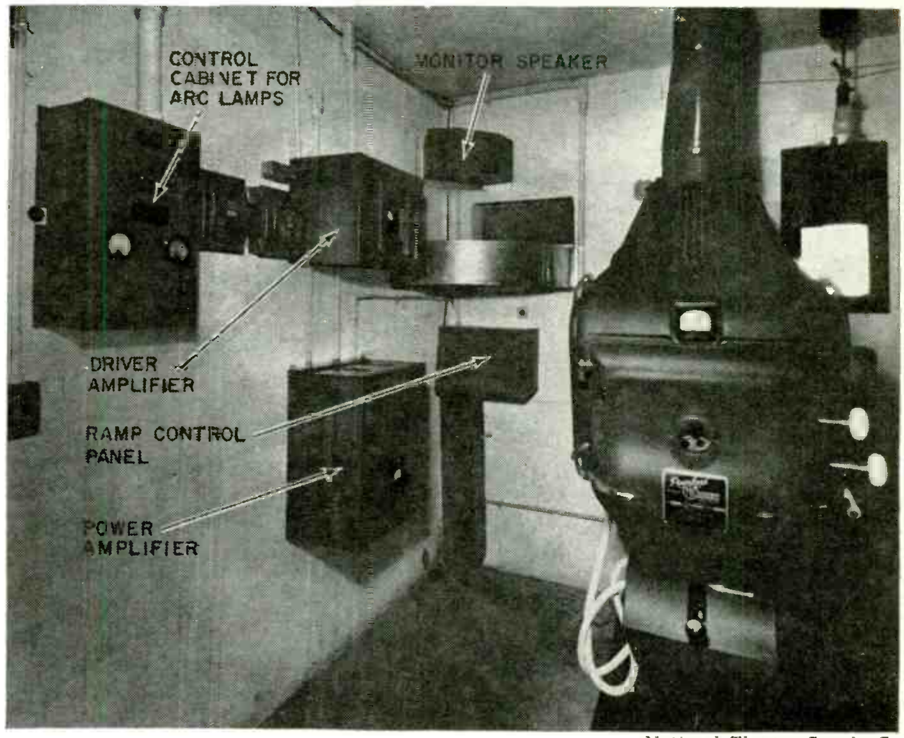
The Altec 260A (Fig. 3), one of the latest designs in high-power PA and industrial sound system amplifiers, is especially well adapted for use in medium to large drive-ins. By itself, this seven-tube 260-watter can feed approximately 1,000 speakers. A typical installation might use three such amplifiers—two operating and one spare.

The 260A's output stage is shown in Fig. 4. The pair of 813 heavy-duty pentodes, operating in class-AB1 push-pull, can deliver 260 watts continuously with 2% or lower distortion over a frequency range of 45 to 15,000 cycles. The 813's are driven by two 6AU6's, also wired in push-pull.

R1 and R2 are screwdriver bias-adjustment pots to balance the 813's. S1 is a "tube-checking" selector switch. It allows the operator to check the condition of each amplifier tube while the unit is in operation.

Motiograph Inc. (Chicago) offers the drive-in operator a choice of two amplifying schemes. One consists of the necessary preamps, one or more driver amplifiers and one or more power amplifiers, available with either a 75- or 250-watt output. This system is recommended for medium to large drive-ins, accommodating 850 or more cars.

The alternate scheme, recommended for smaller installations, consists of the necessary preamps and anywhere from 4 to 10 or more 25-watt power amplifiers. An 800-car drive-in employing this system would need 8 separate power amplifiers and probably 1 or 2 spares.



National Theatre Supply Co.

Fig. 2—Drive-in installation using only one power amplifier. Large object on right is one of booth's two projectors.

A typical RCA installation uses 70-watt power amplifiers in drive-ins of up to 1,120-car capacity, and 150 watters in larger installations. One to four 70-watt amplifiers, according to car capacity, are housed in wall-mounted cabinets. Each cabinet accommodates two amplifiers. The 150-watters are rack-mounted with a tip-out arrangement for easy servicing.

Speakers

The standard speaker is a 4-inch PM unit with a 3.2- or 4-ohm voice coil. Except for its slightly more rugged moistureproof cone, it differs from the conventional table radio speaker only in the way it's mounted in its strong outer casing. The speaker unit must be lightweight, yet completely weatherproof, vandalproof and capable of being dropped or even run over by a car without having its voice coil knocked out of line.

RCA now produces a drive-in speaker with a plastic Impac case.

The Ballantyne Co. (Omaha, Neb.) makes a double-cone speaker. The outer cone, according to the manufacturer, not only protects the inner one (the driven cone), but improves the speaker's bass response at the same time.

The volume control, an integral

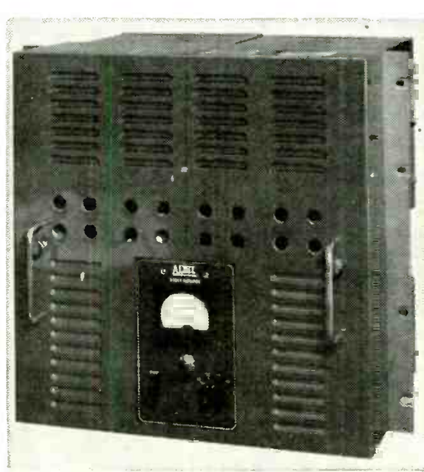


Fig. 3—Altec Lansing 260A amplifier, a popular unit in medium to large drive-ins.

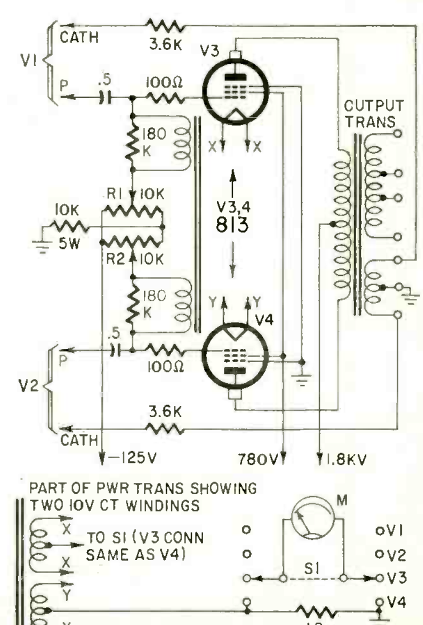


Fig. 4 — Output stage of Altec 260A.

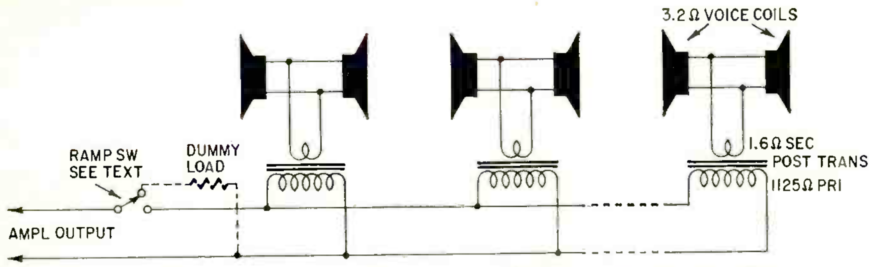


Fig. 5—Basic drive-in speaker circuit. Volume controls not shown.

part of most drive-in in-car speakers, is generally an L-pad, specially designed to withstand humidity and temperature extremes. At full volume, the speaker talks a bit louder—and with slightly better fidelity—than a small radio being played at normal room volume.

In a typical installation, speakers are not connected direct to the amplifier output. In the head of each speaker post is an intermediate transformer which couples the post's two speakers to the main output line from the power amplifier. In Simplex installations, the post transformer has a 1,125-ohm primary winding and a 1.6-ohm secondary to which the two speakers are paralleled. In a 1,000-car drive-in with one operating amplifier, the primaries of all 500 post transformers are connected in parallel across the amplifier output, presenting it with a 2.25-ohm load. Fig. 5 shows the basic speaker circuit. (In some multiple-amplifier systems the post transformer is eliminated and each amplifier feeds a small segment of the speaker field directly.)

The 5 miles, or more, of No. 14 underground cabling required in a 1,000-car drive-in has a negligible effect on the load impedance. The added resistance—about 75 ohms—is distributed equally among the circuit's 500 parallel branches, increasing the impedance of each by slightly more than 1/10 ohm.

Auxiliary equipment

In addition to amplifiers and speakers, the drive-in audio scheme includes certain auxiliary apparatus necessary to insure a smooth-running show. Most of it is standard to all movie theaters, drive-in and conventional.

A preamp, for example, is generally required to raise the signal from the projector's sound head to a reasonable level before it is fed to the power amplifier. As a rule, the preamp is kept as close to the projectors as possible—generally on the front wall of the booth, near an observation port. Usually, separate preamps are provided for optical and magnetic sound heads.

Equally standard are the record player that provides music during intermissions (generally an inexpensive changer) and the monitor speaker unit (Fig. 2), which, in some installations, has provision for testing the outputs of individual amplifiers and the lines going out to the speaker field.

Perhaps the one piece of apparatus peculiar to the drive-in is the ramp control panel—a panel of switches through which the power amplifier output is split up to allow the speakers of each of the theater's parking ramps, or portions of each ramp, to be separately controlled. In case of trouble in a particular group of speakers, only the affected section need be taken out of service, leaving the remainder of the theater in operation.

Usually the switching circuit is arranged so that, when a switch is in the "off" position, a dummy load is substituted for the portion of the speaker field affected, thus leaving the total load impedance unaltered.

The Ballantyne MX-28A ramp control panel divides the speaker field into 20 sections. Each switch has three positions—OFF, TEST and ON. The TEST position allows each section of speakers to be monitored—while the show is in progress—through phones or the booth's monitor speaker to make sure the amplifier output is getting to them unimpaired.

Typical ramp control panels are visible in Figs. 1 and 2. Ramp switching sometimes is not employed in multiple-amplifier installations.

Servicing

Most drive-ins have contracts with specialized servicing organizations (RCA Service Co. and Altec's service division are two examples) for maintenance of their sound equipment. These organizations service drive-ins, conventional theaters and other large public-address and music installations. Besides being available for emergency calls, their services generally include a monthly checkup of all equipment in an installation and whatever preventive maintenance may be deemed necessary (replacement of weak tubes, etc.).

While it's possible that some smaller drive-ins may find it practical to do business with an independent local technician—the drive-in is under no obligation to sign a service contract with any specific organization—a more certain bet for the technician aspiring to do commercial PA work would be to apply at one of the service outfits and state his qualifications. I have been told that, although graduate engineers are preferred, there are openings from time to time for the technician genuinely interested in this sort of work and able to meet the qualifications.

In any event, it's a facet of electronics servicing worth looking into—especially for the "individualist" service technician in search of a specialty. The drive-in is a firmly established institution that promises to be a part of the American roadside scene for some time to come. END

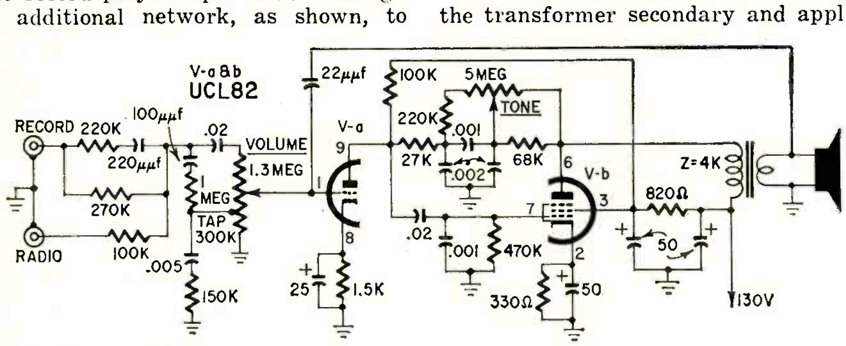
AUDIO— simple but GOOD

THE DIAGRAM SHOWS THE AUDIO STAGES of a Grandin radio receiver. It is an economy model that uses a single triode-pentode.

The volume control is tapped 300,000 ohms above ground. Two circuits connected to this tap produce some bass and treble boost at low listening levels. The record player input is fed through an additional network, as shown, to compensate for recording characteristics.

A feedback chain around the output pentode includes the tone control. When the arm of the tone control potentiometer is moved toward the plate of the pentode, there is some treble cut because of the shunt capacitance between plate and ground. When the arm is moved the other way, the shunt capacitances form a sort of low-pass filter so feedback affects only the low-frequency bass.

Additional feedback is taken from the transformer secondary and applied to the triode grid, introducing a fixed amount of feedback for the high frequencies. The audio system feeds a 4 x 6-inch elliptical speaker.—*A. V. J. Martin*



COVER STORY

Novel features of the Knight 50-watt all-transistor stereo amplifier include special temperature control, single-ended push-pull and electronic filtering

new directions in hi-fi amplifiers

Specifications

Input sensitivities for full rated output: 2 mv for tape head; 2.5 mv for magnetic phono; 300 mv for ceramic phono and 0.5 volt for both tuner and auxiliary inputs.

IHFM music power: better than 50 watts (25 watts per channel) into 4-ohm loads; continuous sine wave power 36 watts (18 watts per channel) at any frequency.

Frequency response: ±1 db from 20 cycles to 20 kc at full power.

Harmonic distortion less than 1% at rated output.

Cross-talk better than 40 db.

Hum level at tape head and phono inputs better than 65 db below rated output.

IM measures less than 2.0% at 15 watts per channel using 60-cycle and 7-kc signals mixed 4:1.

Output impedance approximately 2.0 ohms per channel.

By NORMAN KRAMER*

HIGH-FIDELITY MANUFACTURERS HAVE been slow to take advantage of transistor circuits. Yet, several important factors favor transistors.

One is that low-frequency response is possible practically to dc, with negligible phase shift. Also, the low-impedance circuits make extremely low hum and noise levels a reality. Finally, because of the low-impedance characteristics of transistors, output transformerless amplifiers driving standard impedance high-fidelity speakers become practical. Eliminating the output transformer, one of the most serious limiting factors in amplifier performance, has long been the hope of the hi-fi design engineer.

The output circuit

We built a complete 50-watt stereo amplifier that has no tubes in it at all. We started design with the output circuit. Conventional class-B operation requires both driver and output transformer, so it was to be avoided. As the amplifier must be compatible with existing hi-fi speakers, designs that depend on center-tapped voice coils were ruled out too. Capacitor coupling to the voice coil was also ruled out, since an extremely large coupling capacitor would be needed if the amplifier were to be flat down to 20 cycles. This left bridge or half-bridge operation.

We decided to keep the driver transformer as its effective gain would be needed. The driver circuit was set up for a transformer efficiency of less than 60% and delivers more than enough power to drive the output to clipping before adding feedback to keep distortion to a minimum.

Fig. 1 shows the basic circuit of the single-ended push-pull output transformerless circuit we use. Bias voltage for V1 is supplied by voltage divider R1 and R2 while bias voltage for V2 is supplied by voltage divider R3 and R4. The bias causes enough quiescent collector current to avoid crossover distortion. R5 and R6 stabilize the circuit and make the transistors fairly independent of their individual characteristics. When a signal is fed to the amplifier, equal and out-of-phase voltages are fed from the driver-transformer secondaries to the base of each transistor. Thus each transistor is driven to conduction on alternate half cycles of the signal.

Both transistors are in common-emitter circuits and though they are in series across the split power supply they are in parallel across the single-ended load. As far as the load is concerned, this means that the load impedance to match the transistors is only a

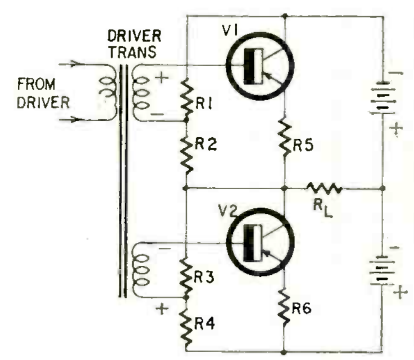
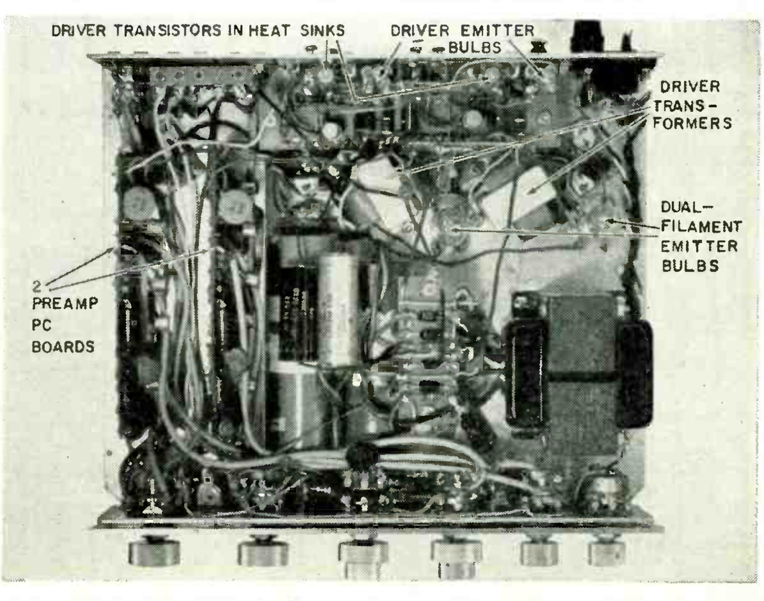


Fig. 1—Basic circuit of single-ended push-pull OTL amplifier.



Inside the cabinet. The little bulbs used to stabilize the amplifier transistors are pointed out.

*Chief engineer, Hi-Fi Div., Allied Radio Inc.

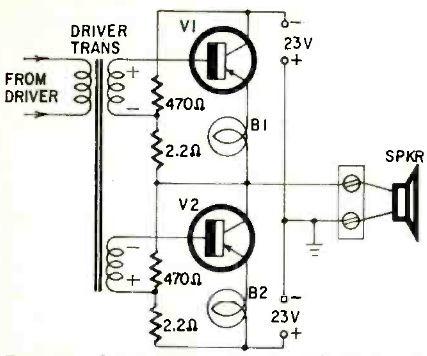


Fig. 2—Output circuit modified for dc stabilization with tungsten filament bulbs.

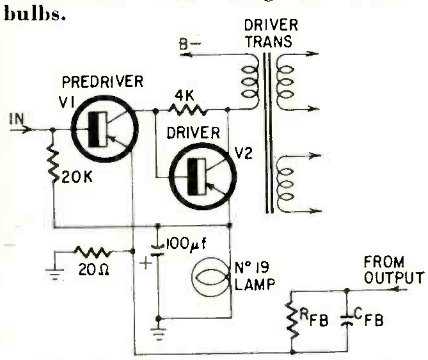


Fig. 3—Driver–predriver circuit.

fraction of that required by a conventional push-pull circuit.

Fig. 1 shows the transistors in series across the split power supply. With reasonably balanced transistors and reasonably similar supply voltages, the bridge is balanced and no current can flow in load R_L. If an input signal causes either transistor to conduct more than the other, the bridge becomes unbalanced and current flows through the load. Sine-wave signals fed from the driver will reach the transistors 180° out of phase and cause an amplified sine-wave signal across R_L. If the transistors are operated class A or B, no dc will flow through R_L. If R_L is replaced with a speaker voice coil, the incoming signal will be reproduced faithfully. And since no dc flows through it, no distortion can be added from this source.

If this approach were tried in conventional push-pull circuitry, the voice coil would have to be center-tapped and only half of the voice coil would be used for each half cycle of the output signal. Naturally, this would reduce circuit efficiency. As far as ac is concerned, the transistors are connected in parallel across the two-terminal or single-ended load.

Thermal runaway

One of the main design considerations in high-power transistor circuits is that of limitations imposed by temperature. At high temperatures, transistor current must be controlled to prevent thermal runaway. Adequate heat-sinking and stabilizing the dc operating point will control transistor current and prevent any rapid rise in junction dissipation as temperature increases.

We use positive temperature coefficient resistors to stabilize the common-emitter circuit. These resistors replace R5 and R6 of Fig. 1. They are actually little light bulbs. We found the resistance characteristic of these tungsten filament bulbs ideally suited for this application (Fig. 2). We used bulbs similar to a 6-volt automotive taillight. They not only give the necessary dc stabilization, but also protect the speaker—just like extremely quick-blow fuses. Furthermore, because of their high positive coefficient of resistance, they are highly sensitive to current differences and make the transistors self-balancing.

Because the most load current flows with a 4-ohm load and lower currents with 8- and 16-ohm loads, the bulbs limit 4-ohm power more than 16-ohm power. This tends to make the amplifier approach a constant-power device rather than a typical constant-voltage device.

Further protection against thermal runaway is in the heat-sinking of the power transistors. To assure that the heat sink can dissipate enough to prevent junction temperature buildup, the six power transistors are mounted directly to the .093-inch thick aluminum chassis. This gives a 300-square-inch surface for heat dissipation.

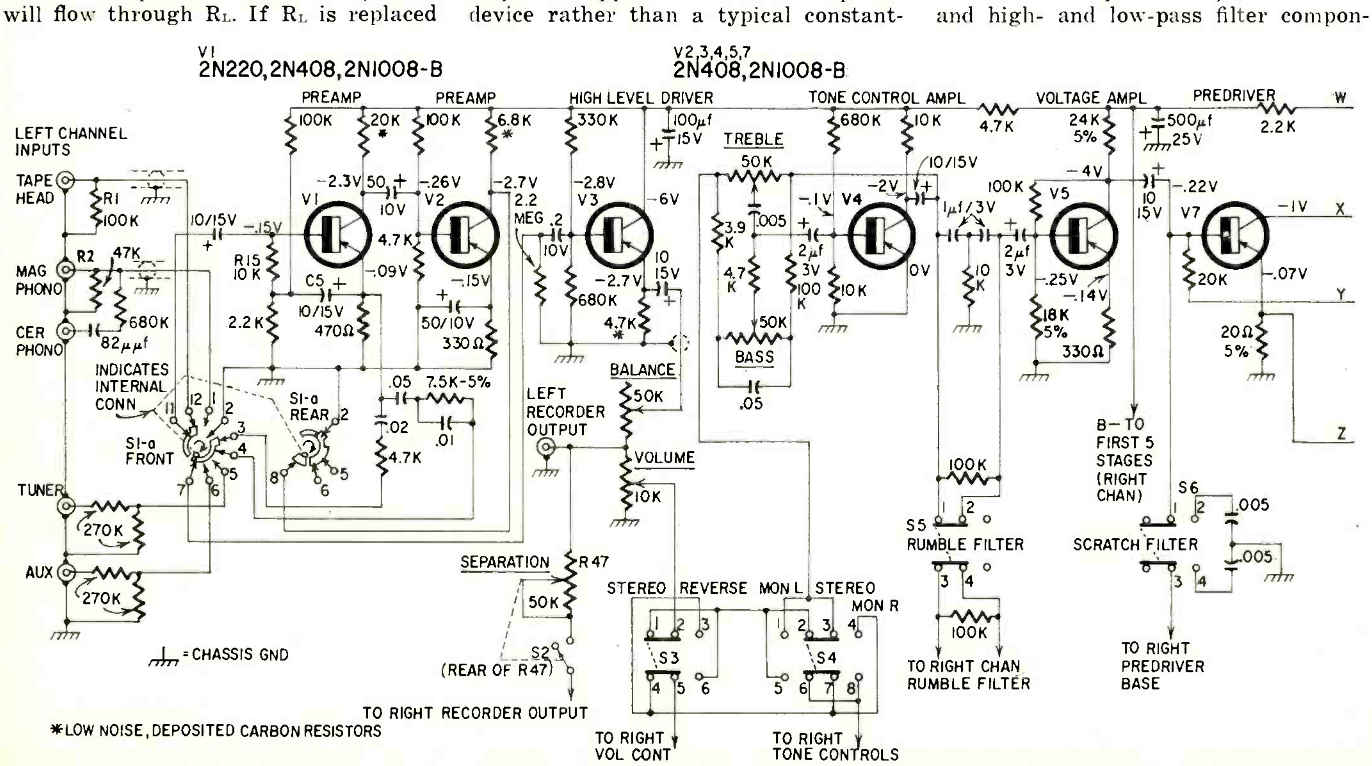
The driver-predriver circuit was chosen because it permitted good stability and transistor interchangeability. It also featured high gain and the high efficiency characteristics of class-A operation. Fig. 3 shows the circuit as it is used in the amplifier. The predriver is direct-coupled to the driver. This eliminates a large coupling capacitor and minimizes phase shift.

Thermal stability of V1 and V2 is largely determined by V1's collector junction temperature. V1's dissipation is low, and the main feedback loop is returned to its emitter through the feedback resistor and shunt capacitor.

Driving the medium-gain power transistors through a relatively low-efficiency driver transformer causes fairly high dissipation in V2. It is protected by dc stabilization (the bulb in its emitter circuit) and by heat-sink mounting to the chassis. The driver transformer was designed to be quite small, and even though V2 operates class A with its necessary dc unbalance, the high amount of negative feedback from the main loop and the local feedback of the 4,000-ohm resistor keep distortion low and extend the frequency response. The transformer secondaries are bifilar wound to avoid ringing in the crossover region.

About the preamp

The preamp section is built on two identical printed-circuit boards, each with all the equalization, tone control and high- and low-pass filter compon-



ents. There are five small-signal transistors on each board. The complete circuit of one of the amplifier channels is in Fig. 4. The circuit analysis that follows applies equally to both channels.

V1 and V2 make up the low-level preamp section. R2 is a 47,000-ohm resistor to match a magnetic pickup. These values can be changed to suit any particular stereo cartridge.

Feedback between V2's collector and V1's emitter gives V1 a high input impedance. The output voltage is converted to current in the feedback process, making the feedback current at the input proportional to the output voltage. S1 varies the components in the feedback path as different inputs are selected and provides either RIAA equalization for magnetic phono or NARTB equalization for tape head. C5 supplies local current feedback to each input stage, making R15 look considerably larger to the incoming signal.

Amplifier controls

Tuner and auxiliary inputs immediately following the preamp stages are switched into the circuit by S1. This switch grounds the preamp inputs and outputs as well as the other high-level input not being selected to eliminate any crosstalk between high- and low-level inputs. These high-level inputs are switched into V3, an emitter-follower stage which, though it offers no voltage gain, provides the necessary high input impedance for the signal while it offers low output impedance for driving the volume control, balance control and switching circuits.

Recorder outputs are taken from the high side of the volume control and are totally independent of all preamp controls other than S1. The balance control is a dual log-antilog potentiometer. It provides maximum balance range with minimum insertion loss. Separation control R47 has a switch on the back which allows for maximum separation in the off position (switch open). As the control is rotated, the switch closes and the signals of both channels are blended till there is no separation.

S3 is a stereo reverse switch for reversing channels. S4 is a rather unique three-position mode switch. In its center position either normal or reverse stereo can be obtained, depending on the position of S3. However, in the left position any program fed into a left-channel input goes to both outputs, while in the right position any right input is fed to both outputs. S5 is the rumble filter. It consists of two stages of R-C filtering for a rather steep cutoff below 50 cycles.

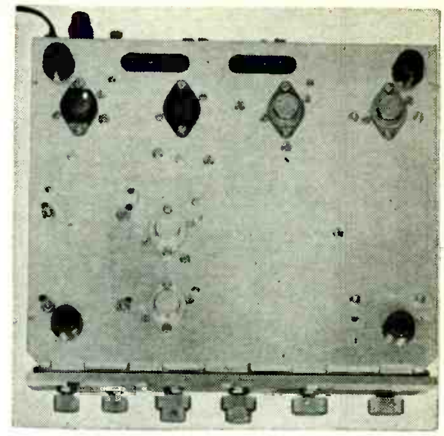
The tone controls can be adjusted individually for each channel, with the internal friction clutch. Being feedback types, they have a variable turnover instead of the more common variable slope characteristic. The low distortion of this type of circuit plus the negative feedback make it an ideal choice for high fidelity. Biasing resistors on V4 make it relatively independent of beta and provide for good transistor interchangeability. V5 is a voltage amplifier which couples the signal into the basic portion of the amplifier. It has local feedback through a 100,000-ohm resistor from collector to base as well as an unbypassed emitter resistor. S6 is the scratch filter. It provides a slow roll off to control excessive brilliance without removing the high frequencies entirely.

Low-noise resistors are used in all critical stages and the low-level transistors are selected for their low-noise characteristics.

Power supply

The power supply delivers both a positive and a negative 23 volts. The transformer is both shielded and copper-banded to minimize radiation. Each secondary feeds a full-wave silicon rectifier with a capacitive input filter.

Because of the rather large current needed for high power amplifier output, conventional filtering would be very costly, as extremely large capacitance would be needed for low ripple output.



Six power transistors are mounted under the chassis. It is extra thick and makes an excellent heat sink.

V14 and V15 provide electronic filtering and some regulation. These circuits have the effect of an extremely large output capacitance. The negative supply has less than 1-mv ac ripple at power supply currents corresponding to full power output from the amplifier. The effective output capacitance of the negative supply is greater than 120,000 μf, while that of the positive supply exceeds 25,000 μf.

A center-channel speaker can be connected between the hot terminals of each of the usual two stereo speakers with only a small sacrifice in total output power if the center speaker is either a 16- or 8-ohm unit. This speaker will yield a difference signal, approximately 10 db down, for typical stereo signals in the amplifier.

The burnout-proof quality of the amplifier can best be illustrated by the fact that the output terminals of both channels can be shorted without damaging the output transistors, thanks to the limiting action of the four emitter bulbs. These tungsten lamps are extremely sensitive to applied voltage. If a wiring error or component failure places the full 23-volt supply on the lamp, it will burn out in approximately 70 milliseconds, which is plenty of protection for both speaker and transistor. Under normal conditions, the lamps will last the life of the amplifier. END

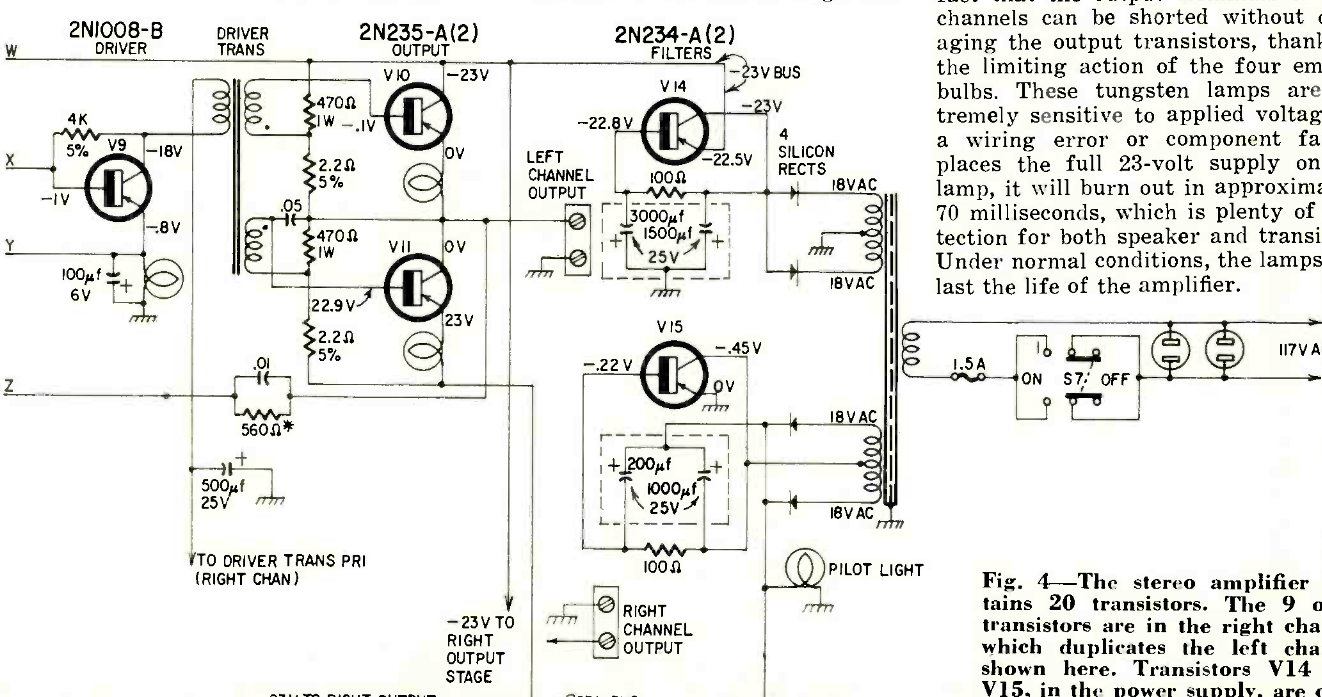
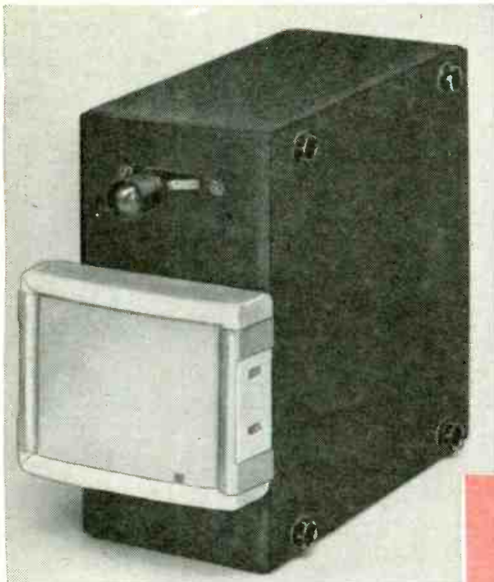
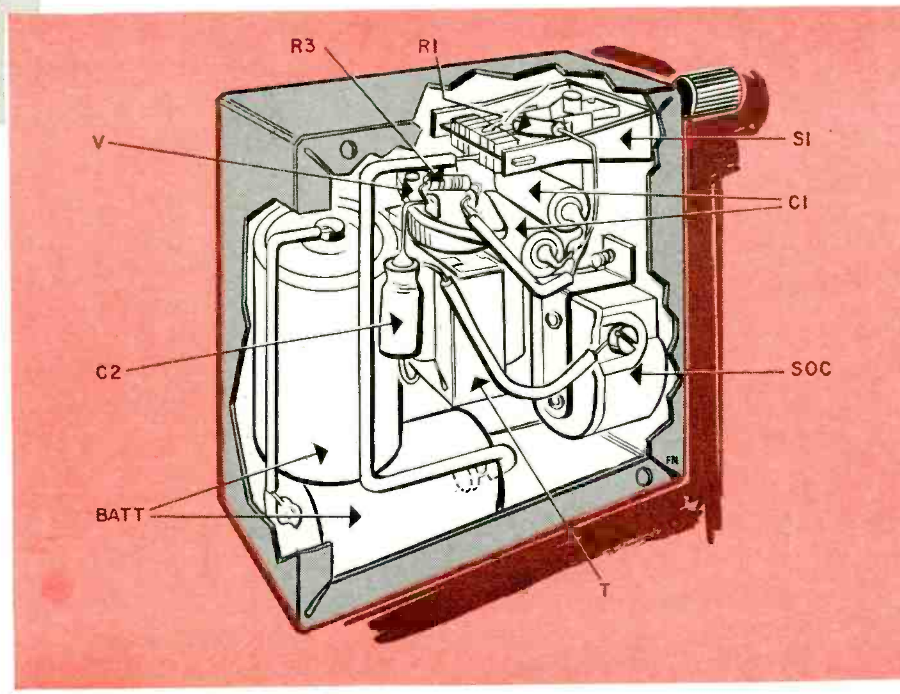


Fig. 4—The stereo amplifier contains 20 transistors. The 9 other transistors are in the right channel which duplicates the left channel shown here. Transistors V14 and V15, in the power supply, are common to both channels.



Battery-Powered Electroluminescent Emergency Lamp

runs 24 hours on two D-cells



Pictorial diagram shows parts layout.

By REGINALD W. NEALE

HERE IS A NOVEL PORTABLE LAMP THAT uses the light source of the future: electroluminescence. First available commercially in the early 1950's, the use of electroluminescent lamps (EL) has been growing steadily.

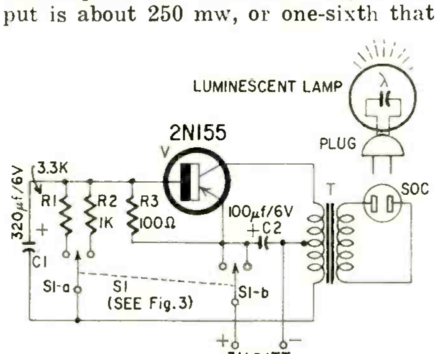
Like a capacitor, an EL lamp has two conductive layers separated by a dielectric. One of the conductive layers is transparent. Thousands of tiny particles of phosphor are embedded in the dielectric material. When an alternating voltage is applied to the two conductive layers, the phosphor particles absorb some of the energy and convert it to light. The amount and color of the light depends on the voltage and frequency of the power source.

The potential efficiency of an EL lamp is greater than that of an incandescent or fluorescent lamp. The light-emitting surface can be manufactured in large sizes and complex shapes. Because there is no filament to burn out, the life expectancy of an EL lamp is measured in years.

This combination of advantages makes EL lamps useful as lighted numerals on clock faces and instrument dials; as highway signs, house numbers, light switches and telephone dials which glow softly, and, in combination with arrays of photoconductive cells, as logic-circuit elements.

The portable nightlight described here uses an EL lamp available at most hardware and department stores. While it does not produce as much light as a conventional flashlight, it gives enough light to read a newspaper, check on the children at 1:00 am, change a tire or replace a fuse.

The circuit is essentially a low-power inverter operating at about 800 cycles (Fig. 1). A transformer matches the impedance of the transistor oscillator to that of the lamp at the operating frequency. The inverter lights the lamp brighter and more efficiently than ordinary household current. It will also flash the lamp repetitively at a high enough brightness level to be useful as a nighttime warning signal. Power consumption for continuous light output is about 250 mw, or one-sixth that of an ordinary flashlight.



R1—3,300 ohms, ½ watt
R2—1,000 ohms, ½ watt
R3—100 ohms, ½ watt
C1—320 μf, 6 volts, electrolytic
C2—100 μf, 6 volts, electrolytic
BATT—3 volts (two D-cells in series)
S1—4-pole double-throw switch, center off (Lafayette SW-20 or equivalent) only 2 poles are used
SOC—117-volt female socket
T—6V6 audio output transformer, tapped as explained in text
V—2N155 or equivalent
Luminescent lamp, see text
Caes, 4 x 4 x 2 inches
Miscellaneous hardware

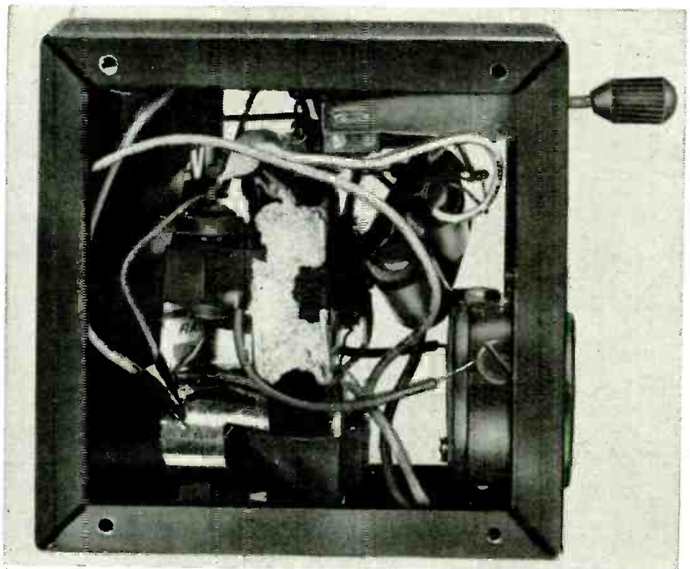
Fig. 1—Circuit of the portable lamp is rather simple.

Two companies market EL lamps which work well with this device. Sylvania Electric's Panelescent lamp provides a bluish-green light, with a battery drain of 70 ma. General Electric's EL lamp has slightly less lighted area but produces a brilliant green light with a battery drain of 75 ma. G-E's Miniature Lamp Dept. can supply, on special order, unmounted

BENCH TESTED

Unit worked well. Provides enough light in a dark room to find your way around. If held close to a printed page, you can read with ease. However, no long-range beam is produced. You can't illuminate a picture on a wall at the opposite end of the room.

Make sure all components are securely fastened in place. Unit we received had an intermittent short. Once located and insulated, it caused no further trouble. Again, careful construction will eliminate the possibility of such faults.



A peek inside the case. Note the liberal use of electrical tape to insulate components from each other.

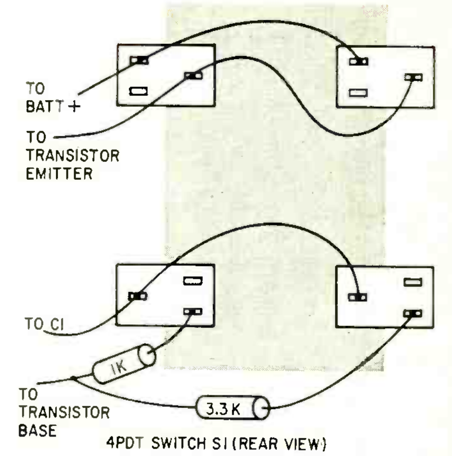


Fig. 3—Details of switch wiring.

lamps of this size in green, blue, yellow or white.

How to build it

Construction is simple. The switch and electrical outlet fasten to the case. The other components are taped together with electrical tape and soldered in place. Layout and lead dress are not critical.

Begin with the transformer. Almost any audio output transformer will operate in this circuit but, for maximum efficiency, use the type designed to match a 6V6 to a 3.2-ohm speaker. The common 5-watt type with 2-inch mounting centers is best. The transformer in my unit was salvaged from the audio output stage of a discarded TV chassis. No rewinding is necessary, but a tap must be added to the low-impedance winding.

Strip the paper insulation from the side of the transformer where the heavy leads come out, exposing the secondary winding. Make the tap on the outside layer, on the beginning turn of wire in that layer (Fig. 2).

Use electrical tape to fasten the transformer, transistor and one D-cell together. Then tape the other cell in place and wire the two cells in series. Select the outside lead of the transformer's tapped winding and solder it to the transistor's collector. Trim the inside lead short and connect it to the negative side of C1. The unit will not operate properly if the inside and outside leads of the tapped winding are accidentally interchanged.

Wire the switch as shown in Fig. 3. Leave 1¼-inch leads on both resistors, and 3-inch leads on the switch terminals.

Cut holes in the case for the switch and outlet. Be sure to mount them far enough apart to prevent the lamp from interfering with the switch action when it is plugged into the outlet.

Final assembly

Slide the transformer and battery subassembly partially into the case and complete all wiring. A ¼-inch-thick foam-rubber pad cemented to the center of each cover will help keep the subassembly in place.

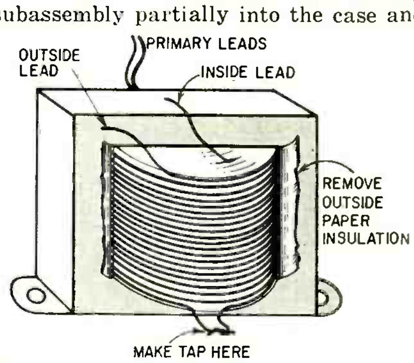


Fig. 2—Adding a tap to the transformer.

If you use the G-E lamp, you must short out the two series resistors which are built in for 60-cycle operation. Disassemble the lamp case and solder a length of bare wire across both resistors.

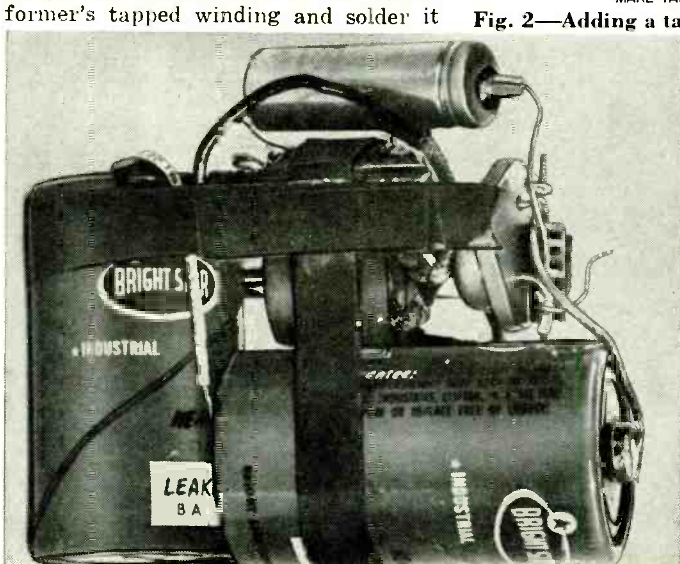
Troubleshooting

If the lamp fails to light or flash in either switch position, recheck the polarity of the transformer secondary leads. Improper connections or the wrong transformer will result in zero or, at best, unsatisfactory light output. As a last resort, try tapping the transformer secondary at a different spot. Although all of the several 6V6 transformers which were tried in this circuit worked best with the tap placed as shown, another type of transformer might require a different tap position.

Don't expect the concentrated brilliance of an incandescent lamp. The light output of an EL lamp is uniformly distributed over the entire lamp surface. Its soft, diffused glow illuminates a larger area and eliminates glare. After your eyes have become accustomed to darkness, you will find the EL nightlight as useful as a flashlight. In strong daylight, however, you may be unable to tell whether it is lit. If you have access to a brightness meter, measure the EL lamp's brightness. The original unit measured 1.5–2.0 foot-lamberts for the G-E lamp, and 1.0–1.5 foot-lamberts for the Sylvania.

The optimum value for R2 may vary slightly with the individual transistor used. If the lamp fails to flash in one switch position, try a larger value. R1 affects the current drain, light output and efficiency. R2 and C1 affect the flashing rate.

The completed EL nightlight is a useful camping accessory. Fishermen can use its distinctive flash to identify their dock at night. It makes a handy all-around emergency lamp. A set of batteries will work for more than 24 hours. END



The wired assembly without the case.

Bibliography

Electroluminescent Lamps, General Electric Co. Publication No. 3-0306, 1961

How Can You Use This Dramatic New Source of Light?, Sylvania Electric Publication No. P-1 DR-859EY, 1959.

FM stereo equipment roundup

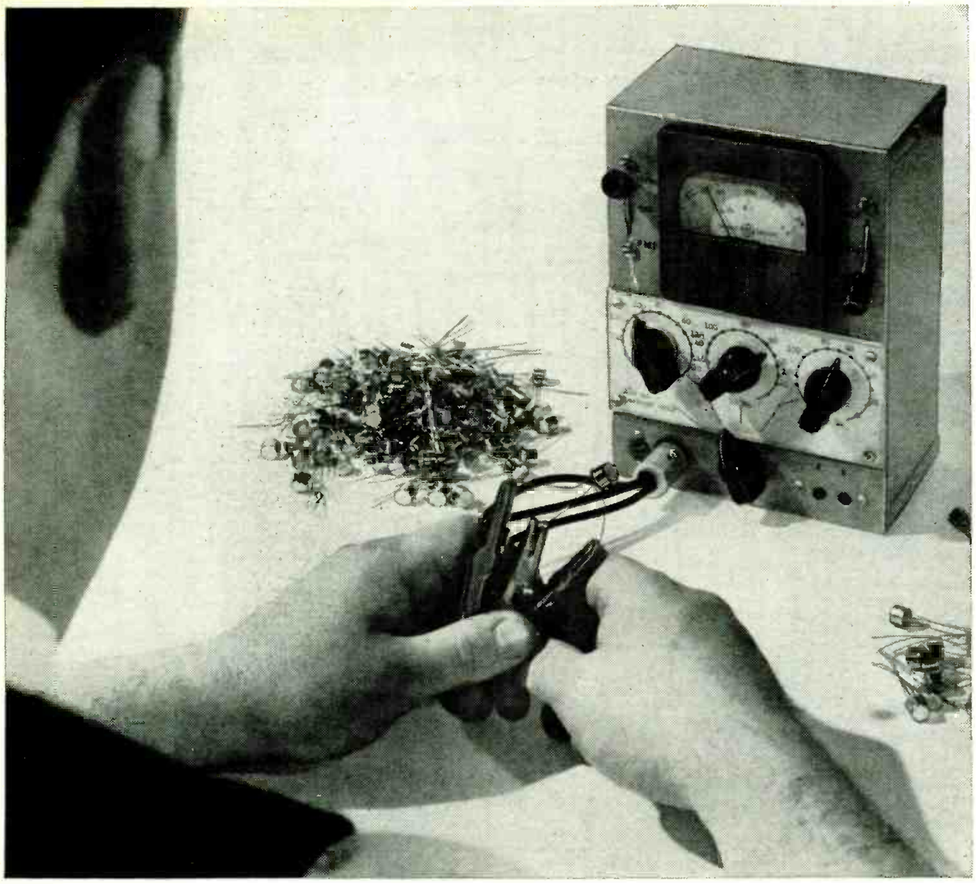
The important dope on the FM stereo gear that has appeared since our October 1961 issue. By using this chart along with the directory in the October issue, you will have a complete comprehensive listing of all FM stereo equipment available today.

MANUFACTURER	MODEL	TYPE	MULTIPLEX SECTION									DIMENSIONS (inches)	PRICE
			TUNERS IT WORKS WITH	OUTPUT VOLTAGE	OUTPUT IMPEDANCE	FREQUENCY RESPONSE (cycles)	HUM & NOISE (db)	38-KC SUPPRESSION	HOW MUCH SUPPRESSION (db)	SELF-POWERED	CHANNEL SEPARATION (db at 1000~)		
ABC ELECTRONICS 440 Boone St. Orlando, Fla.	611	Stereo Adapter	—	3.5	—	30–15,000	—	YES	—	YES	23	3 x 4 x 5	$40.00 or less
	600	Stereo Adapter	—	3.5	—	30–15,000	—	YES	—	NO	23	6 x 6 x 3	$39.95
ALLIED RADIO CORP. 100 N. Western Ave. Chicago 80, Ill.	Knight KU-45	Stereo Receiver	NA	NA	NA	—	−75	NO	NA	YES	25	4¾ x 16½ x 8½	$129.95 Kit
	Knight-Kit KS-10	Stereo Adapter	75-Kc Bandwidth 0.3–1.5 V. Output	1	50,000 Ohms	50–15,000	−50	NO	NA	YES	25	3¾ x 4 x 8½	$19.95 Kit
	Knight-Kit KF-90	AM–FM Stereo Tuner	NA	—	—	50–15,000	−60	NO	NA	YES	25	4⅛ x 15½ x 15	$99.95 Kit
	Knight-Kit KF-75	FM Stereo Tuner	NA	—	—	50–15,000	−60	NO	NA	YES	25	4⅛ x 15½ x 15	$84.95 Kit
	Knight KN-141M	FM Stereo Tuner	NA	0.5	HI-Z	30–20,000	−40	YES	−25	YES	25	4⅜ x 11¾ x 10¾	$89.95
	Knight KN-MX3	Stereo Adapter	100-Kc Bandwidth 0.4 V. Output	2.5	25,000 Ohms	50–15,000	−50	YES	−25	YES	25	4⅞ x 5 x 7⅝	$44.50
ALTEC LANSING CORP. 1515 S. Manchester Ave. Anaheim, Calif.	359A	Stereo Adapter	At Least 0.1-V. Output	1	50,000 Ohms	20–15,000	−50	YES	−50	YES	30	5½ x 5½ x 7½	$89.50
AMPEX AUDIO, INC. Sunnyvale, Calif.	520	Stereo Adapter	Low-Imped Output 0.24–2.4 V.	0–10	15,000 Ohms	50–15,000	−60	YES	−50	YES	30	12½ x 4¾ x 4⅜	—
AUTOMATIC RADIO MFG. CO. 122 Brookline Ave. Boston 15, Mass.	MD-80	Stereo Adapter	100K Load .03–2-V. Output	0.3	2 200 Ohms	20–15,000	NONE	YES	—	YES	25	6¼ x 3 x 5½	$50.00 Approx.
CALBEST ELECTRONICS 4801 Exposition Blvd. Los Angeles, Calif.	MXA-614	Stereo Adapter	Almost All Tuners	Same as input	—	50–15,000	−60	YES	−40	YES	30	5¼ x 5¼ x 9	—
DeWALD RADIO 35-15 37th Ave. Long Island City 1, N.Y.	R-1103	AM–FM Stereo Tuner	NA	2	—	50–14,000	−55	NO	—	YES	—	13 x 4⅛ x 12	$119.95
ELECTRONIC INSTRUMENT CO. INC. (EICO) 33-00 Northern Blvd. Long Island City 1, N.Y.	MX-99	Stereo Adapter	Up to 5-V. P-P Output	Same as Input	1,000 Ohms	20–15,000	—	YES	—	YES	35	3⅞ x 9⅛ x 6⅝	$39.95 Kit $64.95 Wired
ERIC ELECTRONICS 1823 Colorado Ave. Santa Monica, Calif.	3457MX	FM Stereo Tuner	NA	—	100,000 Ohms	50–15,000	−60	YES	—	YES	30	—	$119.95
FISHER RADIO CORP. 21-21 44th Drive Long Island City, N.Y.	KM-60	FM Stereo Tuner	NA	—	—	20–15,000	−70	YES	−55	YES	35	15⅛ x 13 x 4-13/16	—
	MX-100	Stereo Adapter	Any Hi-Fi Tuner	15	3,000 Ohms	20–15,000	−70	YES	−40	YES	35	6-1/16 x 5-5/16 x 12½	$109.50
	500-B	Stereo Receiver	NA	NA	NA	20–15,000	−60	YES	−55	YES	35	17⅛ x 5¾ x 13¼	$359.50
	800-B	Stereo Receiver	NA	NA	NA	20–15,000	−70	YES	−52	YES	35	18½ x 7⅝ x 14⅛	$429.50
	FM-100-B	FM Stereo Tuner	NA	—	—	20–15,000	−70	YES	−65	YES	35	15⅛ x 13 x 4-13/16	$229.50
	FM-50-B	FM Stereo Tuner	NA	—	—	20–15,000	−75	YES	−55	YES	35	15⅛ x 13 x 4-13/16	$189.50

MULTIPLEX SECTION

MANUFACTURER	MODEL	TYPE	TUNERS IT WORKS WITH	OUTPUT VOLTAGE	OUTPUT IMPEDANCE	FREQUENCY RESPONSE (cycles)	HUM & NOISE (db)	38-KC SUPPRESSION	HOW MUCH SUPPRESSION (db)	SELF-POWERED	CHANNEL SEPARATION (db at 1000∾)	DIMENSIONS (inches)	PRICE
GROMMES 9101 King Street Franklin Park, Ill.	M-1	Stereo Adapter	MX Output Flat 50–53,000∾	0.5	HI-Z	30–15,000	—60	YES	—40	YES	30	4½ x 4½ x 9	$59.95
HARMAN-KARDON Ames Court Plainview, N.Y.	Citation IIIX	FM Stereo Tuner	NA	3	1,500 Ohms	2–20,000	—66	YES	—50	YES	45	14⅞ x 6 x 12¼	$239.90 Kit $319.90 Wired
	F500X	FM Stereo Tuner	NA	3	1,500 Ohms	20–20,000	—60	YES	—50	YES	30	15¼ x 5-7/16 x 12	$169.95
HEATH CO. Benton Harbor, Mich.	GRA-21-1	Stereo Adapter	0.5–1.75-V. Output	Same as input	2,000 Ohms	50–15,000	—	—	—	YES	20	15 x 8 x 6	$49.95 Kit
KARG LABORATORIES 162 Ely Ave. South Norwalk, Conn.	MX-3	Stereo Adapter	0.25–2-V. Output	1	5,000 Ohms	30–15,000	—55	YES	—45	YES	35	5 x 5¾ x 10¼	$79.50
	SCT-4	FM Stereo Tuner	NA	1.5	10,000 Ohms	40–15,000	—48	YES	—45	YES	30	—	$149.95
	SXT-1	FM Stereo Tuner	NA	1.5	—	30–15,000	—	—	—	YES	33	—	$274.50
KENWOOD ELECTRONICS 212 Fifth Ave. New York 10, N.Y.	KW-60	Stereo Receiver	NA	—	—	—	—	—	—	YES	—	19¾ x 6 x 13½	$249.95
	KD-1	Stereo Adapter	1–1.5-V. Output	—	—	50–15,000	—60	—	—	YES	20	7⅞ x 4¾ x 7⅞	$49.95
LAFAYETTE RADIO ELECTS 111 Jericho Turnpike Syosset, N.Y.	LT-200	Stereo Adapter	Most Late Model Tuners	1.5	Low-Z	50–15,000	—50	YES	—56	YES	40 @ 400∾	4½ x 6¼ x 8	$47.50
	LT-700	FM Stereo Tuner	NA	1.5	Low-Z	50–15,000	—50	YES	—56	YES	40 @ 400∾	13⅜ x 10⅜ x 14½	$124.50
	LT-300WX	FM Stereo Tuner	NA	1	15,000 Ohms	20–20,000	—60	YES	—60	YES	25	3 x 10⅛ x 8½	$149.95
	LA-445WX	Stereo Receiver	NA	NA	NA	20–20,000	—60	YES	—60	YES	25	10¾ x 6 x 9	$251.45
MOTOROLA INC. 9401 W. Grand Ave. Franklin Park, Ill.	HK54	Stereo Adapter	Flat to 53 Kc	1.5	100,000 Ohms	50–15,000	—60	YES	—40	NO	25	5 x 7 x 3½	—
OLSON ELECTRONICS 260 S. Forge St. Akron, Ohio	RA490	Stereo Adapter	For Model RA-491 AM–FM Tuner Receiver	1.25	HI-Z	20–20,000	—30	—	—	NO	30	—	$188.95 Tuner & Adapter
PACO ELECTRONICS CO. 70-31 84th St. Glendale 27, N.Y.	MX-100	Stereo Adapter	Almost All Tuners	1	100,000 Ohms	15–15,000	—50	YES	38 Kc: —52 76 Kc: —85	YES	28	9 x 4 x 8¼	$49.95 Kit $69.95 Wired
	ST-35 MX	FM Stereo Tuner	NA	1	100,000 Ohms	15–15,000	—50	YES	38 Kc: —52 76 Kc: —85	YES	28	—	—
PILOT RADIO CORP. 37-06 36th St. Long Island City, N.Y.	654M	FM Stereo Tuner	NA	0.3	10,000 Ohms	20–15,000	Negligible	YES	—30	YES	30	5¼ x 14⅝ x 12¾	$329.50
	280	FM Stereo Tuner	NA	.1–2	10,000 Ohms	20–15,000	Negligible	YES	—30	YES	30	3¾ x 9¾ x 7½	$99.95
	380	FM Stereo Tuner	NA	0.3	500 Ohms	20–15,000	Negligible	YES	—30	YES	30	5¼ x 14⅝ x 8¾	$179.50
	602M	FM Stereo Tuner	NA	0.3	10,000 Ohms	20–15,000	Negligible	YES	—30	YES	30	5⅛ x 14⅝ x 10¾	$249.50
	602S	FM/AM Stereo Tuner	NA	0.3	10,000 Ohms	20–15,000	Negligible	YES	—30	YES	30	—	$299.50
RADIO SHACK CORP. 730 Commonwealth Ave., Boston 17, Mass.	Realistic 214	FM Stereo Tuner	NA	1	5,000 Ohms	20–20,000	—50	YES	—50-55	YES	35	15½ x 5⅜ x 1-1/16	$149.95 Kit $189.95 Wired
	Realistic 215	Stereo Adapter	Low-Imped. Output 0.5-1.5 V.	2	5,000 Ohms	50–15,000	—60	YES	—35	YES	20	7¾ x 4⅝ x 6	$23.95 Kit $39.95 Wired
	Realistic 230	Stereo Adapter	Low-Imped. Output 0.2–2 V.	0.3	100,000 Ohms	40–15,000	—60	NO	NA	YES	20	4 x 3 x 5	$19.95 Kit
H. H. SCOTT, INC. 111 Powder Mill Road Maynard, Mass.	355	Stereo Tuner	NA	NA	NA	20–15,000	—60	YES	—50	—	35	—	$449.50
	LT-110	FM Stereo Tuner	NA	2	—	20–15,000	—60	YES	—50	—	35	—	$159.95 Kit
STROMBERG-CARLSON 1400 N. Goodman St. Rochester, N.Y.	MXP-2/MX-477	Stereo Adapter	20,000-ohm Imped. 0.5–2-V. Output	Same as input	250,000 Ohms	—	—55	YES	—30	YES	26	8½ x 4-5/16 x 2⅞	$39.95
V-M CORP. 305 Territorial Rd. Benton Harbor, Mich.	1441	Stereo Adapter	Output Less Than 2 V.	2	15,000 Ohms	50–15,000	—60	NO	NA	YES	25	2¼ x 10 x 3	—
WEBCOR SALES CO. 5610 W. Bloomingdale Ave. Chicago 39, Ill.	A1945	Stereo Adapter	Most Good Quality Tuners	Same as input	30,000 Ohms	—	—45	YES	—30	YES	20	7¼ x 5 x 3	—
ZENITH RADIO CORP. 6001 W. Dickens Ave. Chicago, Ill.	MH910	Stereo Adapter	Ordinary FM Radio	—	—	—	—	—	—	YES	—	9¾ x 13⅛ x 7⅞	$99.95

NA—Not Applicable.
All data from manufacturers, specifications.



check transistors 3 ways

- *Are they good or bad?*
- *What's the leakage current?*
- *What's the beta?*

By Capt. W. B. Bernard, USN, Ret.

Most of the simpler transistor testers use one fixed collector current. Because transistor beta may vary widely with collector current and because of the varying amounts of collector current which may be attributed to I_{CO}, such tests often do not give an adequate picture of the condition of the transistor under test. The unit described in this article tests transistors at currents ranging from 250 μa to 100 ma. Although 100 ma is at the lower borderline for realistic power transistor testing, it was selected as the maximum current that could be used with a power supply consisting of three size-D flashlight cells. If portability were not a factor, an ac-operated supply or No. 6 dry cells would extend the current range up to 10 amperes.

The checker makes the three tests shown in Fig. 1. In Fig. 1-a it is connected to check transistor collector-to-base leakage (I_{CO}). A resistor in series with the circuit limits current in case the transistor has a short between collector and base. In Fig. 1-b the base is left floating and the meter measures collector-to-emitter current, with no external current applied to the base. We have to know this current to determine the amount of collector-current change when we supply current to the base through the resistor R in Fig. 1-c.

We are interested in the change of collector current since $\beta = \frac{\Delta I_C}{\Delta I_B}$. The collector current flowing with zero base current will often be negligible. So for the time being we will consider that $I_C = \Delta I_C$. Since no base current can flow except when the external circuit to the base is closed, $I_B = \Delta I_B$. With this simplification of terms, we can write:

$$\beta = \frac{I_C}{I_B} \qquad (1)$$

Since the base-to-emitter voltage of a transistor is very small, we can say

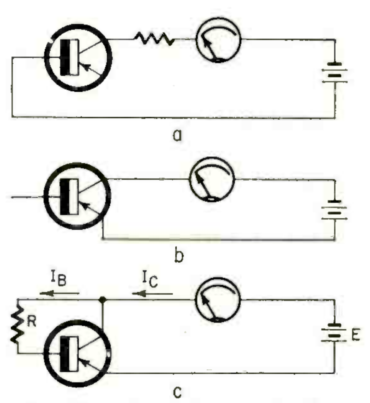


Fig. 1—The three basic checks made by the instrument: a—collector-to-base leakage; b-collector-to-emitter current with the base open; c — collector-to-emitter current with current supplied to the base.

with little error: $I_B = \frac{E}{R}$ (2)

Substituting 2 in 1 we have: $\beta = \frac{I_C R}{E}$ (3)

or $R = \frac{\beta E}{I_C}$ (4)

It is apparent from Equations 3 and 4 that, if E and I_C are held fixed in value, R and beta are directly related. We can make R in Fig. 1-c variable and calibrate the dial associated with it directly in the value of beta.

We will now assume that our meter has a full-scale sensitivity of 1 ma and that it would be most convenient to fix the value of I_C at half scale or 500 μa. Since we are using three flashlight cells, we use 4.2 volts for E. Substituting these values in Equation 4 we have:

$$R = \frac{\beta \times 4.2}{500 \times 10^{-6}} = \beta \times 8{,}400$$

Using this relation we can calibrate the dial which controls the value of R with the proper values of beta for the conditions of $I_C = 500$ μa and $E = 4.2$ volts.

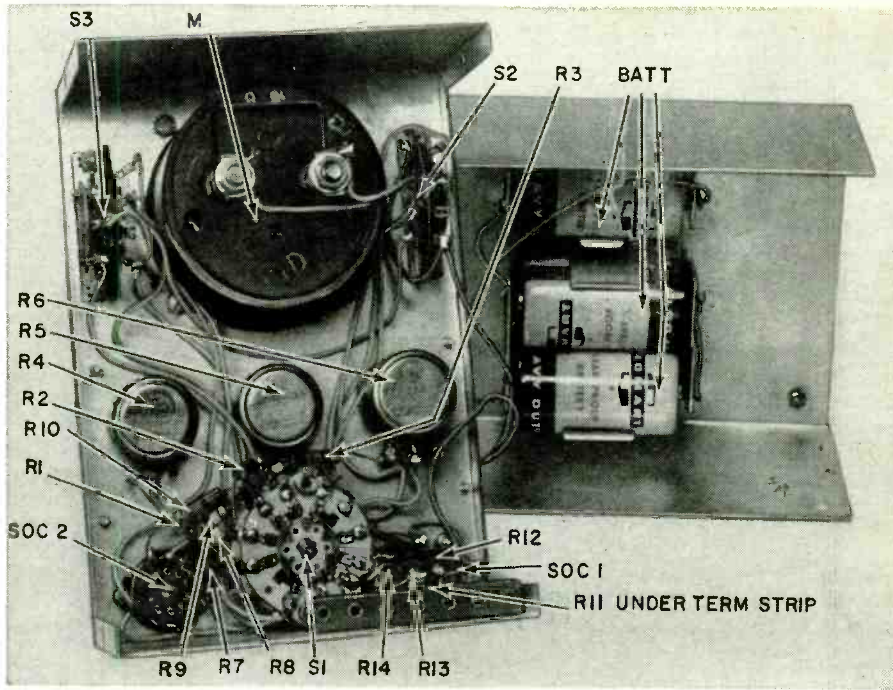
Earlier we mentioned that a single value of collector current will not test all classes of transistors realistically. We can remedy this by shunting our meter so its full-scale sensitivity is 10 ma and reading beta at a collector-current value of 5 ma. Leaving E as 4.2 volts, we have $R = \frac{\beta \times 4.2}{5 \times 10^{-3}} = \beta \times 840$

Because of the factor of 10 change in the value of R for a given beta, it would seem desirable to switch in a different variable resistor for R when we switch a shunt onto the meter. This resistor can be calibrated in beta for an I_C of 5 ma.

Now, shunting the meter so it has a full-scale sensitivity of 100 ma, we select a value of 50 ma for I_C. Calculating for this, we find that $R = \beta \times 84$. Again we can switch in a new variable resistor and calibrate it for values of beta corresponding to $I_C = 50$ ma and $E = 4.2$ volts.

The table is developed from these formulas and may be used to calibrate the three base resistor sets. If possible, this calibration should be done with a bridge to determine the resistance values. However, a good ohmmeter will do a satisfactory job.

So far we can measure the beta of our transistors at 500 μa, 5 ma and 50 ma. Without too much trouble we can measure beta at half and twice these values of current, thus adding to the three values listed, 250 μa and 1, 2.5, 10, 25, and 100 ma.



Suggested parts layout inside the case.

BETA VS. I_C RESISTORS

Beta	*500 µa*	*5 ma*	*50 ma*
10	84 K	8.4K	840
20	168 K	16.8K	1,680
30	252 K	25.2K	2,520
40	336 K	33.6K	3,360
50	420 K	42 K	4,200
60	504 K	50.4K	5,040
70	588 K	58.8K	5,880
80	672 K	67.2K	6,720
90	756 K	75.6K	7,560
100	840 K	84 K	8,400
110	924 K	92.4K	9,240
120	1.008M	100.8K	10,080

Let us refer to Equation 3,

$$\beta = \frac{I_C R}{E}$$

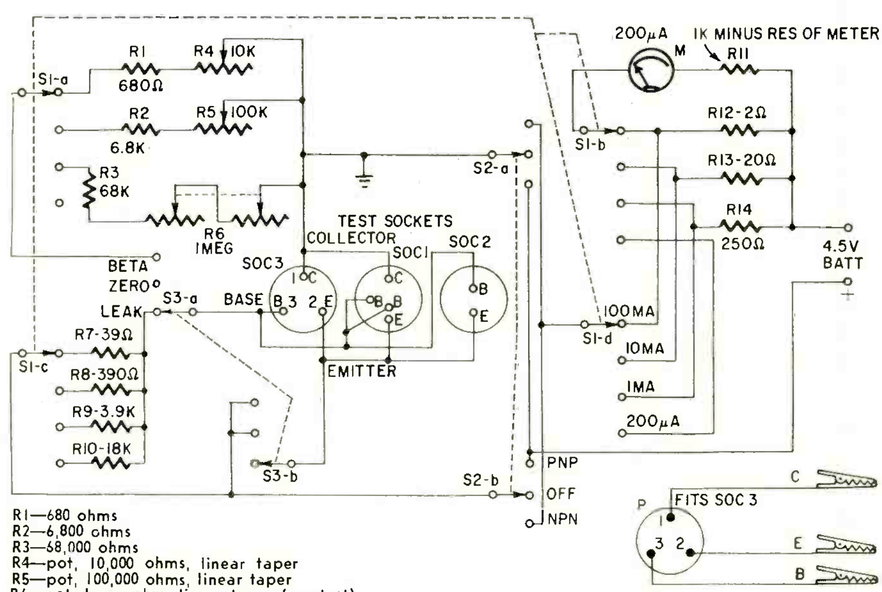
If we maintain R and E fixed, beta must change by the same factor as I_C. Therefore, if we leave our setup unchanged and set I_C at half the value we used in the calculations above, the beta of the transistor will be half the value we read off the scale on R. If we set I_C to twice the amount calculated above, beta will be twice the value we read off the scale. Since the division or multiplication can be done easily, we need only two more reference marks on the meter scale. Since we selected half scale for calibrating our resistors, we may label a mark at one-quarter scale "Multiply by ½" and a mark at full scale "Multiply by 2." Thus we can read beta at the additional current values.

To check collector-to-base leakage (Fig. 1-a), we need a meter sensitivity better than 1 ma. In this tester a 200-μa basic meter movement is used for the most sensitive scale of leakage measurements. It is shunted for all beta measurements.

Fig. 2 shows the circuit of the tester. R4, R5 and R6 are the variable base resistors for the three current ranges. R1, R2 and R3 provide a fixed minimum resistance, so beta can be measured to just below a value of 10. The maximum beta value that can be measured is about 125. At the × ½ setting of the meter, beta can be measured from values of 5 to 60 and at the ×2 setting from 20 to 240.

R7, R8, R9 and R10 are the meter protector resistors which prevent meter overloading when leakage measurements are made on a shorted transistor. R12, R13 and R14 are the meter shunts used to set up the ranges of 100, 10 and 1 ma, respectively. R11 builds out the meter resistance to a value that allows the use of standard resistance values for shunts.

The proper value of resistance in all the circuits is selected by S1. S2 selects the proper test-voltage polarity for n-p-n or p-n-p transistors. S3 selects the desired test function. When S3 is in the LEAK (leakage) position, the transistor emitter is open-circuited and the meter, battery and protective resistor are connected in series with the collector–base junction to measure the leakage across that junction. When S3 is in the ZERO position, the transistor



R1—680 ohms
R2—6,800 ohms
R3—68,000 ohms
R4—pot, 10,000 ohms, linear taper
R5—pot, 100,000 ohms, linear taper
R6—pot, 1 megohm, linear taper (see text)
R7—39 ohms
R8—390 ohms
R9—3,900 ohms
R10—18,000 ohms
R11—1,000 ohms, minus the resistance of the meter movement. The meter I used has a resistance of 330 ohms, so I used 680 ohms for R11 (670 ohms was needed).
R12—2 ohms (two 1-ohm units in series)
R13—20 ohms (two 10-ohm units in series)
R14—250 ohms (150 and 100 ohms in series)
All resistors ½-watt 10%

BATT—4.5 volts, 3 flashlight cells
M—200 μa, dc, full scale
P—3-contact male connector to match SOC 3
S1—4-position, 4-pole, shorting rotary switch
S2—3-position, 2-pole, shorting lever switch
S3—3-position, 2-pole, shorting lever switch, spring return from beta position
SOC 1—universal type transistor socket
SOC 2—power-transistor socket
SOC 3—3-contact female connector to match P
Alligator clips (3)
Case, 7 x 5 x 3 inches

Fig. 2—Circuit of the complete tester.

base is open-circuited and the meter and battery are in series with the collector and emitter terminals of the transistor. This measures the collector current with zero base current from the external circuit. With S3 in the BETA position, a base current equal to $\frac{E}{R}$ is supplied to the base so that the change in collector current caused by the base current can be measured.

Build it yourself

The tester was built into a 7 x 5 x 3-inch aluminum box. The beta calibrations were made on drawing paper protected by a thin sheet of transparent plastic. In addition to the calibrations, lines leading from the knob pointer positions of S1 indicate which meter scale is in use and which base resistor is connected into the circuit.

S2 is at the upper left of the front panel. In its center position, the battery and the meter are disconnected from the rest of the circuit. In the upper position, the polarity of the circuit is set for testing n-p-n transistors. With S2 in the lower position, the polarity is right for testing p-n-p transistors. S3 is at the upper right of the panel.

At the bottom of the panel are three test sockets. The one at the lower right is for power transistors. At the lower left is a combination socket that takes either the in-line or semicircular arrangement of leads of small transistors. Between this small socket and the knob for S1 is a three-pin socket which accepts a plug connected to flexible leads terminated with insulated clips. These leads are used when checking transistors that cannot easily plug into the sockets. One of these leads is used as the collector connection for any transistor plugged into the power-transistor socket.

The interior of the instrument is relatively uncrowded and there are no particular problems in parts arrangement. Batteries are mounted inside the bottom of the case and are arranged to clear S1 and the meter terminals.

A 1-megohm linear pot was not available for R6 during construction so I used a dual 500,000-ohm linear pot with sections connected as in the diagram. A 1-megohm linear single-section pot is preferable.

How to use it

To test a transistor, place S2 in the OFF position, S3 at LEAK and S1 on a scale suitable for measuring the expected leakage. Then plug in the transistor. Next move S2 to select the proper polarity of test voltage, and read the leakage current. If the meter needle goes off scale, move S2 to OFF immediately. An off-scale reading indicates that the transistor has a shorted collector–base junction or that the wrong polarity was selected for the test. Reversing S2 will determine if the polarity was set correctly in the first test.

If the leakage reading is normal, we are ready to measure the collector current that flows when there is no external base current. Set S1 to the desired beta scale and S3 to ZERO. If appreciable collector current is flowing under this condition, compared to the I_c at which the test is desired, this zero current must be added to the desired I_c reading so the change of I_c is equal to the desired current. For example, if we have set the tester to test the transistor at 500 μa and the zero current is 100 μa, we must set the meter needle to 600 μa for an accurate beta reading. A high zero current may prevent testing at the full-scale mark (×2) on the meter. In this case, add the zero current to ¾ of the full-scale reading of the meter and multiply the reading by 1½.

Having decided at which current, on the selected scale, we are going to test for beta, set S3 to the BETA position, read the scale under the pointer of the proper R knob, and multiply by the value indicated on the meter face.

The 4.2 volts supplied by the batteries was selected as low enough to test all the transistors commonly listed in the catalogs, yet high enough to saturate most power transistors. An external supply can be inserted in series with the collector lead to raise or lower the voltage if we want to test at other than the conditions available within the tester. So long as the internal supply voltage is not changed, beta readings on the instrument face will remain correct.

Check diodes for leakage by connecting them between the base and collector clips, setting S3 at LEAK and selecting the proper polarity with S2. You can get a rough idea of the forward conduction of the diode by reversing the polarity of the applied voltage with S2.

Information for setting up the tester for a given transistor type is best obtained from manufacturers' data sheets. However, the data given in mail-order catalogs will, in many cases, give enough information for meaningful tests. Be careful not to exceed any of the transistors' limiting factors—voltage, current and power dissipation. END

improving inexpensive amplifiers

By R. C. SANDISON

HERE ARE THREE SIMPLE STUNTS, USING junkbox parts, which will very noticeably improve the overall sound and extend the range of a medium-fidelity amplifier somewhat in both directions.

A circuit similar to Fig. 1 was used in some Philco models over 20 years ago. The sound from these ancient sets, though limited in range, compares favorably with many modern amplifiers. The original circuit used a tapped field coil plus a choke, but the choke alone works equally well when inserted directly into the screen feed line.

The special feature is the improved clarity and "cleanness" of the middle frequencies, which makes the circuit especially valuable in PA systems intended primarily for voice reproduction.

The value of the choke is not critical. If you have an impedance bridge, pick a choke whose value is between 20% and 30% of the output transformer's primary impedance. If you have only an ohmmeter, choose a choke with a quarter to a half the primary's dc resistance.

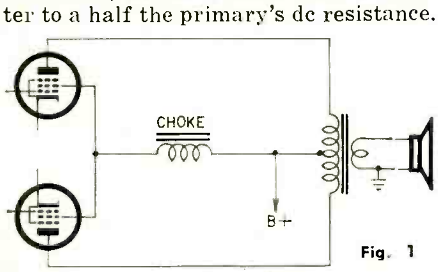


Fig. 1

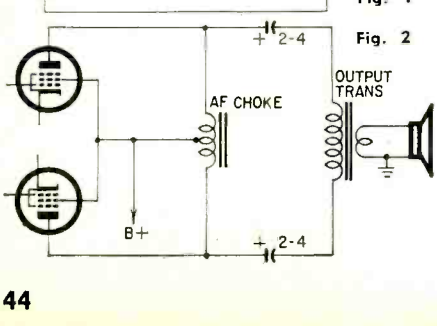


Fig. 2

If possible, try two or three chokes of various ohmages, listening carefully to spot the one giving the best results.

Because of the comparatively small screen currents, any small ac-dc choke will do, or you may be able to use the primary of a midget output transformer.

Fig. 2 shows an old (easy but seldom used) way of increasing the inductance of any output transformer. B-plus current is removed from the primary and fed through a center-tapped choke to plates and screens. (Of course, this may be combined with Fig. 1, by using a second choke in the screen feed.) This does away with any possibility of dc saturation and will give considerably better reproduction than the transformer alone. Bass response is especially improved, often by several decibels.

The impedance value of the choke is not critical. The primary of almost any push-pull output transformer can be used, and I have even used the high-voltage winding of small power transformers. A 2-μf capacitor in each of the plate leads is ordinarily enough, although you might like to try values as high as 4 μf.

If your amplifier employs a phase inverter or other interstage transformer, you can still improve matters by removing dc from its primary. Just couple the plate to the transformer (Fig. 3) through a .01- to .05-μf capacitor and feed the B-plus separately through about a 200,000-ohm resistor. The exact value depends on the circuit and especially the tube used. END

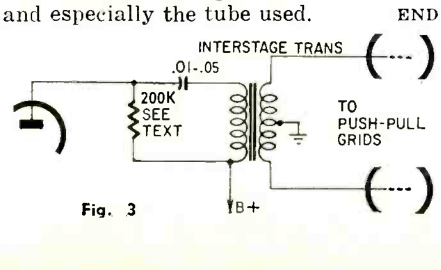


Fig. 3

CUT HERE

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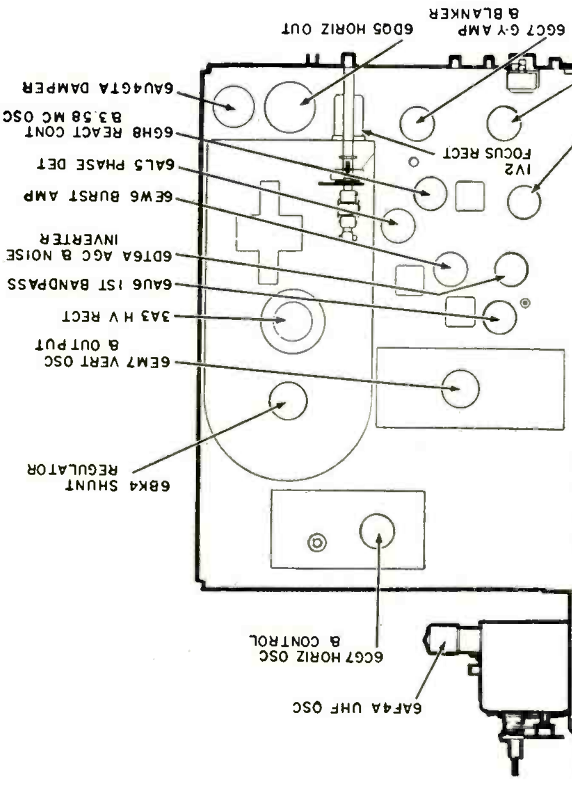
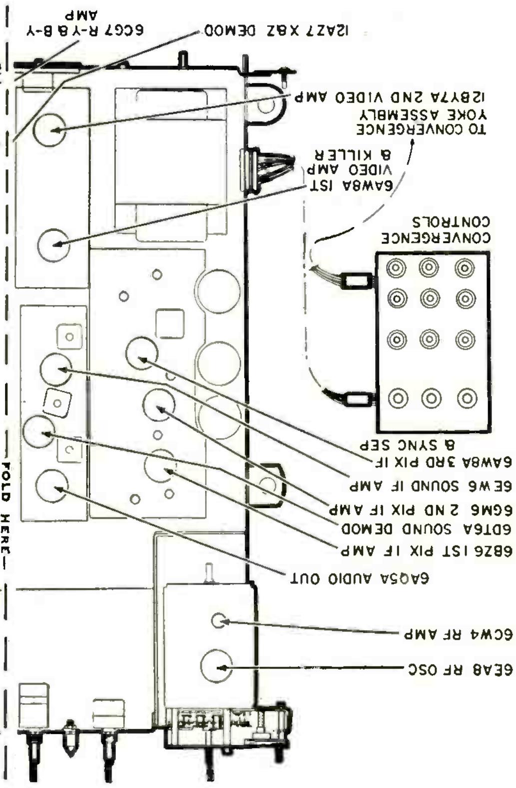


Models M940W, 950W, 960W, 941W, 951W, 961W

FOLD HERE

4



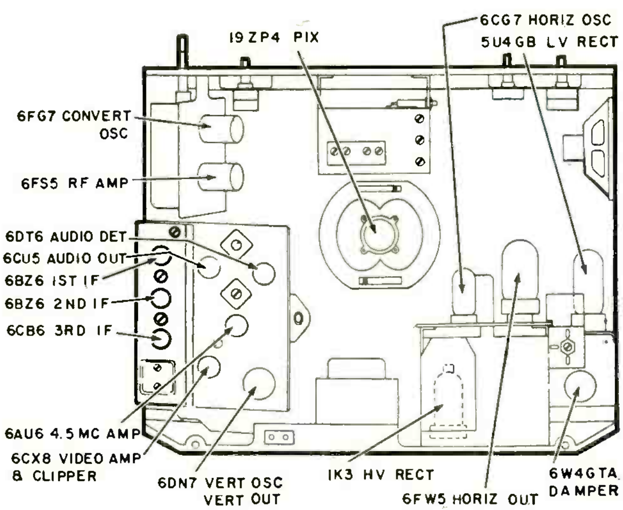
CW COLOR CHASSIS

CUT HERE

CUT HERE

TRIM HERE AFTER FOLDING

LW CHASSIS
Models M202, 3, 4, 5



HOW TO FOLD

Fold the top down and back, keeping the cover facing you. Then fold from left to right on the line marked fold here, keeping the cover facing you. Staple the booklet along the left-hand edge. Now run a sharp knife or razor blade along the closed top and you're finished. You now have another useful piece of service data, exclusive with RADIO-ELECTRONICS.

8

Radio-Electronics

TUBE LAYOUTS
IN TV SETS

Compiled by **Larry Steckler**, Associate Editor

GENERAL ELECTRIC
1961-1962

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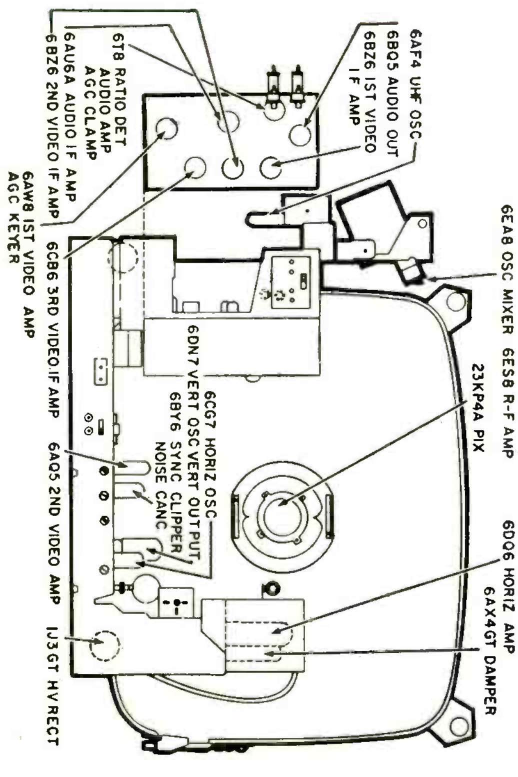
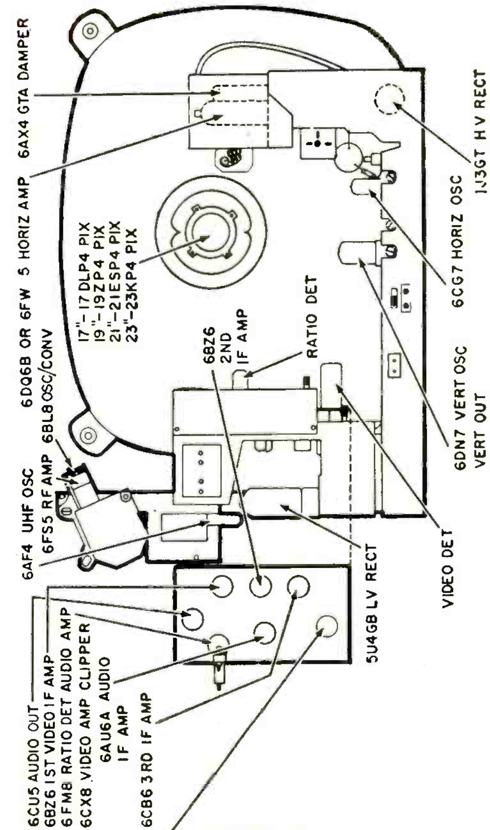


U5 CHASSIS
Models M870VWD, 871VWD, R870VML, VWD



M6 CHASSIS

MW CHASSIS
Models M604, 5, 10, 11, R610, 14, 15

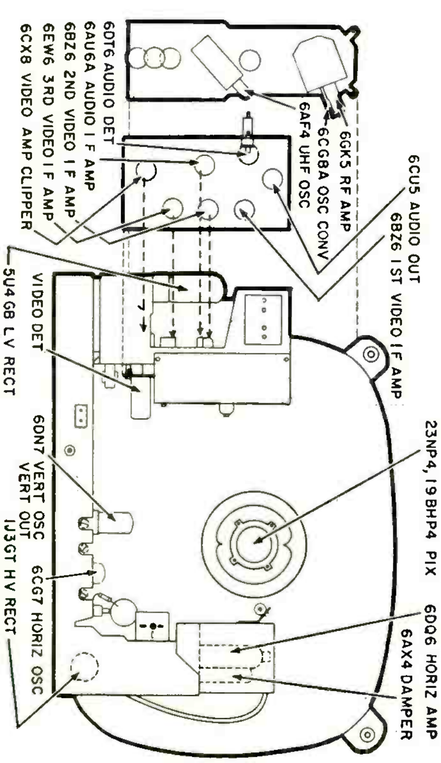


Chart of Service Hints goes with M6 Chassis

M6 CHASSIS — SERVICE HINTS

SYMPTOMS	POSSIBLE TROUBLE
No picture or sound, line fuse open.	1. Check the low voltage rectifier V11 (5U4). 2. Check the VHF tuner for shorts. 3. Check the audio output tube V9.
Intermittent picture and sound or no picture or sound.	1. Check the low voltage rectifier V11 & its socket filament connections. 2. Check the VHF tuner for lead dress. 3. Check the VHF tuner for loose or cold solder connections. 4. Check the video dctector assembly for proper contact to the I-F board.
Fine tuning has no effect on manual tuned models.	1. Check for excessive travel of the fine tuning plunger. Adjust cam stop by bending slightly downward to prevent excessive plunger travel.
Weak picture or busy background.	1. Check 1st I-F amplifier V3. 2. See production changes 7 & 8 on Page 27.
Intermittent or no sound on remote equipped receivers.	1. Check remote plug connections. 2. Check muting switch on power tuning motor.
No remote audio control.	1. Check audio stepping relay in remote receiver.
Vertical buzz in audio.	1. Check lead dress of vertical hold control.
Low brightness.	1. Check for shorted spark gap SG201.
Intermittent, no vertical or vertical stretch.	1. Check vertical hold control.
Unstable horizontal or jittery horizontal.	1. Check capacitor C401. 2. Check Y251A & B.
Horizontal oscillator inoperative.	1. Capacitor C257 defective.
Intermittent high voltage.	1. Check fuse F251.
Arcing or multiple-line tearing of raster.	1. May be caused by internal arcing in 6FW5 tube.

2

7

SERVICING CB transistor transceivers

How to handle these units profitably

By LEONARD E. GEISLER*

Large numbers of pocket-sized all-transistor CB transceivers are in every-day use. At one time or another, every one of them will be brought to a service technician for repairs. Are you ready for such repairs? This article will show what is needed to repair these sets and what basic steps to take while servicing.

The first thing a technician must have is an FCC First or Second Class Radiotelephone license. *Without one, you are not authorized to do any work on the transmitter section of the unit; at least nothing that really counts.*

Second come instruments:

- A good standard signal generator, well shielded, with μv attenuator. It should tune from 100 kc to 30 mc.
- BC-221 heterodyne frequency meter or unit with equivalent accuracy.
- Simple field-strength meter.
- CB crystal checker, if available.
- Oscilloscope. One with access for direct connections to the vertical deflection plates of the CRT.
- 20,000 ohms-per-volt vom with standard and needle prods.

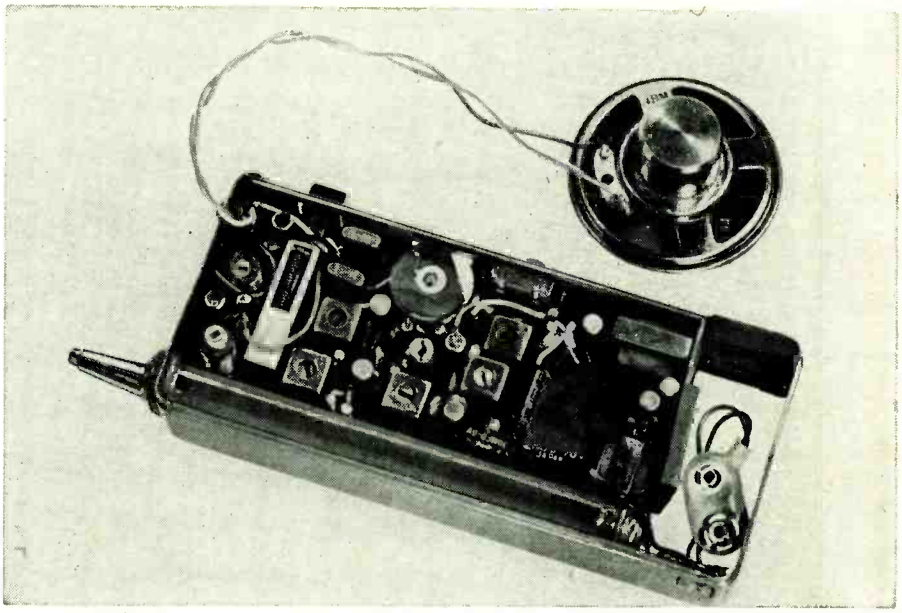
Third come the hand tools:

- Long-nose pliers (4-inch).
- Duckbill pliers (4-inch).
- Diagonal cutters (4-inch).
- Magnifying eyeshade or other magnifying device.
- Set of watchmaker's screwdrivers.
- Assorted tweezers.
- Alignment tools—nylon or hard fiber.
- Low-wattage soldering iron, preferably with a ¼-inch tip.

Troubleshooting procedures

When a set comes into your shop, quiz the customer, note his description of trouble. Then, while he watches, check the set for loose, dead or improperly inserted batteries. Eliminate this common cause of trouble right at the start.

Now that you know the set really needs repair, you'll have to hunt around till you find the combination and get the case open. The set I use as an example has a single closure screw located under the trademark-cum-pocket clip—a special offset screwdriver must be used. Once you have the case open, what do you look for?

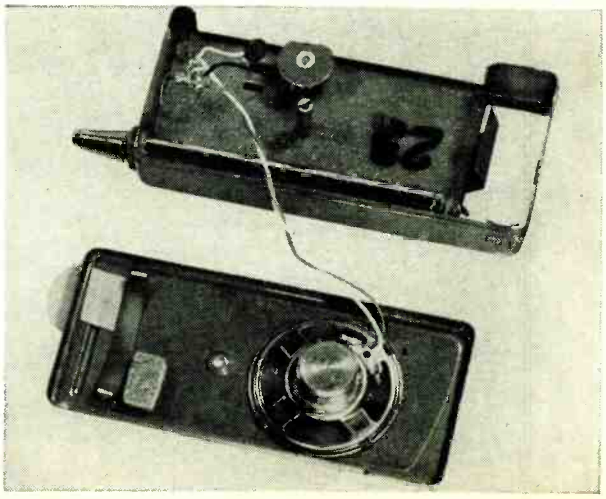


Typical transceiver with cover removed. Note compactness of layout.

Most troubles are the result of ordinary wear and tear, but some are caused by improper or careless use of the equipment. Remember these units are very portable and it isn't unusual to get one that has taken a bath or been dragged through the mud on a hunting trip.

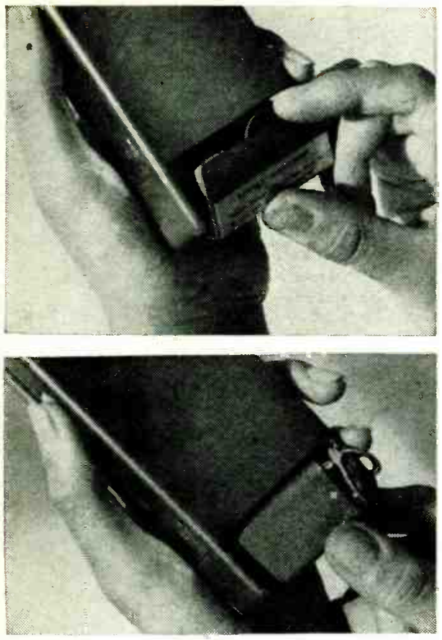
Inspect each set carefully. Look for components that have broken loose, broken leads, cracks in the printed-circuit board, and drool from dead or over-age batteries. Sometimes a small piece of metal or a wire clipping will find its way into the case and short out the set. Blow out all the pocket fuzz and dust. You'll repair a few sets this way.

If inspection reveals no visible faults or if components are mounted



View of the transceiver minus most of the components shows location of mounting screws and phone jack which must be removed before taking out the printed-circuit board.

*Applications engineer, Apollo Electric Industries, Ltd., Tokyo, Japan.



Even battery replacement can be tricky. On this set first you must remove the cover on the battery compartment. Then lift out battery and replace.

under the printed circuit board, your next step is to remove the chassis (printed circuit) from the set. This takes careful handling. These boards are fastened in place in two or more spots. If you don't get all the fasteners loose before applying pressure to the board, you may end up with a two-piece P-C board. So work carefully and never apply more than moderate pressure while trying to remove the chassis.

Puzzling troubles are to be expected. When you get the case open, you may find that the set works again. Yet when you close it up, it stops operating. For example, there's one set that has a pocket clip with two spring-retaining legs that fit through the front of the case. A heavy-handed operator can force the clip down enough to short the antenna. The solution to this problem, once it is located, is to clip off a small piece of the offending leg and stick a piece of electrical tape onto the antenna to prevent further shorts.

Keeping the heavy-handed customer in mind, look for mechanical failure throughout the set. Push-to-talk switches don't last very long if the operator applies too much pressure. In some sets the switch won't break, but the shaft will bend. Straighten it and tell the operator what happened and why.

Check the volume control too. It may have been forced past the limit of its rotation. Occasionally someone leaves batteries in the set a little too long and leakage finds its way onto the foil of the P-C board. This can cause shorts between or corrosion of the thin foil conductors. After removing the defective batteries, clean the board with radio solvent applied with a cotton swab. Then flow solder over the damaged foil to build up its thickness.

If a set has been exposed to extremes of temperature, look for dried-out electrolytics first. As a rule, the transistors will not fail because of extremely high temperature, but it could happen. Check the transmitter output transistor in particular.

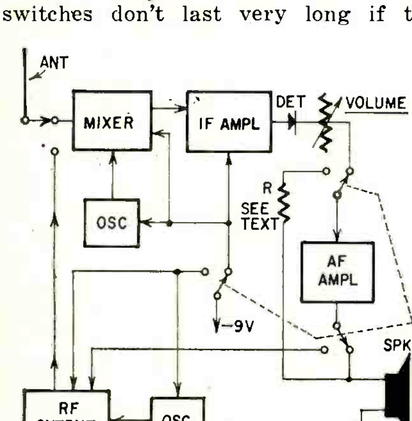


Fig. 1—Generalized block diagram of typical CB transceiver.

Receiver alignment

If you've never aligned a transistor receiver, keep in mind that they do not take kindly to inputs greater than about 500 μv. A block diagram of a typical unit is shown in Fig. 1. So keep the signal-generator output low! Better still, use the CB crystal checker (it checks crystal activity) and the set's own *transmitter* crystal as a source of alignment signal. Place the crystal checker close to the transceiver so you can hear its output and keep backing the checker farther away as the alignment brings up the sensitivity of the set. Be extra careful not to align to the image frequency. To check this, listen to a known good set on the same channel the repair job is on and make sure you're receiving the same station on both sets at the same time.

Multiple-conversion superhets call for extra care in alignment as it is possible to tune the second mixer to an image of the first mixer's i.f. or vice versa! This will result in puzzling images and reduced sensitivity until the trouble is located and the set retuned.

When aligning the i.f. transformers, disable the local oscillator by shorting the oscillator coil or pulling the oscillator crystal. For accurate output indication and best alignment, hook the vtvm's dc probe to the emitter of the first i.f. transistor and tune the i.f. transformers for *minimum* voltage across the emitter resistor to the common battery return line.

Should an i.f. transformer have to be replaced and you think you have the exact — or nearly exact — replacement, check all the other i.f.'s in the set for proper connections. Should the new transformer refuse to align properly, with the set oscillating or motorboating, the transistor ahead of the transformer may be improperly impedance-matched and will have to be neutralized.

To neutralize an i.f. stage, remove the existing neutralizing capacitor, if any, and replace it with a slightly smaller value, shunting it with two lengths of insulated hookup wire twisted to form a "gimmick." Adjusting the gimmick usually cools off the stage enough to permit successful alignment. To make doubly sure that the set is "cool," always apply slightly higher battery voltage than the nominal battery supply. Some fresh 9-volt batteries measure 10 volts under load and a hot i.f. string will really take off.

Remember that an accurately calibrated signal generator is a must for accurate channel calibration!

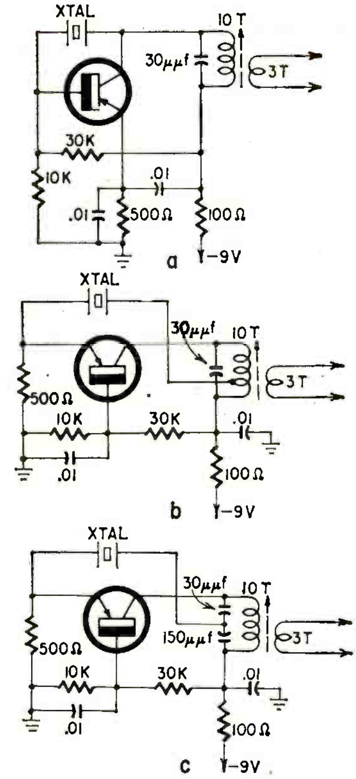


Fig. 2—Three basic CB transceiver oscillator circuits. a—Grounded-emitter "Pierce". b—Grounded-base, collector-emitter feedback. c—Grounded-base "Colpitts". By replacing the 100-ohm resistor to the −9-volt supply with a modulation transformer, any of these stages could be used as a modulated oscillator.

Transmitter tuning procedures

WARNING! DO NOT TUNE THE TRANSMITTER OSCILLATOR UNLESS YOU HOLD A FIRST- OR SECOND-CLASS RADIOTELEPHONE LICENSE!

Tuning up a CB transmitter without a valid FCC phone ticket in your possession could result in legal action against you or the set owner.

Most transmitters are relatively simple. However, an occasional complex neutralization circuit or impedance-matching circuit is found.

Alignment of the transmitter oscillator is generally not necessary unless the owner requests a channel change. Three transceiver oscillator circuits are shown in Fig. 2. If only one or two channels difference is involved, no tuneup may be necessary. For a change from, for example, channel 2 to channel 20, repeaking the oscillator and final tanks will be necessary. Use the heterodyne frequency meter to check the transceiver oscillator for exact alignment. The

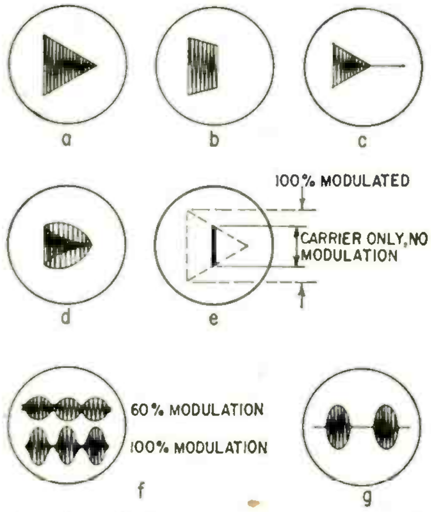


Fig. 3—CRT patterns seen using the test setup of Fig. 4. When scope is fed only rf and sweep is applied to horizontal plates, the modulation envelope can be seen clearly. a—100% modulation. b—60% modulation. c—Overmodulation. Carrier clipping. d—Phase shift in audio. e—Carrier only. No modulation. f—Undistorted waveforms of (a) and (b) using horizontal oscillator to scope CRT. g—Overmodulation, about 200%.

article "Using the BC-221 to Check CB Frequency" (*Electronics World*, May 1961) describes a method of using this instrument to check CB frequencies to within ±.0025%.

If the output of the transmitter has fallen off and you feel that alignment will bring it back up, it is quite easy to do this job. Simply set the field-strength meter about 18 inches away from the CB set and, using a fiber or nylon screwdriver, tune the final tank slug (or capacitor) until the field-strength meter shows a maximum reading. If there is an antenna loading-coil adjustment, touch it up after tuning the tank.

After all tuning is done, the input to the final must not exceed a total of 100 mw. If final input power is too high, detune the final tank slightly until the FCC limit is met. The transmitter will still function satisfactorily. If the transmitter cannot be brought within FCC limits, increase the value of the oscillator emitter resistor by 10% or 20% to drop final drive power enough to meet the limits.

To make sure that the transmitter is modulating properly, see the waveforms shown in Fig. 3 and the setup in Fig. 4. For more complete information on modulation patterns, you'll probably find the ARRL Handbook an excellent guide.

Assuming you've got your modulation analyzing system set up, whistle into the CB transceiver microphone (or

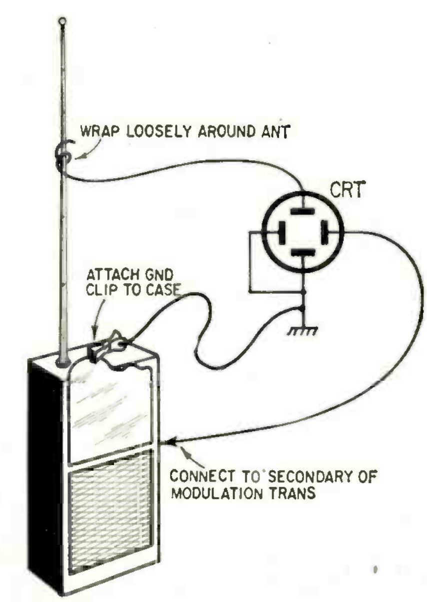


Fig. 4—Simple modulation check setup. Transceiver case must be grounded to scope.

Troubleshooting and Repair Hints

Symptom	possible troubles—repair
Set dead, no sound or transmitter output	Check battery. Replace if output low on open circuit. Locate circuit breaks and repair. Volume control may have been damaged by overrotation. Replace. Operator may have inserted battery backward. Reverse.
Receiver OK. Transmitter dead.	Push-talk switch damaged. Replace. Loose crystal or oscillator tuning slug may have dropped out. Reinsert slug. Antenna shorted. Check and clear. Antenna lead broken. Repair.
Receiver OK. Transmitter has only carrier output, no modulation.	Mike (or speaker) lead loose. Locate and repair. Push-talk switch damaged. Replace. Operator not depressing switch all the way. Instruct operator.
Receiver OK. Transmitter audio sounds gravelly or scratchy with background noise mixed in.	Loose crystal or oscillator tuning slug may have dropped out. Reinsert slug. Open bias resistor or emitter resistor in oscillator circuit. Replace. Bypass capacitor may have changed value. Replace.
Receiver and transmitter sound distorted.	Check battery. Replace if output low on open circuit. Main filter capacitor dried out. Replace. Audio transistor bias or emitter resistor changed value. Locate and replace. Inspect for cold-solder joints. Repair. Bad transistor in audio stages. Replace. If bad unit is one of two in push-pull output stage, replace both.
Receiver OK. Transmitter output weak.	Antenna shorted. Check and clear. Battery weak, OK for receiver but not transmitter. Replace. Antenna not fully extended. Operator touching antenna during transmission. Operator allows antenna to touch something during transmission. Set too far off vertical.
Transmitter OK. Receiver dead.	Check battery supply to rf and i.f. sections. Also check decoupling resistors. Replace defective components. Repair open circuits. Inspect bypass capacitors. Replace defective units. Check detector diode with ohmmeter. Replace if front-to-back ratio less than 10:1. Check all i.f. transformers with ohmmeter. Replace defective units. Push-talk switch spring weak and switch hangs up in transmit position. Inspect and repair.
Transmitter OK. Noise audible from speaker, but no reception.	Local oscillator incorrectly peaked. Retune.
Transmitter OK. Receiver sensitivity low.	Battery weak. Replace. Receiver antenna input coil not peaked properly. Retune. I.f. transformers not peaked correctly. Retune.
Mechanical damage. Obvious and unseen.	Inspect set carefully. If obviously caused by improper use or willful disregard of operating instructions, instruct operator carefully. Stress that fault will recur if operating procedure is not changed to conform with manufacturer's instructions.

speaker) and observe the scope pattern. It should be a sharply defined horizontally oriented triangle. If the triangle is not a triangle but a "lazy" pyramid with its top cut off, you are not getting 100% modulation. If the triangle has a horizontal line spread from its point outward, you may be overmodulating. A loopy-appearing pattern indicates either phase shift in the monitor hookup or in the set's audio circuits.

Note that overmodulation is

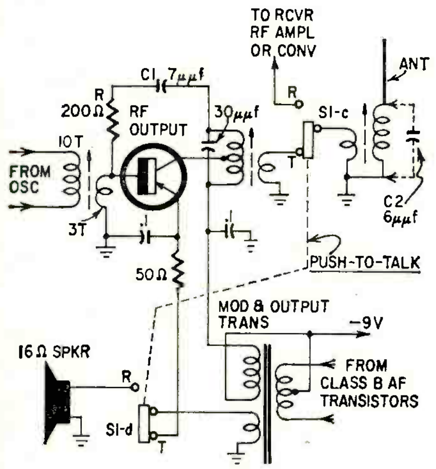


Fig. 5—Typical output stage of a transistorized CB transceiver. Note similarity to circuit of i.f. amplifier (ignoring the modulator transformer). Network R, C1 is needed to prevent transmitter parasitics. C2 is stray capacitance.

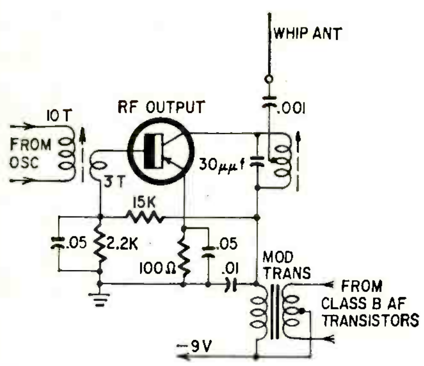


Fig. 6—Another transmitter final. Circuit is susceptible to thermal runaway, parasitics and spurious emission.

frowned upon by the FCC, even with flea-power rigs. Should it be difficult to reduce the gain of the transceiver modulator, insert a fixed resistor (cut and try for the best value) in series with the microphone line to the modulator driver —around 100 ohms would be a good starting value. Two transceiver output stages are shown in Figs. 5 and 6.

Final checkout

Having fought your way through the set, double check for unfinished business and button it up. Install the proper type of battery, check that the set still functions properly while in the shop, that the field strength has not fallen off when the metal case is closed. Then as a final check try the set out over several hundred yards to make sure it functions well. If it works OK, you can be reasonably sure you're finished. END

SW PROPAGATION FORECAST

March 15–April 15 **By STANLEY LEINWOLL†**

During the spring and fall months the sun is directly overhead in equatorial regions and illuminates the Northern and Southern hemispheres equally. As a result, the number of hours during which daylight and darkness occur at the same time in both hemispheres is at a maximum.

Since propagation of short-wave radio signals is best over all-daylight or all-dark paths, openings between the hemispheres occur for longer periods of time than at any other season.

This is particularly true of antipodal paths (to the "other side" of the earth). For example, openings from the east coast of the US to southeast Asia, and from the west coast of the US to South Africa occur for the longest periods of time.

This will happen primarily in the 15-mc band when the transmitter and receiver are in daylight, and in the 6- and 7-mc bands when both terminals are in darkness.

With the continued rapid decrease in sunspot activity, the 15- and 17-mc bands are expected to be best during the daylight hours, while the 6- and 9-mc bands will be optimum at night.

The tables show the optimum broadcast band, in megacycles, for propagation between the locations shown during the time periods indicated.

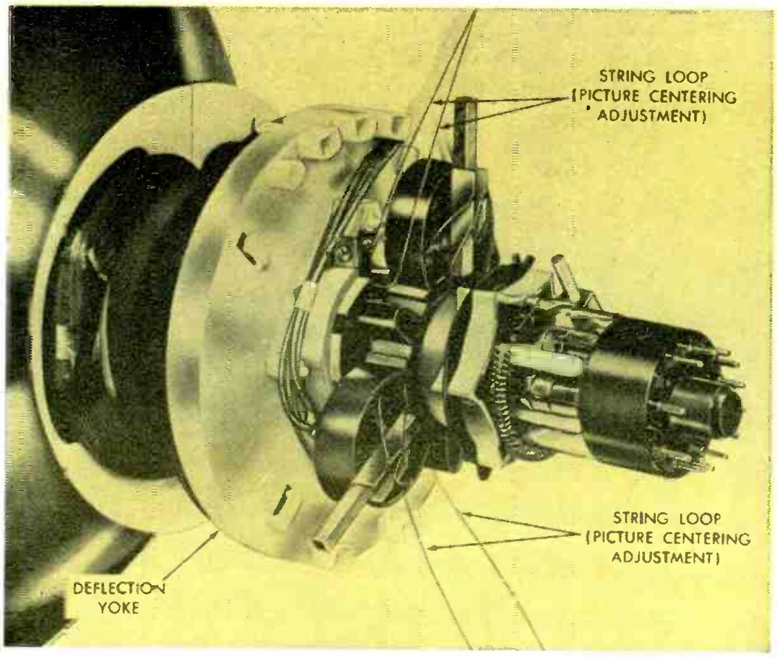
These tables are designed to serve primarily as a general guide for the listener, since day-to-day variations in receiving conditions can be considerable, particularly during disturbed radio conditions. At certain hours, propagation over some of the paths given in the tables may be extremely difficult, and stations heard over these circuits at these hours probably are utilizing very high power and high gain antennas.

EASTERN US to:	Mid	2	4	6	8	10	Noon	2	4	6	8	10
West Europe	6	6	6	15	15	17	15	11	9	6	6	6
East Europe	7	6*	6*	11	15	15	15	11	9	7	7	7
Northern Latin America	9	9	9	9	15	17	15	15	15	15	6	6
Southern Latin America	9	9	9	11	15	15	15	15	15	11	9	9
Near East	7	7	7*	9*	15	17	15	11	11	7	7	7
North Africa	6	6	6	11	15	15	15	15	15	9	7	7
South & Central Africa	7	7	7	11	17	17	15	15	11	11	11	7
Far East	7	7	6	9*	9	7	7*	7*	7	11	11	9
Australia & New Zealand	9	9	9	9	9	9	9*	17*	21	21	15	11

CENTRAL US to:												
West Europe	6*	6*	6*	15*	15	17	17	11	9	7	6	6
East Europe	7	6	6*	15	15	15	15	9	7	7	7	7
Northern Latin America	9	9	9	11	17	15	15	15	11	9	6	6
Southern Latin America	9	9	9	11*	15	15	15	15	11	9	9	9
Near East	7	6	6*	15	17	15	11	9	9	7	7	7
North Africa	6	6	6*	15	15	15	15	11	9	9	7	7
South & Central Africa	7	6	6*	11	17	17	17	11	11	11	11	9
Far East	7	6	6	6	7	7*	7*	9*	17	15	11	9
Australia & New Zealand	11	11	9	9	9	9	17	17	17	17	15	11

WESTERN US to:												
West Europe	6	6*	6	15	15	15	11	9*	7	7	7	6
East Europe	6	6*	6*	15	15	9	9	7	7	7	7	7
Northern Latin America	9	9	9	15	15	15	15	15	11	9	9	9
Southern Latin America	9	9	9	15*	15	15	15	15	11	9	9	9
North Africa	6	6	6*	15	15	15	11	11	9	7	7	6
South & Central Africa	7	7	7*	11*	17	17	17	11	11	9	7	7
Far East	7	7	6	6	7	7	7	15	17	17	15	9
South Asia	6	6	6	6	9	11*	11*	9*	9*	15	11	9
Australia & New Zealand	11	11	7	9	9	15	21	21	21	17	17	15

†Radio-frequency and propagation manager, RADIO FREE EUROPE.
*Reception may be very poor or impossible on this path at this hour.



Convergence assembly on the neck of the Zenith color picture tube.

YOU can set up COLOR

Simplified and to the point procedure speeds color setup adjustments on the new Zenith and RCA receivers.

By WAYNE LEMONS

YOU'RE GOING TO BE SEEING MORE AND more color in the next year or so. The big push is just beginning and you'll want to share in the profits. So, you must become familiar with color receivers and know how to adjust them.

With new color tubes and closer chassis tolerances, plus many refinements, all you *may* have to do with a new color set is to demagnetize the picture tube and explain tuning in the color picture to the customer. Some sets, though, will require more elaborate adjustments.

First, let us caution you not to be overly critical. At close range, almost any color set will have minor contaminations, which are invisible at normal viewing distances. The customer who insists on no color contamination at all in the black-and-white picture at a range of less than 3 or 4 feet from the picture just isn't ready for color!

Before beginning any adjustments, read these hints:

1. When adjusting a set, move it straight out from the wall. Do not rotate it.

2. The quality of the color picture depends on the black-and-white quality. Do not try to evaluate a color program until you have made all the black-and-white adjustments.

If the set is badly out of adjustment, the worst condition should be corrected first, before the full setup procedure is started. This will eliminate back-tracking later on and may show up any bad convergence components.

4. It is faster and more accurate to run rapidly through the vertical and horizontal convergence adjustments several times, rather than one slow and careful time. Observe the sequence, but do it several times.

5. Only the reactance coil and the "tint" coil may be adjusted without test equipment. All if and bandpass transformers should be left STRICTLY ALONE! *Nobody can adjust if's or bandpass correctly without complete alignment equipment. Any attempt will just make matters worse!*

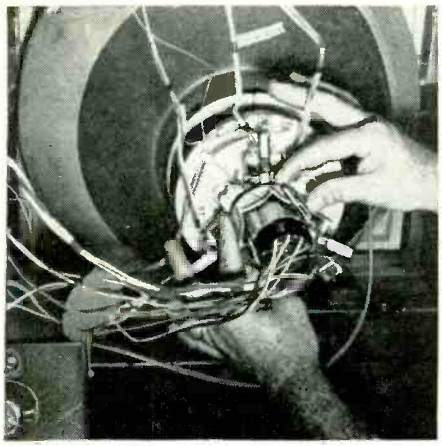
This article covers the practical angles of installing and setting up the Zenith and RCA color receivers. A story in February described the circuitry of the new Zenith TV and compared it with the RCA color set.

Preliminary set-up procedure

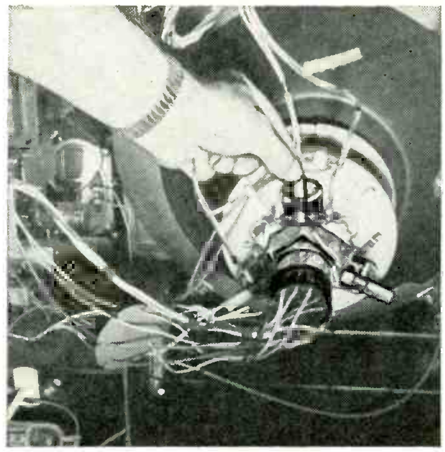
Remove the back and mount the convergence subchassis on the screws provided for it at the rear of the cabinet. Plug in the power cord and hook up the antenna. Tune in a station and adjust vertical hold, horizontal hold, fine

Adjusting height control inside contrast-control shaft. ←

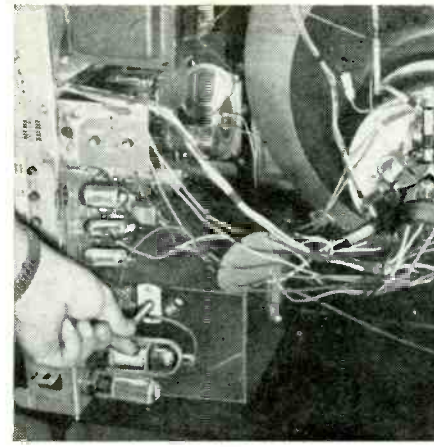
Degaussing set before starting color setup. →



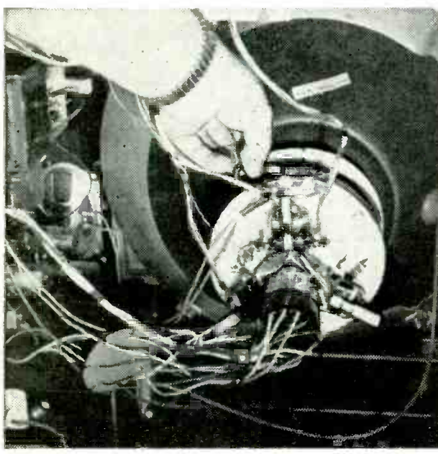
Rotating purity-magnet tabs.



Adjusting blue dc convergence magnet.



Focus adjustment is easy to get at.



Width adjustment calls for connecting jumper wire on yoke. This adds a 47-$\mu\mu$f capacitor across the yoke.

tuning, etc., just as with black-and-white sets. Adjust the height and linearity for about a 1-inch overscan at both top and bottom, with good linearity. (Height and linearity are inside the contrast and tone controls on RCA sets.) Vertical centering on RCA sets is a pot on the rear chasis apron. Magnet ring adjustments manipulated by strings coming out of the yoke are used for centering on Zenith sets.

Using a black-and-white picture, adjust focus for best detail.

Adjust the horizontal centering for a centered picture with about ½ to 1 inch overscan on the sides. If the picture needs widening, connect the attached jumper to connect an extra 47-$\mu\mu$f capacitor across the yoke.

You normally will not have to adjust agc since it is factory-set. However, if overloading occurs, you may have to move the control slightly.

Purity adjustments

Impurity is when, with only one color gun on, one or more other colors appear on the blank screen. The first cure to try is a degaussing (demagnetizing) coil. Move it about the face of the tube for a few seconds then remove the coil about 6 feet from the set and turn it at right angles before turning it off. This prevents a magnetic "set" caused by the collapsing field.

If the impurity is still there, turn down the blue screen. Center-converge the red and green fields by sliding the dc convergence magnets in their holders on the convergence yoke. Now turn up the blue and center-converge, using both the sliding magnet and the blue lateral magnet. The blue lateral magnet looks something like an ion-trap magnet on a black-and-white set but do *not* move the whole assembly like an ion trap! Simply rotate the magnet in its holder.

Now examine each color individually for posible impurities. If all three colors are pure at this point, you may go on to tracking adjustments. If the fields are still not all pure, turn on the red and turn down blue and green. Loosen the yoke clamp. Move the deflection yoke back against, but do not disturb, the convergence yoke, being careful not to tilt the deflection yoke.

Adjust the two purity magnet rings (they resemble the positioning rings of black-and-white sets) to bring the red area to the center of the picture tube. Now move the yoke slowly forward to where there is best red purity, especially at the edges of the screen, and tighten the yoke clamp. Again readjust the purity rings for a pure red field. Recheck center convergence and check each color for purity. If necessary, repeat yoke, purity-magnet and center convergence until you have *perfect* purity on all three colors.

Special note: Purity must begin and end with good center convergence. If impurity occurs on opposite sides of the raster, adjust the deflection yoke. For impurity on one side or in the middle, adjust the purity-magnet rings.

Screen color and tracking

1. Slide the NORMAL - SERVICE switch to SERVICE position (see Fig. 1 for location on rear of chassis). This disables the vertical circuit and you see a single horizontal line whose brightness is unaffected by the brightness control.

2. Turn all "screen" controls fully clockwise.

3. With a grid shunt box (Fig. 2), determine which of the three colors produces the *dimmest* horizontal line. Adjust the KINE BIAS control until this dimmest line is just barely *extinguished.*

4. Adjust the other two screen controls, one at a time, until their horizontal line is barely extinguished.

5. Return the NORMAL-SERVICE switch to normal.

6. Tune in a station.

7. Turn the blue and green drive controls fully *counter*clockwise. This should give the picture a brownish tint.

8. Alternately advance the drive controls until you obtain a normal blue-

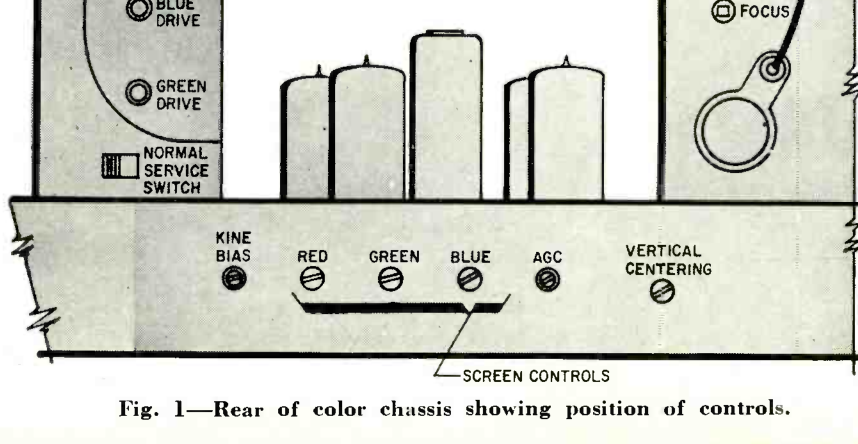


Fig. 1—Rear of color chassis showing position of controls.

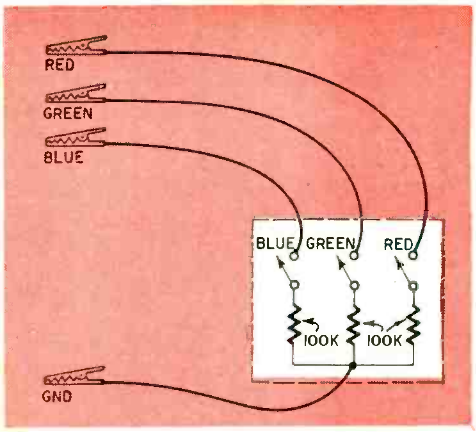


Fig. 2—Grid shunt box disables color picture-tube guns during purity, convergence and gray-scale tracking adjustments.

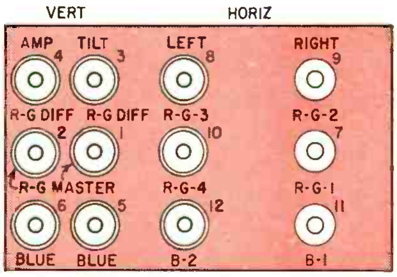


Fig. 3—RCA convergence panel with sequence of adjustment.

white picture. The picture should now track (colors not change) at all normal brightness and contrast control settings.

Convergence

There is no great mystery about making convergence adjustments. You must have a good dot-bar generator or its equivalent, but otherwise you need only common sense and some practice. Fig. 3 shows the sequence of adjustments for RCA. Fig. 4 gives the sequence for Zenith sets. As we said at the beginning, make several fast adjustments rather than one slow and careful one, since the controls interact somewhat.

The crosshatch is used for dynamic convergence adjustments. For vertical adjustments, watch *only* the complete vertical center bar, also a horizontal bar about 2 inches from the top, one about 2 inches from the bottom and one at the center—*but only where they cross the center vertical bar* (Fig. 5)!

For horizontal convergence, watch *only* the middle horizontal bar, also a vertical reference bar about 2 inches from the left, one about 2 inches from the right hand side and the middle vertical bar—*but only where they cross the middle horizontal bar* (Fig. 6).

The idea in convergence is to get good relationship between all the color lines at these checkpoints. The color bars need not overlap but should be in the same relationship. For example, if one color bar is ¼ inch above the other at a specific check point, it should also be ¼ inch above it at the other check points. Don't be afraid to jiggle the controls for the best effect even if it may not always be in the specific order—this is especially true in the final touchup procedures.

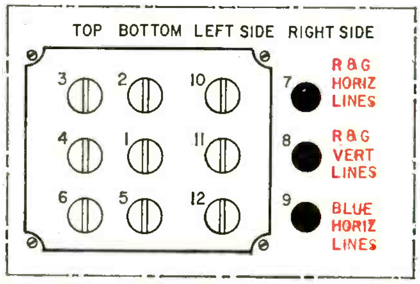


Fig. 4—Zenith convergence panel layout. Note top row of controls for red and green horizontal lines; second row for red and green vertical lines.

Final touchup

After you have completed the convergence adjustments, change the generator to dots. Carefully center-converge again (dc). Recheck all the vertical and horizontal adjustments (dynamic convergence) and then center-converge again!

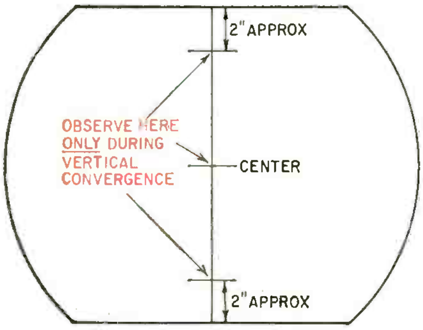


Fig. 5—What to look at in the crosshatch pattern when adjusting vertical convergence.

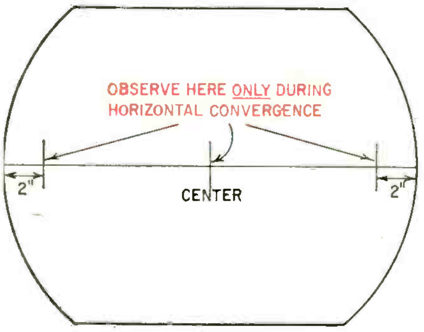


Fig. 6—What to look at in the crosshatch pattern when adjusting horizontal convergence.

Color-killer adjustment

Tune in a normal black-and-white picture. Adjust the fine tuning for sound bars then back up until they just disappear. Turn the color control full on. Adjust the color-killer control (inside shaft of vertical hold control) until the colored snow barely disappears. Recheck to see that screen color and tracking is still OK.

We especially want to thank Carl Babcoke, service manager of RCA Distributing Co. of Kansas City, for a great deal of help in the preparation of this story. END

transistor antenna coil

AN EXCELLENT — FERRITE — TRANSISTOR antenna coil can be built by using a half-section core from a discarded flyback transformer and winding approximately 28 turns of No. 20 plastic-coated hookup wire around it as shown in Fig. 1. Any ferrite unit of the two-section variety is suitable. The most difficult job is removing the bad flyback coil, which should pull right off.

Most flybacks come apart from the coil by unfastening the bolts holding the assembly and core. Some cores may have to be tapped gently with a screwdriver handle to separate the sections.

Start the antenna-coil winding by securing the first turn with electrical tape tucked under the next few windings. Tap the third turn for a low-impedance ground return — a good ground at this point makes a surprising difference—then continue winding until the last turn is in place on the core leg (Fig. 1).

It is sometimes necessary to spread the last few turns from the main body of the coil to make it track efficiently on the low-frequency end of the broadcast band when used in a superhet circuit. The coil turns on the core leg provide for this requirement.

Ferrite antenna coils and loopsticks can be critical in operation and final adjustment, so it is recommended that the constructor do a little experimenting with his coil to suit the particular setup involved.

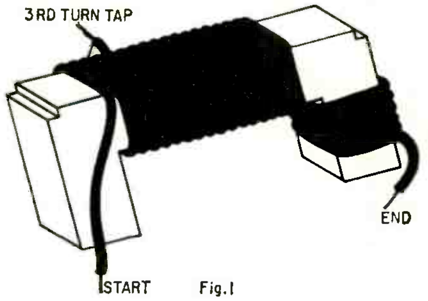


Fig. 1

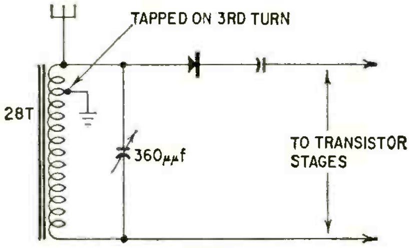
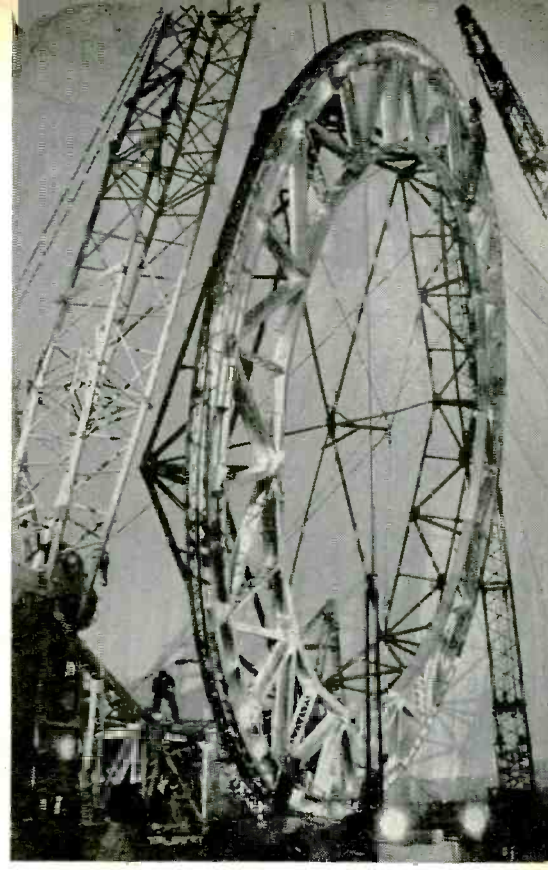


Fig. 2

Using a 1N64 diode as a simple detector (Fig. 2), a transistor af circuit with two 2N107's, a 1.5-volt penlight cell and a mighty sad pair of earphones, I was able to separate and really enjoy reception from four local stations. Volume was more than ample and comparable to anything using vacuum tubes.—*George D. Philpott*

What's New



PRECISION SATELLITE TRACKING from Bell Telephone satellite station in Andover, Me., will depend on accuracy of this 70-foot wheel (right). Machined to greater precision than a wheel for a fine watch, it weighs in at 40 tons, will be used to rotate a large antenna for experiments in satellite communications.

TUBELESS ELECTRON TUBE (left) has no envelope. Developed by ITT for use in spacecraft or satellites where there is no air, the envelope is not necessary. The particular unit shown here is a windowless multiplier phototube. A conventional tube of the same type is on the table.

CORONA HUNTER uses ultrasonic "gun" to check high-voltage transmission line for electrical leakage. Corona produces high-frequency sonic waves which are received by the Westinghouse instrument and made audible through electronic circuitry. Telescopic gunsights on the unit pinpoint corona sources. Loudspeaker is built into gunstock at ear level.

TELESCOPIC TV EYE gets once-over from two Scouts. This unit is a model of the RCA TV camera carried aboard each Ranger space vehicle. Peeping through a specially designed telescope, it will take detailed views of the moon's surface.

I HAVE A VERY THIN FACIAL SKIN AND a *very* stiff beard. Consequently, practically every day I cut myself with my razor; then I have to use alum and styptic sticks to repair the bloody damage. This can become very annoying over the years.

Well, you might ask, why not use an electric shaver? A good question, but I have tried many and found them wanting, particularly with my heavy, stiff beard. None of them give me the clean, close shave I demand.

I began to think deeply for a long time, and study the entire razor subject from A to Z because I became convinced that there *must* be something better than present-day razors. Well, there is.

A few years ago I read in a RADIO-ELECTRONICS editorial a piece that impressed me greatly. This was the August, 1957, issue and the story was entitled "Electronmechanics" (Page 29).

It pertained to a newly-issued patent by R. H. Steigerwald (Patent 2,793,281; May 21, 1957). The device is chiefly a cathode-ray oscilloscope (CRO) generating powerful cathode rays. Says the editorial:

"It uses the kinetic energy of a concentrated electron beam to drill fine holes of the unprecedented order of 0.1 millimeter. *Yet these microscopic holes can be drilled in the hardest materials, such as steel, stone, glass, tungsten (and its carbides), molybdenum, and even diamonds!*

"Using the same means, unbelievably fine holes with a diameter of only .001 millimeter can be drilled in these same substances in times measured in seconds. Nor are the holes drilled through thin foils. *They have a depth of several millimeters.* Also, the holes can be drilled conically, if desired.

"While the term 'drilling' is constantly used in the description of the invention, it should be noted that the drilling is actually done by heat. Therefore, it must be called a thermomechanical means."

This gave me the fundamental idea for my *Electronic Razor*. I have worked on it intensely for several years, and I have it perfected now. It will be ready for the market shortly.

Now, as all CRT technicians know, cathode rays are generated only in an evacuated tube. Hence all CRT's, particularly those that generate powerful streams of rays, do so only in a high vacuum. Thus the glass wall of a TV cathode-ray tube absorbs practically all cathode rays.

Up to now, cathode rays could not be projected in a satisfactory manner into the atmosphere, that is *outside* of a cathode-ray tube.

I experimented with various thin, metallic "windows", like those of a Lenard tube, from which the cathode rays would emerge, but none proved satisfactory. Such windows were of course very small, usually less than ⅛ inch in diameter, just large enough to let the cathode rays through. But, as I discovered, the electron stream was largely absorbed by the metallic window.

Finally I started to work with semiconductor windows, and that

*Institute Radiation Engineers.

NEW-electronic razor

No moving parts and no razor burn

By MOHAMMED ULYSSES FIPS, IRE*

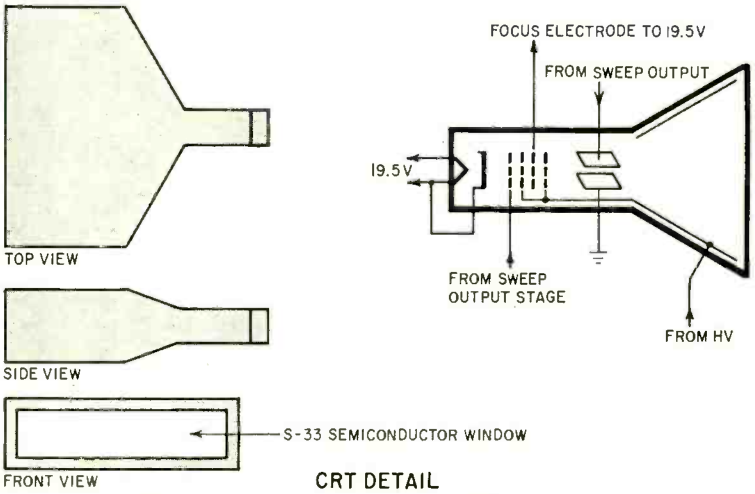


Fig. 1—Three views of the special CRT plus a schematic representation.

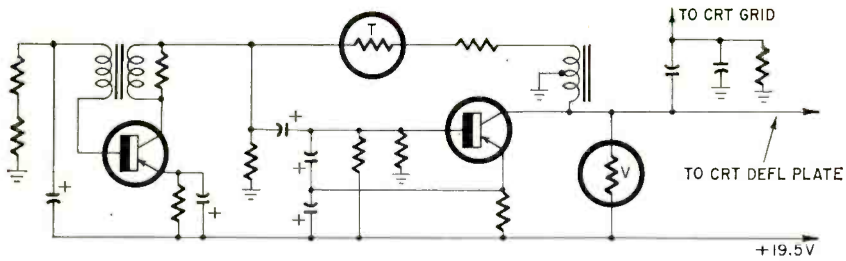


Fig. 2—This simple sweep circuit directs the sheet beam of the CRT across the screen.

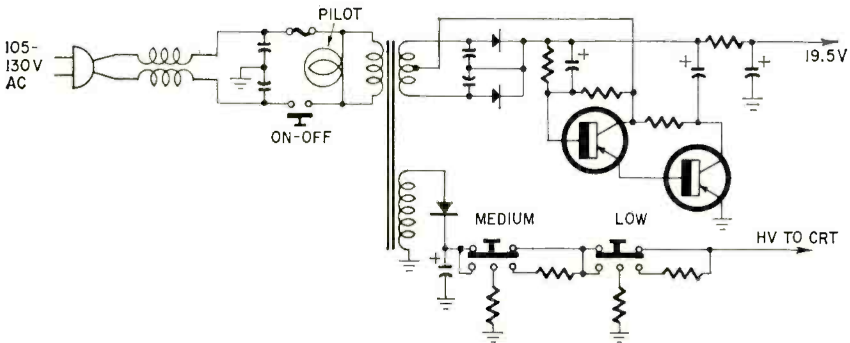


Fig. 3—Power supply for the razor. When on-off switch is closed, razor operates at maximum power to handle tough beards. Depressing the medium button reduces high-voltage applied to the CRT, and reduces intensity of the electron beam for medium beards. Depressing the low button reduces high voltage further for light beards or sensitive skin.

proved to be the solution of the problem. I tried silicon, germanium and others, but the ideal proved to be what is now technically called S-33, a combination of refractory semiconductors. It really is what I call a semi-conductor alloy. It has a very high melting point, is hard and refractory, and makes the ideal window in that it passes a very high percentage of the powerful cathode rays. For obvious patent reasons, the actual specifications and composition of S-33 and its manufacturing processes cannot be divulged here.

If the thickness of the S-33 window is chosen carefully, the cathode ray stream that issues from S-33 will not cause burns on the skin for the following reasons.

The window shape as shown in diagram Fig. 1 is rectangular, about 1/16 inch high by one inch wide. Because the cathode ray rapidly sweeps from side to side over the full ⅜-inch arc of the window, and because the whole razor sweeps over the face, too, the cathode rays can remain over only any one point on the face for a small fraction of a second. This, however, suffices to burn off the whisker protruding *above the skin*, cleanly and efficiently.

The completed electronic razor.

Note particularly that as in all safety razors, there are metal safety shields on both long sides of the CRT. They extend a fraction of an inch ahead of the face of the CRT and prevent the "razor" from coming too close to the skin.

As *the burning effect* of the electron stream is confined to about ⅛ inch from the surface of the window, the metal shields keep it from harming the underside of the nose, lips or ears. This effect, as already stated is due to the correct thickness of the S-33 window.

In practice, the electronic razor gives the fastest shave of any known razor. You go over the face *only once,* so rapidly that the average "shave" takes only about 8 to 10 seconds! Then you use the usual after-shave lotion—that is all.

I predict that in time the electron razor will supplant all present-day razors.

For fuller explanation of the technical details of the new razor, see the illustrations in Figs. 2 and 3.

* * *

Because all the research on my new razor had been done in my elaborate laboratory at home, none of my co-workers and editors knew anything about my invention—least of all the Big Boss in the front office, who has the habit of sticking his nose into everyone's affairs.

Thus, a few weeks ago, right after lunch, when the illustrious Big Man—we actually call him Bignose—was smoking his 7-inch cigar, I went in to see him with my perfected model of the electronic razor.

I explained the principle to him in a few sentences, and as I could see that he hadn't shaved that morning, I invited him to try it out. On his agreeing, I plugged the cord in the outlet behind him, and he proceeded to "shave." He did it in 10 seconds flat on my pocket stop watch. He evidently liked it, since he smiled one of his rare grimaces.

He even offered me a high price for my illustrated article and its sole publishing rights. He was in a rare mellow mood.

Suddenly his face contorted into dark clouds, and lightning flashed from his black, beady eyes.

He slammed his lit cigar ferociously onto his glass-topped desk, which instantly caused a beautiful pattern of fireworks and shredded cigar particles.

Then he yanked the plug from its outlet and smashed the only model of my electronic razor on the hardwood floor, where it created a far from beautiful pattern as all the smashed components flew in every direction.

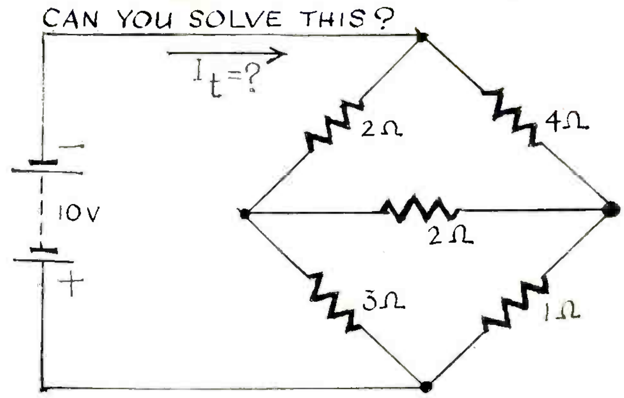
His face an apoplectic blue-red, he now bellowed: "Fips, you . . . you . . . vacuum-brained nogoodnik . . . what are you trying to do to me? You know that I own thousands of shares of Hemington and Schlick Razor companies! Don't you know that that insane contraption of yours will ruin all razor companies and me, too? Out of my sight, you . . . you electronut!"

With that he took me by the coat collar and propelled me from his office. Here I collided with the cashier, who was on his rounds distributing the weekly paychecks. He handed me my check as I sailed past him.

Still stupefied from my unexpected treatment by the boss, my eyes scanned the top of the check. It read:

APRIL 1

"My new arm tracks fine, but the record keeps falling off the turntable."



solve your problems with Kirchhoff's Laws

It's simple to figure out networks that look hopelessly complicated

By JOHN COLLINS

CAN YOU SOLVE THE BRIDGE PROBLEM IN Fig. 1? It will probably give you trouble. Why? Because most radio men are thoroughly familiar with Ohm's law but have little more than a nodding acquaintance with Kirchhoff's laws. This is unfortunate. Kirchhoff extended Ohm's theory, and his method makes it easier to analyze complicated circuits like the bridges, filters and impedance-matching networks so common in radio and electronics. So the technician who can apply Kirchhoff's method has a leg up over one whose knowledge stops with Ohm.

Kirchhoff's laws themselves (there are two) are pretty self-evident:

1. *The sum of the currents flowing into a junction is equal to the sum of the currents flowing out of it.*
2. *In any closed circuit, the sum of the voltage drops is equal to the applied voltage.*

Fig. 2 illustrates these concepts.

In applying Kirchhoff's laws to network problems, follow these rules:

1. A separate current is assumed for each closed circuit, or "loop," and is called its "loop" current. (Since the bridge circuit in Fig. 1 has three closed circuits, three loop currents are needed for the solution.)
2. In a given loop, the IR drops caused by its loop current are always positive.
3. In a given loop, the IR drops caused by the current from an adjacent loop may be either positive or negative, depending on whether the direction of flow is the same or opposite to the direction of the loop current. (Don't worry if you don't understand this; it will become clear from the examples that follow.)
4. A voltage source is given a positive sign if its polarity is such that it aids the loop current—that is, if the loop current flows from negative to positive in the external circuit. It is negative if it opposes the loop current.

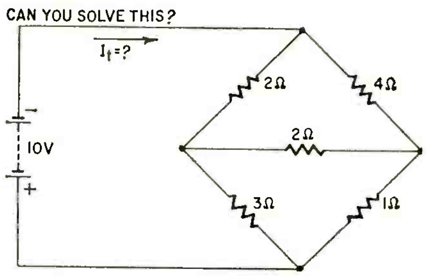


Fig. 1—This typical bridge circuit looks really hard to calculate when unbalanced.

A practical example

The above rules are logical consequences of the two laws of Kirchhoff. To demonstrate how to apply them to practical circuits, we will start with an analysis of the series-parallel circuit shown in Fig. 3-a. Since there are two loops, we begin by assuming two currents, I_a flowing through loop A and I_b through loop B. There is nothing in the rules about the direction of the assumed currents. We have shown both flowing in a clockwise direction simply as a matter of choice.

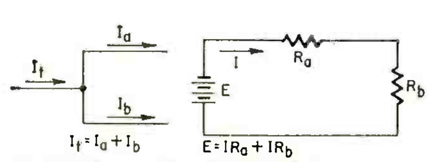


Fig. 2—Kirchhoff's two laws illustrated.

Loop A is redrawn in detail in Fig. 3-b, so that we can concentrate on the factors in that loop without being distracted by the rest of the circuit. I_a flows through both the 2-ohm and 6-ohm resistors, producing IR drops of $2I_a$ and $6I_a$. Since I_a is the "loop" current, both these IR drops are positive, according to Rule 2 above. However, I_b, from the adjacent loop, also flows through the 6-ohm resistor. Since its direction is opposite to I_a, it causes a negative IR drop, $-6I_b$, in accordance with Rule 3. The polarity of the battery is such as to aid I_a and hence, by Rule 4, it is given a positive sign.

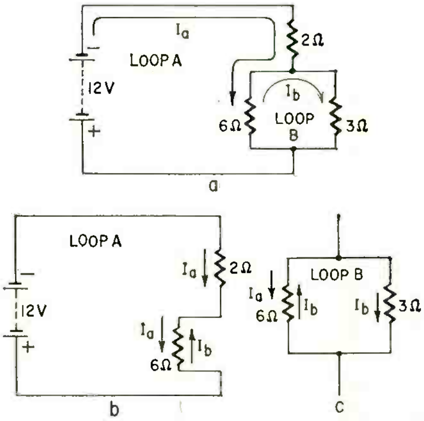


Fig. 3—How Kirchhoff's laws are applied to a simple series-parallel circuit.

Putting all these facts together, we can now write the equation describing loop A:

$2I_a + 6I_a - 6I_b = 12 \quad (A)$

When the two terms involving I_a are added, the equation becomes:

$8I_a - 6I_b = 12 \quad (A)$

We next examine loop B, as redrawn in Fig. 3-c. You will observe that I_b, the so-called "loop" current for loop B, flows through both the 6-ohm and the 3-ohm resistors, creating two positive IR drops, $6I_b$ and $3I_b$, (Rule 2). Since I_a flows in the opposite direction through the 6-ohm resistor, it produces a negative IR drop, $-6I_a$, (Rule 3). Finally, since there is no battery or generator in the circuit, the IR drops are equal to zero.

Expressing these observations as an equation, we write:

$-6I_a + 6I_b + 3I_b = 0 \quad (B)$

We add the two terms involving I_b, and the equation becomes:

$-6I_a + 9I_b = 0 \quad (B)$

We now have two equations with two unknown quantities, I_a and I_b. Any number of values can be found for I_a and I_b that will satisfy either equation taken by itself. Equation B, for example, can be solved with any of the following sets of values: $I_a = 3, I_b = 2$; $I_a = 6, I_b = 4$; $I_a = 9, I_b = 6$; $I_a = 12, I_b = 8$; etc. However, only *one* set of values will satisfy both Equation A and Equation B. Since both must be considered at the same time to find this single solution, they are called "simultaneous" equations.

Simultaneous equations are solved by adding or subtracting them in such a way as to obtain one equation with one unknown. The first step is to modify the equations by multiplying or dividing them so that a term in one becomes identical with a term in the other. As long as each of its terms is multiplied or divided by the same number, the equality of the equation is not changed.

To illustrate, we first divide Equation A by 2, and obtain:

$4I_a - 3I_b = 6 \quad (A)$

Next, we divide Equation B by 3, obtaining:

$-2I_a + 3I_b = 0 \quad (B)$

Then we add the two equations:

$$\begin{array}{rl} 4I_a - 3I_b = 6 & (A) \\ -2I_a + 3I_b = 0 & (B) \\ \hline 2I_a \qquad = 6 & \\ I_a = 3 & \end{array}$$

I_b is obtained by substituting the value found for I_a into either of the original equations. If we substitute 3 for I_a in Equation B, we obtain:

$(-2 \times 3) + 3I_b = 0$
$-6 + 3I_b = 0$
$3I_b = 6$
$I_b = 2$

To prove the answer, you can substitute 3 for I_a and 2 for I_b in Equation A. Since they are simultaneous, both equations are solved by the same set of values.

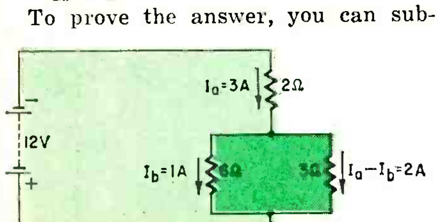


Fig. 4—Solution of the Fig. 3 problem.

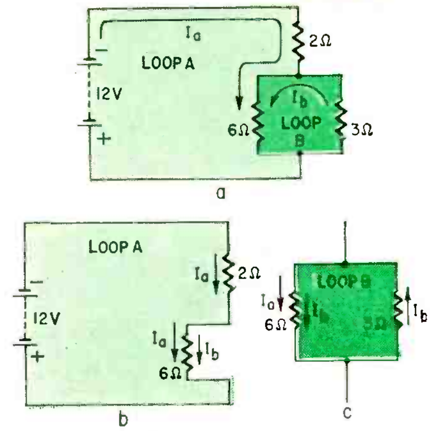


Fig. 5—Kirchhoff's laws work both ways.

The final solution is obtained by going back to the original problem and filling in the values we have found for the currents, adding or subtracting them as necessary where more than one current flows through a branch of the circuit. The result is shown in Fig. 4. I_a, a current of 3 amperes, flows through the 2-ohm resistor; I_b, a current of 2 amperes, flows through the 3-ohm resistor, and 1 ampere, the difference between I_a and I_b, flows through the 6-ohm resistor.

It's hard to go wrong

In the foregoing example, current flow was in the direction we originally assumed. In more complicated circuits it is not always easy to tell beforehand which way the current will flow through a particular branch. Before leaving this example, therefore, let's see what would happen if we had guessed wrong on the direction of current flow and had assumed I_b to flow counterclockwise, as shown in Fig. 5.

With the detailed diagram in Fig. 5-b before us, we write the equation for Loop A:

$2I_a + 6I_a + 6I_b = 12 \quad (A)$

You will notice that this is identical with the equation we previously found for loop A, except that the voltage drop caused by I_b now has a positive instead of a negative sign. This is because I_b now is assumed to flow in the same direction as I_a through the 6-ohm resistor, and Rule 3 applies. Adding the two terms involving I_a and dividing the entire equation by 2, we obtain:

$4I_a + 3I_b = 6 \quad (A)$

Referring to Fig. 5-c, we write the equation for Loop B:

$6I_a + 6I_b + 3I_b = 0 \quad (B)$

This equation is the same as in the original example except that the IR drop caused by I_a in the 6-ohm resistor is now positive, since I_a is now assumed to flow in the same direction as I_b.

When the terms involving I_b are added and the entire equation is divided by 3, we obtain:

$2I_a + 3I_b = 0 \quad (B)$

We then eliminate I_b by subtracting the two equations:

$$\begin{array}{rl} 4I_a + 3I_b = 6 & (A) \\ 2I_a + 3I_b = 0 & (B) \\ \hline 2I_a \qquad = 6 & \\ I_a = 3 & \end{array}$$

I_b is found next by substituting 3 for I_a in either of the equations. If we substitute in Equation B, we obtain:

$(2 \times 3) + 3I_b = 0$
$6 + 3I_b = 0$
$3I_b = -6$
$I_b = -2$

A negative sign in the solution means that we have assumed current flow in the wrong direction, and that it actually flows in the opposite direction. In other words, our assumption that I_b flows counterclockwise is false, and it actually flows in a clockwise direction. If we make this correction, we wind up with the same result as in the original solution, even though we started with a false assumption.

The fact that answers are *always* correct, no matter what preliminary assumptions are made, is one of the more attractive features of the Kirchhoff technique. At the risk of working this example to death, let's try one more set of assumptions, as shown in Fig. 6. We again assume that both I_a and I_b flow in a clockwise direction, but this time we assume that I_a takes the long route, though the 3-ohm resistor.

The details of loop A are shown in Fig. 6-b. Observing the rules previously stated, we write the equation for that loop:

$2I_a + 3I_a + 3I_b = 12 \quad (A)$
$5I_a + 3I_b = 12 \quad (A)$

Referring to Fig. 6-c, we next write the equation for loop B:

$3I_a + 6I_b + 3I_b = 0 \quad (B)$
$3I_a + 9I_b = 0 \quad (B)$

Equation B is then reduced by dividing it by 3, and we obtain:

$I_a + 3I_b = 0 \quad (B)$

The solution is completed as in the previous examples, by subtracting the two equations to eliminate I_b and thus

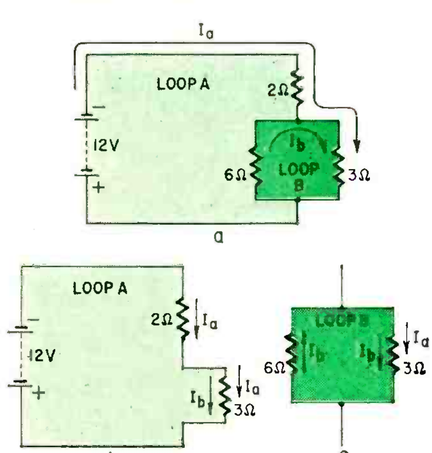


Fig. 6—In fact, they work three ways.

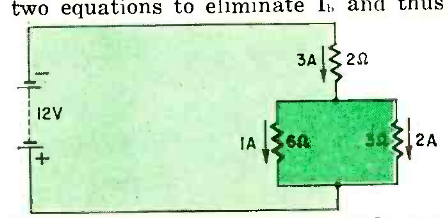


Fig. 7—Fig. 6's way of getting the answer.

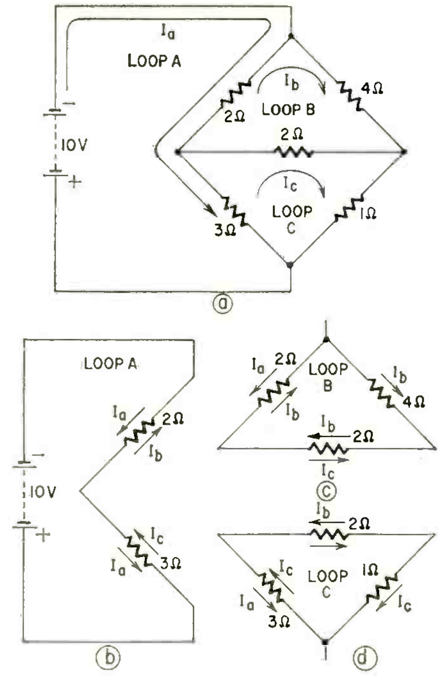


Fig. 8—Back to the bridge circuit.

find the value of I_a. That value is then substituted into either of the first equations to obtain the value of I_b. This procedure yields $I_a = 3$, $I_b = -1$.

The negative value means that I_b actually flows counterclockwise. The result is illustrated in Fig. 7. I_a flows downward through the 2-ohm resistor, and I_b flows downward through the 6-ohm resistor. In the 3-ohm resistor, the current is the difference between I_a and I_b, or a current of 2 amperes in a downward direction. So the final solution is the same as in Fig. 4, even though we started with a different set of assumptions.

The several other possible combinations will all give the same answer—you can't go wrong!

Solving a real problem

The real benefits of the Kirchhoff method show up in problems that are hard to handle with Ohm's law. Now that we are familiar with the ground rules, we can tackle the bridge circuit of Fig. 1. It is redrawn in Fig. 8 to show the three loop currents needed for the solution and to provide detailed drawings of the individual loops. We can write the equations easily:

$$5I_a - 2I_b - 3I_c = 10 \qquad (A)$$
$$-2I_a + 8I_b - 2I_c = 0 \qquad (B)$$
$$-3I_a - 2I_b + 6I_c = 0 \qquad (C)$$

No matter how complicated a circuit may be, it is easy to write the equations describing it. Solving the equations can be harder. When there are only three equations, it is not hard to combine, say, the first and third to eliminate one unknown, and then the second and third to eliminate the same unknown. This will leave two equations with two unknowns, which can then be solved as in the previous examples.

Multiplying the first equation by 2 and adding it to the third equation:

$$10I_a - 4I_b - 6I_c = 20 \qquad (A)$$
$$-3I_a - 2I_b + 6I_c = 0 \qquad (C)$$
$$7I_a - 6I_b = 20 \qquad (AC)$$

The second equation is then multiplied by 3 and added to the third:

$$-6I_a + 24I_b - 6I_c = 0 \qquad (B)$$
$$-3I_a - 2I_b + 6I_c = 0 \qquad (C)$$
$$-9I_a + 22I_b = 0 \qquad (BC)$$

We now multiply Equation AC by 11 and Equation BC by 3 and add them:

$$77I_a - 66I_b = 220 \qquad (AC)$$
$$-27I_a + 66I_b = 0 \qquad (BC)$$
$$50I_a = 220$$
$$I_a = 4.4$$

By substituting 4.4 for I_a in either equation AC or BC, we find that $I_b = 1.8$. Similarly, by substituting the values found for I_a and I_b in any of the original equations, we find that $I_c = 2.8$.

We get the final solution by going back to the circuit diagram and filling in the values for the currents, adding or subtracting them as necessary. The result is shown in Fig. 9.

If you want to experiment, you can assume different directions or paths for the currents. In any case, you should get the same result.

The above examples involve only resistance. Kirchhoff's method works just as well with impedances in ac circuits. In such problems, the instantaneous current at some part of the cycle can be used to establish direction. Once you have mastered the mechanics, you will find Kirchhoff's laws useful in analyzing a variety of circuits that don't respond to other methods. END

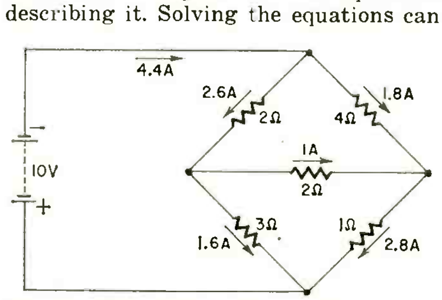


Fig. 9—Kirchhoff's laws make this as easy to solve as the simpler circuits.

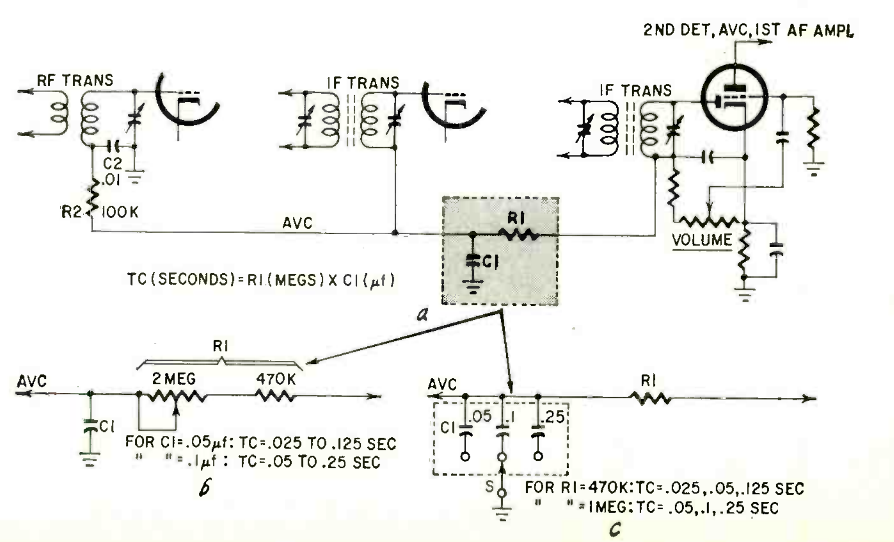
Variable Time-Constant Avc

THE usual AM-broadcast or all-wave receiver has an avc circuit similar to that shows in Fig. 1-a. The rate at which the varying avc voltage decays is determined primarily by the product of R1 and C1, and to a lesser extent by R2 and C2. The product of R1 (in megohms) and C1 (in μf) gives the avc time constant system discharge in seconds. For example, if R1 = 0.5 megohms and C1 = .05 μf, TC = .025 sec.

Ordinarily, the set designer selects a combination of R1 and C1 which is a compromise of several factors. If the time constant is too fast, the avc voltage will vary with the audio modulation of a signal, rather than with carrier strength, causing distorted reception. If the time constant is too long, tuning is difficult. When tuning across a strong station, a large avc voltage is developed, but because of the long time-constant it takes an appreciable time to decay. As a result, the receiver may be insensitive for an appreciable time after tuning past the strong station. Another disadvantage of too long a time constant is the inability of the avc voltage to follow rapidly fading signals.

Ideally, the time constant should be adjustable so that the operator can select the one best suited to the signal being received. A variable time constant can be added to existing avc systems by making either R1 or C1 variable. Fig. 1-b shows a circuit where R1 is varied, giving continuous variation of the time constant over a wide range. Fig. 1-c varies C1, using a three-position switch. Of course this does not provide continuous variation but is desirable where R1 cannot be increased in value because of possible damage to controlled tubes of high mutual conductances. In no case should R1 be made less than about 470,000 ohms.

As a general rule of thumb, the longer time constants are preferable when listening to music programs, particularly on good-fidelity receivers. The shorter time constants are more useful where fading is common. END



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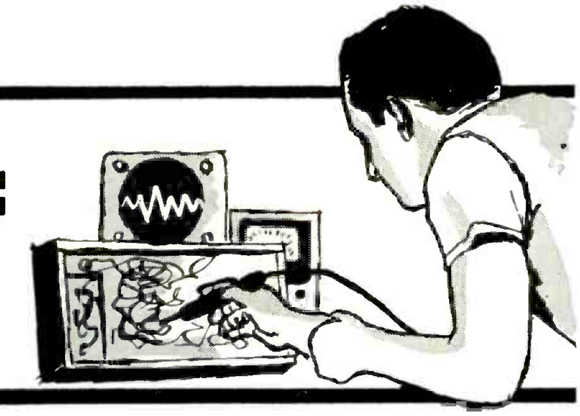


Conducted by
JACK DARR
SERVICE EDITOR

This column is for your service questions. We answer them free of charge and your name and address will be kept confidential if you wish. The main purpose is to help those working in electronics with their problems.

We've changed our target a little and are no longer restricted to TV. Radio, audio and industrial electronics problems are also grist for the mill. All letters get a prompt individual answer and the more interesting ones will be printed here. So if you have a service problem, send it here. We'll do our very best to help you solve it.

THE DESIGN OF A TV SET CAN RESULT IN troubles for the TV technician. This turns up mostly in the smaller and cheaper sets, but also crops up every now and then in the better makes. If the set designer has a tendency to overdrive his tubes, for economy, especially in the sweep circuits, their life is shortened greatly, and the resulting troubles are often blamed on the technician.

This can be avoided by checking the operating constants carefully every time one of these sets is serviced. Check plate currents on horizontal output tubes. If they are not within limits, see that they are before you return the set. For instance, if a 6BQ6 tube is used in the horizontal output stage, with a plate current of more than 100 ma, its life will be very short. If the width and high voltage are not right after this current has been reduced to proper values, replace the 6BQ6 with a 6DQ6. This tube is electrically equivalent to the 6BQ6 but will withstand as much as 140-ma plate current. It is also very useful for getting that last inch of width on some sets.

The 6W4 damper used in many older sets usually breaks down between the heater and cathode. These sets often have a highly insulated separate winding on the power transformer for the 6W4 heater. Heater and cathode are tied together at the socket. Unless the transformer has developed shorted turns in the damper heater winding, replacing the tube with a 6AX4 and cutting the tie between heater and cathode will cure the trouble. If the heater–cathode peak voltage is very high, use a 6AU4 to replace the damper. The only difficulty with this is the 6AU4 heater current. It needs 1.8 amperes as compared to the 1.2 amperes of the 6W4 and 6AX4. In a transformer-supply set, the power transformer will usually handle the added 600 ma without overheating. In series-filament sets, only tubes with the same current drain can be used.

The 6SN7 is used in quite a few sets as both vertical oscillator and output. If it gives trouble, try replacing it with a 6BL7. This tube is electrically identical, but has a higher output. If the tube is a 6BL7 to begin with, use a 6BX7. It is also identical to the 6SN7, but has more output than the 6BL7. If the set used a type 6BX7 originally, and still has short tube life and insufficient height you may be up the proverbial river. This actually happened to one well known manufacturer. The only cure was to write the manufacturer. He provided special 6BX7 tubes culled from regular production tests as being especially hot. They were marked with a big X of yellow paint.

In some special cases (we don't recommend this as everyday procedure) if the set's value warrants it, circuits may be worked over to use a different tube type entirely. For example, it might be possible to replace the vertical output transformer and use a 6CM7 or 6CS7 to replace a 6BL7. This is emergency procedure and should be used only if proper replacement parts are not available. We wouldn't recommend trying to redesign every TV set that comes along.

Low contrast

The contrast control on a Philco E3034 doesn't have enough range. I can't get enough dark and light in the pictures, only a slight change. I've checked all voltages, resistances and the agc. Brightness good, sounds good.—R.A., Olean, N.Y.

In some circuits, contrast control doesn't have the range of the standard video-output cathode type, which should run from a very pale picture to an almost completely burned-out one. This set has a sort of combination. It works with the agc and the video amplifier bias. It doesn't have the range of some other circuits.

Check video if alignment and the trap circuits in the video amplifier. The video amplifier should have a gain of over 25—4 volts peak to peak on the grid and 115 volts peak to peak on the plate. Loss of gain here affects contrast. Aside from the 6AW8 tube, another possibility would be leakage in the printed-circuit board between the contrast control and the sync separator grid.

Intermittent high voltage

I've a Philco 52T-2259 in the shop with intermittent high voltage. If I pull the cap off the second anode and put it back, the high voltage comes on. Sometimes it will go for days before the picture goes. Everything in the high-voltage system checks out good when it is working. Could it be the picture tube?—C. Z., Hillside, N. J.

Yes, it *could*, but it is a remote possibility. I'd check a few other things first.

This Philco uses a voltage-doubler system in the high-voltage supply. The plate of the 1X2 doubler is returned to the heater of the 1B3-GT through a pair of *special* high-voltage resistors, 2.5 megohms each. Either or both of these could be the cause of the trouble.

The most likely suspect would be a corroded connection on the coupling capacitor (from the plate cap of the 1B3-GT to the plate cap of the 1X2) as this was quite common in this chassis. If it is mounted in spring cups, clean these well with sandpaper and tighten. Check the resistors by replacement. Be sure to get the correct resistors; these are special high-voltage types! Standard 2.5-megohm resistors will not hold up in this circuit as many technicians have found out to their sorrow. Philco distributors should have them in stock.

The originals had a bad habit of burning in two right across the middle. They were molded carbon resistors, and the hairline break was often very hard to spot. Check the sockets on the two rectifier tubes for signs of green corrosion on the heater connections.

I believe I would check the picture tube carefully on a good picture-tube tester before doing anything drastic in that department.

Clipped capacitor

In a Tele-Tone TV-357 chassis, the .0022µf capacitor between the plate of the 6W4 damper and the accelerator grid of the picture tube has been clipped out. What is its purpose? The set seems

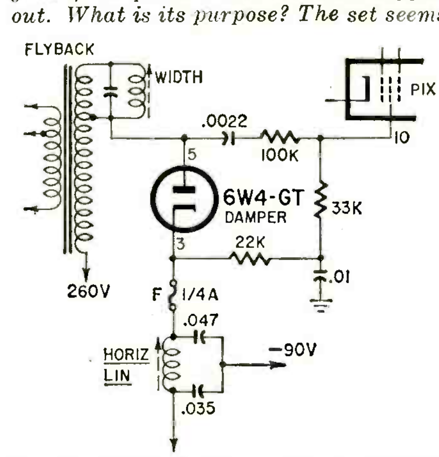


Fig. 1—Clipped capacitor is the .0022µf unit. It was part of the horizontal blanking network and should be reconnected.

to work all right without it.—M. R., New Hyde Park, N. Y.

This .0022 capacitor in Fig. 1 was part of the horizontal blanking circuit. It and the 100,000-ohm resistor in series fed a pulse (spike) to pin 10 of the CRT. This helped eliminate horizontal retrace lines, shadowing from the left, etc. As long as your horizontal oscillator stays right on the nose, you might not notice any difference in the set's performance. If you do replace it, be sure to use a high-voltage unit as it must withstand the high pulse voltage that will be applied to it.

What value

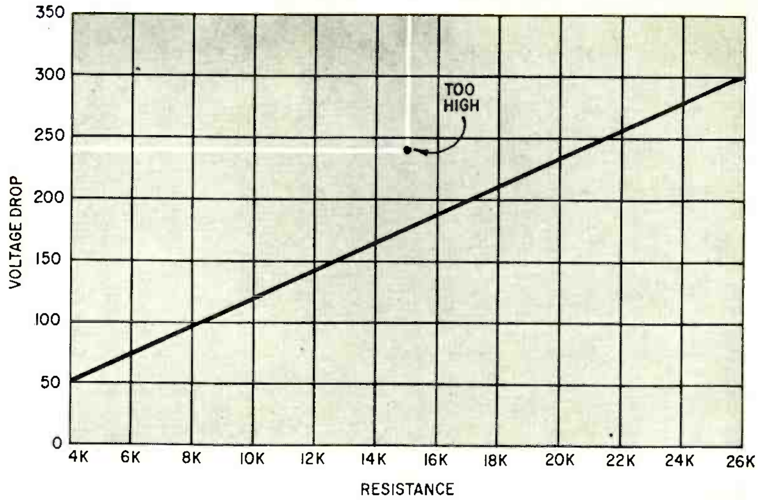
What is the value of the screen dropping resistor on the horizontal output tube of a Tele-King 812? It looks like a 10-watt resistor, but it's made of plastic without any identifying marks! I can't find a schematic for this set.—J. M., Glendale, N. Y.

I couldn't find a listing in any data services for this chassis. However, my transformer catalogues and similar sheets show the flyback and other parts the same as a "712," which is listed in Rider TV-4 and Sams 88-12. These ought to be close enough to give you the data you need.

Size of the screen resistor varies with the B-plus voltage applied to it. Fig. 2 is a chart that shows the proper screen voltages and gives you the correct amount of screen dissipation. If dissipation is too high, the result is excessive current drain through the horizontal output tube, overheating the flyback and causing short tube or flyback life. Always check the screen voltage when a horizontal output tube or flyback is replaced. This also applies whenever changes are made in the horizontal output circuit which could affect the current drain through the tube.

You can measure current directly by breaking the circuit and inserting a milliammeter. If you don't have a milliammeter handy, read the voltage drop across the resistor, measure the resistance and calculate the current. The proper screen current for the 6BQ6 should be about 12.5 ma. Now use the chart in Fig. 2. If the operating point comes out above the line you're dissipating too much wattage. Lower the operating point by either increasing the value of the dropping resistor or tapping it on to a lower-voltage source in the B-plus supply.

This procedure will lower total wattage dissipated by the tube, cool the flyback, and usually result in better operation all around. Sometimes it will even increase width and high voltage.



Triad

Fig. 2—Screen dropping resistance chart for 6BQ6 horizontal output tubes. To use the chart, measure the resistance of the screen dropping resistor. Be sure you get an accurate measurement and that a shunt path isn't throwing you off. Then measure the voltage drop across the screen resistor. Now draw a vertical line, on the chart, from the resistance value you measured straight down. Also draw a horizontal line from the voltage scale on the left side of the chart. Use the voltage drop you measured.

If the lines intersect above the diagonal line, the screen is dissipating too much power. If they meet on or below the line, everything is OK.

16- to 21-inch conversion

Can I convert a Philco 50-T1630 chassis from its present 16AP4 picture tube to a 70° 21-inch tube. Since it has a voltage-doubler high-voltage circuit, I ought to have enough high voltage.—W. B., Montclair, N. J.

You can make this conversion OK. I'd recommend a tube such as the 21EP4, which is easy to sweep, and calls for only 12 kv, which is the same as your present 16AP4. Aside from mechanical troubles in mounting the tube, your present sweep circuits should work, provided they are all cleaned and put in first-class shape.

Hula-skirt wiggle

Can you help me with this problem? The complaint is an undulating waviness of the picture, like a Hula girl's grass skirt! Also, I've got a horizontal drift. The frequency of the undulations is not constant, but varies at about 5 seconds per cycle. The drift can be corrected by resetting the horizontal hold about once every 15 to 30 minutes. I'm told this condition has existed ever since the set was purchased in 1952.—F. M. S., Philadelphia.

This is an *interesting* complaint, if nothing else! However, it should be curable. Check the two 470,000-ohm resistors across the 6AL5 horizontal phase discriminator, preferably by replacing them. Be sure that the replacements are exactly equal in value. Check the 6AL5 for equal emission of both diodes and replace it if the inequality is more than about 5%.

Realign the horizontal phase discriminator transformer, according to standard procedure. If you don't have that handy, here it is:

Tune in a picture and adjust the bottom slug on the transformer until the blanking bar moves to the right. If your ripple or wiggle shows up at this time, turn the slug clockwise until it straightens up. About ½ inch of screw protruding from the bushing is considered a normal adjustment.

Now, turn the horizontal hold control counterclockwise and adjust the top slug until the picture falls back into sync. Check by turning the hold control clockwise, then snapping the tuner off-station and back again. The picture should come in and straighten up all by itself. Turn the control counterclockwise and repeat. You may not have quite a full turn of adjustment on the control, but if the picture will come in by itself with the control in the central 250–275° of its rotation it is working fine.

While you're at it, check electrolytic capacitors connected to the horizontal oscillator circuit. Watch out for high power factor and low capacitance. If this condition has existed ever since the set was bought, you may find a filter capacitor someplace in the circuit whose value will have to be increased. Using a scope, check the B-plus supply circuits around the oscillator and phase comparer for any signs of horizontal (or vertical) frequency ripple. If excess ripple is found, add more capacitance until it is eliminated.

Vertical jitters

I have a Crosley 426 chassis, a 17-inch portable, with vertical jitter. Fellow technicians say that this is a design weakness. Do you know of any modifications that can be made to increase the stability?—R. D., Cincinnati, Ohio

From the frequency of similar complaints on this chassis, your friends may be right. The most likely suspect is the little PC network between the 6U8 sync amplifier and the vertical oscillator grid (Fig. 3). The Crosley part number is 157812-1, but it seems to

(*Continued on page* 64)

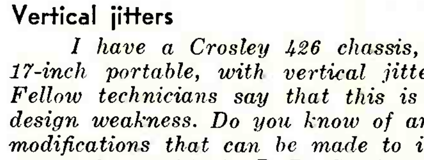


Fig. 3—This PC unit in the Crosley 426 may need replacement if the complaint is vertical jitter.

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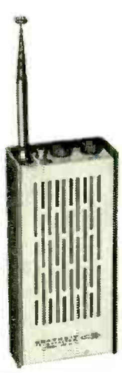

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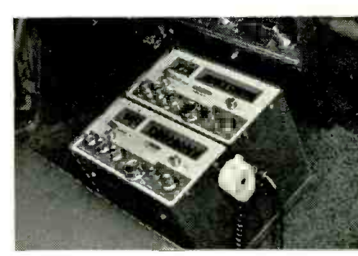

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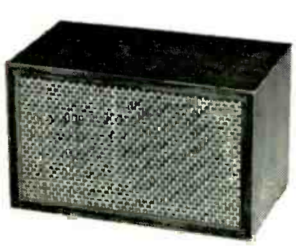

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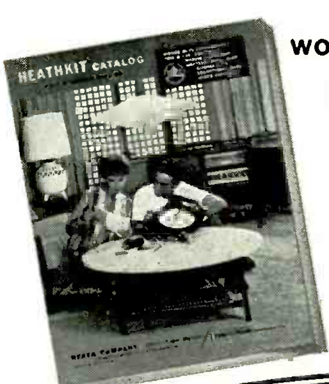

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ITEM	MODEL NO.	PRICE

(*Continued from page* 61)
be wiser to replace it with a Sprague 5HK-U5 or by individual parts if you want to.

Check all the plate and grid resistors, plate load resistors and supply voltages on the 6U8. Make sure you have plenty of vertical sync pulses on the grid waveform of the vertical oscillator.

Picture bending

I've noticed a peculiar trouble in a number of TV sets using multivibrator horizontal oscillators. The picture bends much as if 60-cycle ac was getting into the sync, although a scope shows the sync to be clean. Shorting out the ringing coil straightens the picture. Replacing all parts in the horizontal circuit does not help. Damping the ringing coil with a 10,000-ohm resistor seems to help, but I'd like to know what causes it!—W. D. O., St. Louis

The bending you mention is almost always due to lack of filtering *somewhere* in the circuit. It can be due even to a capacitance loss in the main power-supply filters, but is more often found in the low-capacitance electrolytics close to the point where the B-plus supply for the horizontal oscillator is taken off.

The electrolytic connected from B-boost back to B-plus is a frequent offender. So are agc filters which allow vertical blanking pulses from the video signal to leak into the horizontal circuits. The easiest way to find out is to check out the B-plus supply line (s) to the horizontal oscillator with a scope. Look for excessive ripple. This will cause your trouble.

You can get a similar bend from an oscillator circuit that is improperly set up—operating right on the edge of falling out of sync. Run the standard setup procedure. Short out the ringing coil and adjust the hold control for a stationary picture. Then remove the short and adjust the ringing coil slug for lock-in without moving any other controls. If the oscillator won't hold or straighten up after this, there is a defective part somewhere—a slightly-leaky capacitor, an off-value resistor or a bad part in one of the time-constant (R-C) circuits somewhere in the oscillator stage. These are usually in the grid circuits. END

Substitution Box for power resistors

10 to 25,000 ohms with four resistance units

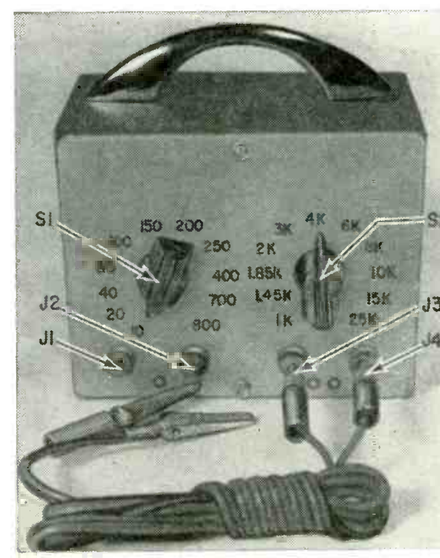
By **HOMER L. DAVIDSON**

This little resistance substitution box uses only four resistance units, yet covers 10 to 25,000 ohms in 22 steps. Furthermore, all values are rated at 10 watts minimum. How do we do it? By using four multi-element units each containing four 10-watt resistances sealed in a special steatite housing. Interconnecting the elements with two 11-position rotary switches makes available most of the 10-watt values needed in radio and TV servicing.

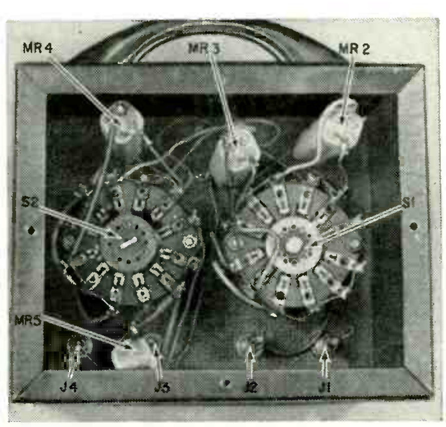
All the resistance units used are made by the International Resistance Corp. The MR2 multirange power resistor contains 10-, 20-, 40- and 80-ohm elements. Many basic connections are possible, but those shown appear most practical and useful.

The MR3 has a 10-watt power range between 50 and 1,500 ohms. Again there are four 10-watt resistors in one steatite body with 100,- 200-, 400- and 800-ohm elements. The two multirange power resistors (MR2 and MR3) are switched into use by S1, giving a useful range of 10 to 800 ohms. Also parts of both are used in the next higher resistance range, switching in various resistances to add to those in the MR4 and MR5.

The multirange MR4 power resistor covers 10-watt resistance values



The completed unit. The carrying handle is an optional convenience.



Inside the case, parts arrangement is no problem since there are only two switches, four jacks and four resistance units.

between 500 and 1,500 ohms. The MR5 has two 10,000- and two 15,000-ohm resistors. These two units are switched into higher resistance range with S2. The resistance at the output terminals will be between 1,000 and 25,000 ohms.

Looking at the schematic, we see that we get 1,450 ohms by switching into the circuit 1,000 ohms of MR4, 10, 20, 40, and 80 ohms of MR2 and 100 and 200 ohms of MR3. Similarly, to total 1,850 ohms, an additional 400 ohms of MR3 is switched into the circuit. The resistors are switched by a 2-gang 11-position rotary wafer switch. Two of these switches are needed to cover the range of 10 to 25,000 ohms.

Construction details

Only a drill and various hand tools are needed to build this instrument. First drill all necessary holes. Then spray on about three coats of white or gray enamel paint.

I soldered and mounted the MR2 and MR3 power resistors on switch SI before mounting on the front panel. Then I checked out the switching of the various resistors with an ohmmeter to make sure that there

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Two remarkable examples of SONY transistor technique are illustrated above. Each is unique (among other reasons) for the fact that it was designed, engineered and manufactured by SONY, recognized as a world leader in quality transistorized electronics. Some other reasons: The SONY 8-301W TV is fully transistorized. Has 23 transistors, 20 diodes, and operates from 3 power sources—its own rechargeable alkaline battery power pack (see illustration); standard AC or 12v auto/boat battery. Weighs only 13¼ lbs., which means it's truly portable. Direct-view 8½" aluminized screen, too. SONY 8-301W list **$249.95.** BCP-2 power pack, **$39.95.**

The SONY CB-901 transceiver employs a separate microphone and speaker, rather than the single combination mike-speaker system usually used in ordinary units. Built in accordance with Class D Citizens Band specifications, it lists at **$149.95** per pair, includes batteries, earphone and carrying case.

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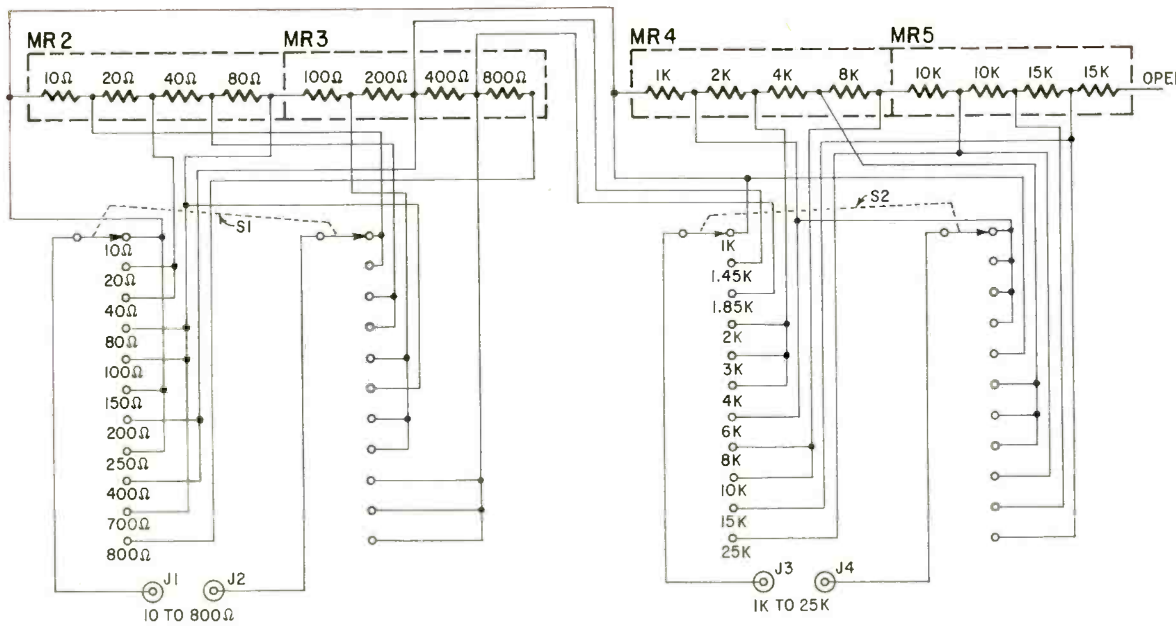


Complete circuit of the simple unit.

MR2—IRC multirange resistor, 10 watts, (10, 20, 40, 80 ohms)
MR3—IRC multirange resistor, 10 watts, (100, 200, 400, 800 ohms)
MR4—IRC multirange resistor, 10 watts, 1K, 2K, 4K, 8K)
MR5—IRC multirange resistor, 10 watts, (10K, 10K, 15K, 15K)
S1, S2—2-pole 11-position rotary switch
J1, J2, J3, J4—pin jacks.
Case, to suit
Miscellaneous hardware

were no wiring mistakes. Next, I proceeded to MR4 and MR5 and mounted them to S2. The resistance was again checked for mistakes and then mounted to the panel board. Tying in leads to form the 1,450- and 1,850-ohm resistances was done next from S2 and S1. Wiring the resistors on the switches before mounting the switches left little wiring to do once the switches were mounted to the front panel.

Switch positions are marked on the front panel and two separate pairs of jacks are available—one for each switch. Bolt a small kitchen type handle to the top of the cabinet for easy carrying. The back panel can be made from Masonite. The test probe consists of two simple alligator clips, brown ac line cord and two male phone tips.

Not only will this resistance box substitute for ordinary resistors, but different arrangements will give you other values. The wiring is simple and the cost is nominal compared to using a separate 10-watt resistor in each leg of the multi-range power resistors. END

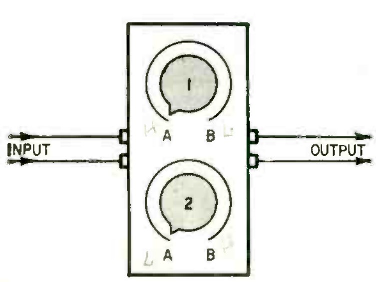
WHAT'S YOUR EQ?

It's stumper time again. Here are three little beauties that will give you a run for the money. They may look simple, but double-check your answers before you say you've solved them. For those that get stuck, or think that it just can't be done, see the answers next month. If you've got an interesting or unusual answer send it to us. We are getting so many letters we can't answer individual ones, but we'll print the more interesting solutions (the ones the original authors never thought of). Also, we're in the market for puzzlers and will pay $10 and up for each one accepted. Write to EQ Editor, Radio-Electronics, 154 West 14th St., New York, N. Y.

For answers to last month's puzzle see page 80.

Why The Decrease?

Knobs 1 and 2 are continuously variable from A to B. Set knob 2 at A



as shown, and rotate knob 1 from A to B. The output will increase.

Now set knob 2 at B and rotate knob 1 from A to B. The output decreases!

Why?—*Henry P. Houton*

Too-automatic tuner

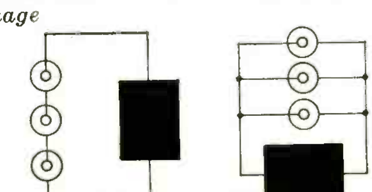
Symptoms: Automatic tuner changes stations, turns volume up or down, turns set off, etc, all by itself! Horizontal hold off quite a bit. Very fine lines on screen. Customer has turned horizontal hold control quite a bit out of range. Set is a Zenith 16C21Q.

Clues: As soon as set warms up, automatic tuner takes off and may do anything at all. Cutting it off with selector switch on back allows set to work normally, outside of horizontal hold being away off frequency.

Hint: When picture was locked in by restoring horizontal hold control to normal, automatic tuner worked perfectly. Is auto-tuner intermittent or what?

Black Box No. 4

In this variation of Black Box No. 3, which appeared in the September 1961 issue, any number of cells may be connected to the box as shown. Whether the cells are connected in series or in parallel, the current will be the same. What is in the box?—*Douglas A. Gammage*



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Typical examples where a VTVM performs best . . .

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- very high resistance measurement
- measuring peak to peak voltage
- alignment, AGC trouble shooting or ratio detector touch up
- reading 2nd anode voltage
- transistor radio voltage measurements

Typical examples where a portable VOM is best . . .

- instant action when you can't wait for warm up and stabilization. The VTVM can be warming up while you are using the VOM.
- working on a hot TV chassis
- checking anything remote where power isn't available such as antennas, auto, etc.
- reading DC current

And look at these specifications!

Voltage

6 AC and DC ranges from 0 to 1000 volts on both VTVM and VOM
6 peak to peak ranges from 0 to 2800 volts peak to peak on VTVM
Zero center scale on VTVM

Resistance

6 ranges from 0 to 1000 megohm on VTVM
2 ranges from 0 to 1 megohm on VOM

Current

one easy reading scale from 0 to 1000 milliamp on VOM

Batteries

one 1.5 volt "D" cell

Accuracy

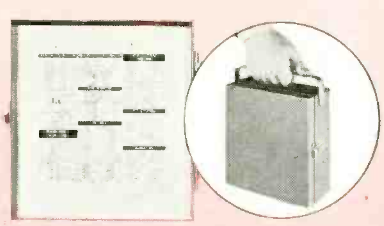
3 percent on DC volts; 5 percent AC volts with a 6 inch, 200 microamp, 2 per cent meter.

Circuit Loading

10 megohms on VTVM, 15,000 ohms on VOM low range, 5 megohms on highest range.

Special Servicing Features for the Man on the Go!

Unbreakable steel case and protective removable cover. No leads to drag or line cord to "hank".



Inside the cover is a real surprise: short cut technical data to make every job easier and faster . . . standard transformer lead color code, fuse resistor burn out voltage, transistor testing guide, etc.

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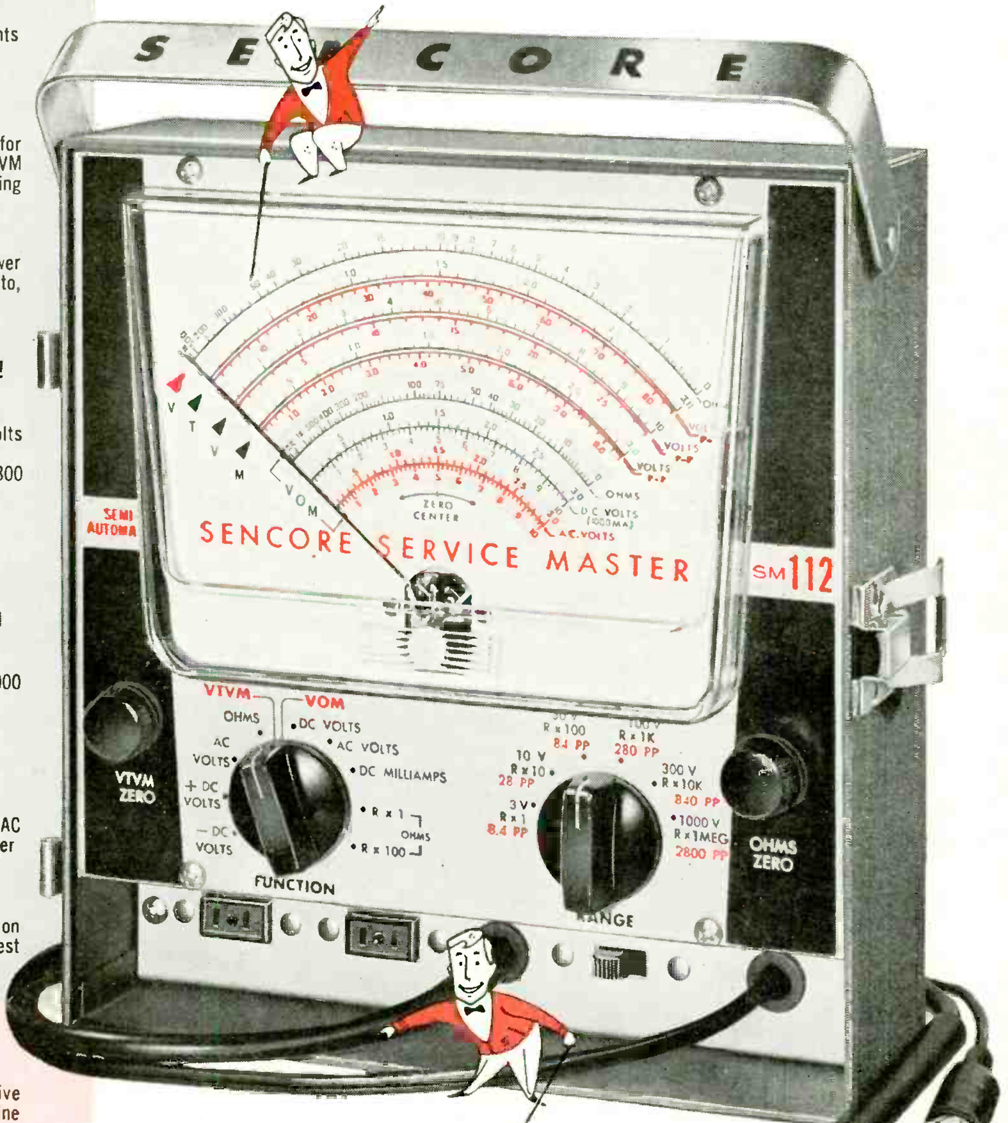

You'll like this! One permanent test lead for every job. Even the Hi-voltage probe fits on the end of it. And look at this storage compartment for test lead and line cord. The two 115 volt AC outlets sure come in handy on service calls!

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TV SET USES 6 COMPACTRONS

By T. E. DUVALL*

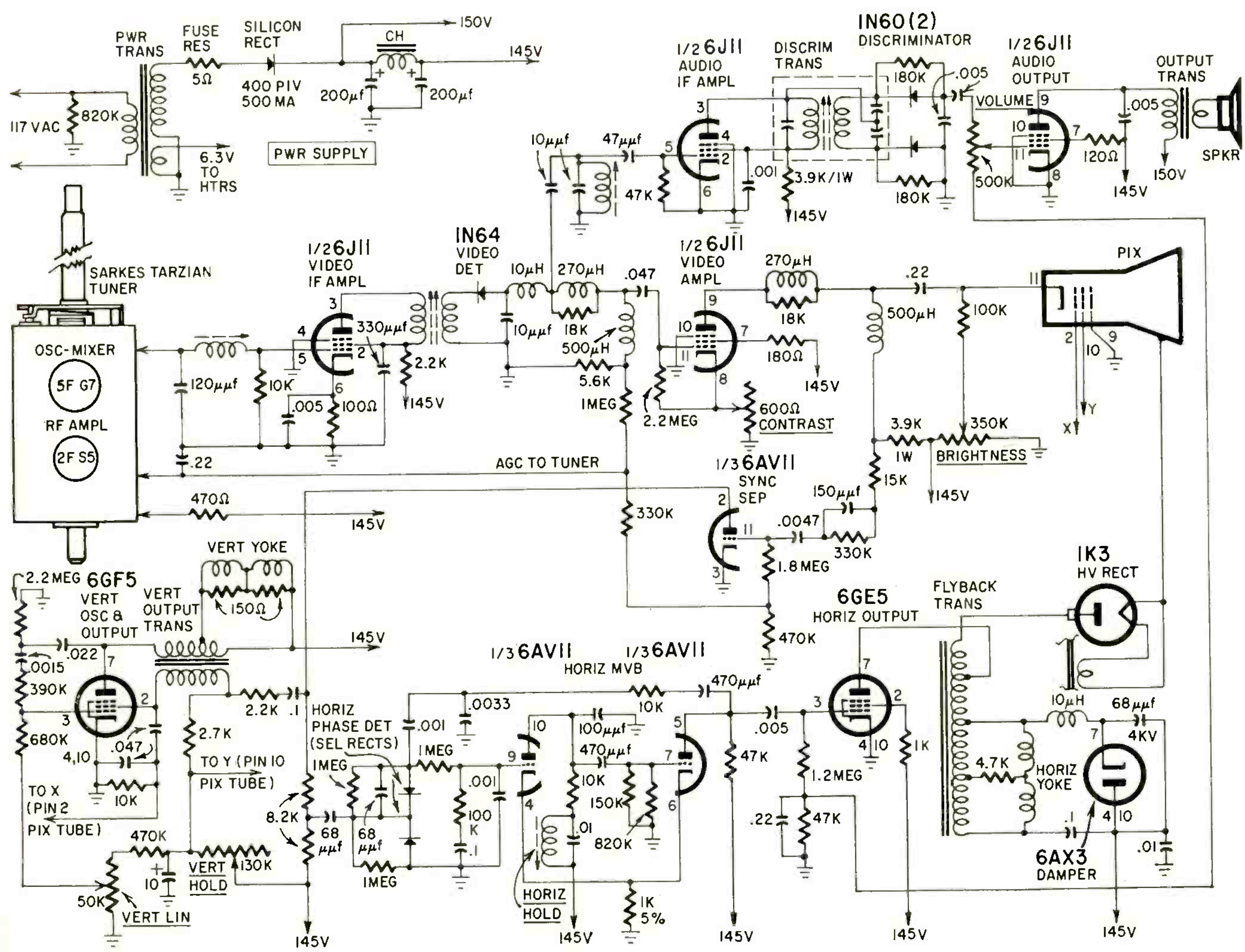
THE NEW MUNTZ MODEL 19 MET TV RECEIVER is designed around General Electric's new 12-pin multi-function compactrons and is intended for use in metropolitan areas.

While the set is designed to operate within 50 miles of the transmitter, using a standard outdoor antenna, field tests have shown adequate performance with indoor antennas in most areas.

Power consumption is about 80 watts. This permits it to run cool and leads to long life for components. The receiver uses a 92 degree deflection system with a 19-inch picture tube.

The six compactrons in the 19 Met are two 6J11 twin pentodes; a 6AV11 triple triode; a 6GE5 horizontal output; 6GF5 beam pentode, and a 6AX3 damper diode. Four standard tubes complete the tube complement—a 5FG7 oscillator-mixer, a 2FS5 rf amplifier, a 1K3 high-voltage rectifier and the picture tube.

*Chief engineer, Muntz TV, Inc.



Circuit of the Muntz receiver. The tuner is a standard Sarkes Tarzian unit and its circuitry is not shown.

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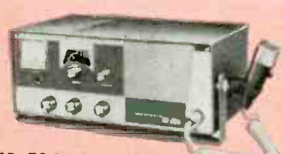

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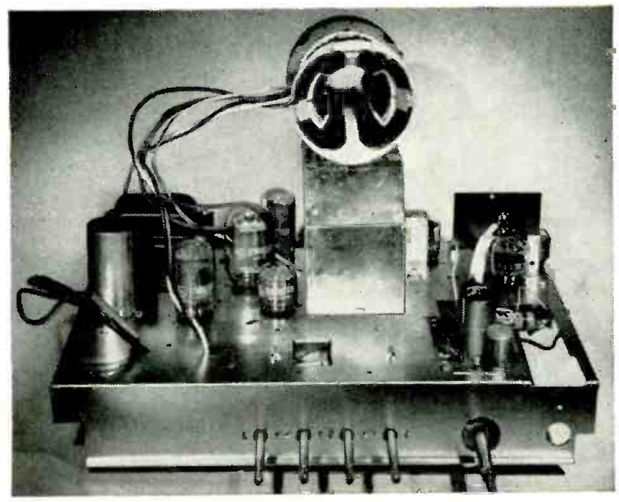

Chassis view of Muntz 19 Met. It drives 19-inch picture tube.

The tuner is a switch type made by Sarkes Tarzian.

The output of the mixer is coupled to the i.f. amplifier through low-side capacitance coupling. The i.f. transformer is double tuned and passes the i.f. signal to a conventional video detector. The detector circuit includes a tweet filter along with series and shunt video peaking. Agc is derived from the detector load, additional assist voltage being obtained from the sync separator grid. Only the rf amplifier in the tuner is controlled by this voltage.

The audio i.f., half of a 6J11, gets the 4.5-mc signal from the video detector and drives a Foster-Seely discrinator that uses two 1N60 germanium diodes for the rectifiers. The detected audio is applied direct to the audio output tube. It is operated with a grounded cathode and obtains its bias by taking a portion of the horizontal output amplifier grid bias and applying it through the bottom end of the volume control.

The video signal from the video detector is amplified through the video amplifier and applied to the cathode of the picture tube. This CRT is a new design that employs a low cutoff voltage of approximately 25 volts. The CRT grid is connected to the vertical retrace blanking network. Grid 2 is operated at approximately 27 volts obtained from the voltage source for the screen grid of the vertical circuit. The focus voltage required is approximately zero and the focus electrode is therefore connected to chassis ground.

The sync separator gets its signal from the plate load of the video amplifier and supplies negative sync for the vertical and horizontal circuits.

The vertical oscillator and output is a self-oscillating type. This circuit is connected between the plate and screen grid and oscillates because of the phase relationships of the plate and tertiary (screen grid) windings on the vertical output transformer. The resistance-capacitance networks between the plate and control grid serve as wave-shaping networks for the inverse feedback voltage going to the control grid. This voltage helps shape the current flowing through the vertical output transformer and thus controls the vertical linearity. The vertical hold control is part of a voltage-divider network from B-plus to ground. The control grid voltage can be changed a small amount with this control, thus varying the operating point of the tube and changing the operating frequency.

The vertical output (height) is controlled by changing the screen grid voltage of the tube. Vertical sync pulses from the sync separator are applied to the screen grid through the tertiary winding, thus keeping the circuit synchronized to the incoming signal.

Horizontal sync pulses are applied to an unbalanced phase detector using a pair of selenium diodes to develop the afc control voltage for the horizontal multivibrator.

The output wave-shaping network supplies the comparison voltage for the horizontal phase detector and shapes the drive signal for the horizontal output amplifier. The adjustable ringing coil core acts as the horizontal hold control.

The horizontal output amplifier drives a flyback transformer to provide approximately 14 kv at the cathode of the high-voltage rectifier. A 6AX3 compactron acts as the damper. **END**

Test Speakers Before Buying Them

A NEW PLAN INTRODUCED BY ACOUSTIC Research (AR Inc.) will make it possible to test loudspeakers in your own home before buying them.

Acoustic Research has instituted a rental plan under which any model speaker or stereo pair can be rented from the dealer for a week, for $1.00 per unit. If the speaker is purchased, the dollar is applied toward its price. Authorities and hi-fi enthusiasts have long agreed that a speaker may sound much different at home than in the showroom. While speaker manufacturers know this, never before has one of them attempted to do something about it.

EQUIPMENT REPORT

single instrument for color servicing

With this color bar/dot/crosshatch generator and a degaussing coil you're all set for color

By WAYNE LEMONS

RCA RECENTLY INTRODUCED A NEW combination instrument for the setup and service of color sets. It is a color bar/dot/crosshatch generator (model WR-64A) and outside of a degaussing coil, is the only instrument needed to enter the color service field. Field reports on the WR-64A are good. It is stable and easy to operate, and the lines and dots are exceptionally sharp and well defined.

It is fixed-tuned to channel 3, and the output cable connects to the antenna terminals of the color set. If channel 3 in your area causes beat interference—and it has to be strong to do so—you can adjust the WR-64A to channel 4 without much trouble.

Color bars are produced using the "offset-subcarrier" principle. The subcarrier frequency is 15,750 cycles below the color burst frequency of 3.579545 mc (usually referred to as 3.58 mc). This results in a 1-cycle difference frequency for each horizontal scan line, or 0° to 360°, and a "rainbow" color display on the TV screen. A rainbow pattern isn't too useful since the colors run together and do not produce distinct outlines. To get color bars, the WR-64A "gates" the rainbow pattern with narrow brightness pulses. The bars are then useful for checking brightness registration (fit). With this constantly available color signal you can check all color sets for phase (hue) and matrix, and align automatic frequency and phase circuits. Also, you can demonstrate to the customer the ability of the set to receive color when no color program is available.

The DOT position of the generator can be used for color convergence, especially center convergence. Since the dots are very small and stable, you can actually evaluate, after some experience, the quality of receiver alignment by interpreting the black edging preceding and following each dot (preshoot and overshoot).

The CROSSHATCH pattern has extremely well defined lines. Since the number of lines is fixed, both horizontally and vertically, it is easy to judge the correct amount of raster overscan. Overscan is required in all sets for best convergence.

Because the lines are sharp and stable, you can do all color convergence

Specifications for RCA WR-64-A

Output:	
Frequencies	61.25 mc (channel 3 video carrier) 65.75 mc (channel 3 audio carrier, unmodulated)
Voltage	.05 maximum (video carrier) .005 maximum (audio carrier)
Horizontal sync	15.750 cycles
Color subcarrier	3.563795 mc, keyed at 189 kc
Output impedance	300 ohms (approximately)
Test Patterns	color bar dot crosshatch
Dimensions	13½ x 10 x 8 in.
Weight	13¼ lbs.
Price	$189.50

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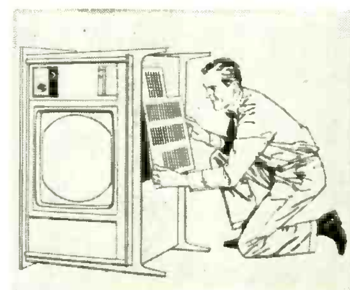

When this plate is removed, 90% of the chassis is accessible for servicing without taking it out of the cabinet. Saves time and effort! Even the back of the cabinet is specially designed to come off in seconds with just 5 easy-turn clips—no screws!

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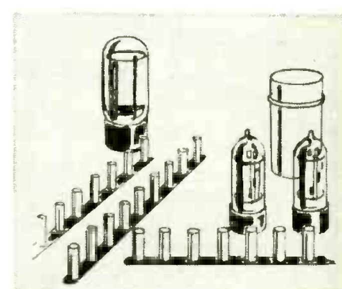

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ZENITH *The quality goes in before the name goes on* work, even dc, using only the crosshatch if you wish.

How the WR-64A works

A crystal-controlled 189-kc master oscillator feeds pulses to blocking-oscillator counters that divide the 189 kc down to the other required frequencies—15,750 cycles for horizontal sync, 300 cycles for horizontal lines, and 60 cycles for vertical sync (Fig. 1). The pulses are clipped, shaped and fed to a 6AZ8 mixer which in turn drives a 6CS6 that modulates the output of a 6BQ7 rf oscillator tuned to channel 3 (or 4).

A 4.5-mc oscillator beats against the rf oscillator in the PATTERN + SOUND position of the FUNCTION switch. This is used to adjust the color set's fine-tuning control accurately.

The color subcarrier oscillator is crystal-controlled at 3.563795 mc. This signal and the 189-kc signal are combined in a 6AZ8 keyer–shaper. The 189-kc signal, after it has been shaped here, provides the 10 separate color bars at 30° intervals. Fig. 2 shows the color bars in their correct order and phase. This display is reproduced on the WR-64A face for quick reference.

How to use the WR-64A

Because adjustment of the fine-tuning control on the receiver is important when checking a color set, a fine-tuning reference signal is supplied by the instrument. To use, you simply turn the PATTERN switch to COLOR BARS. Turn the FUNCTION switch to PATTERN + SOUND; CHROMA control to 100%. Turn the receiver fine tuning until the sound carrier blanks out the color bar pattern. Then, turn the fine tuning back until the sound interference just smoothes away. This, of course, is exactly how you adjust the fine tuning when tuning in a station.

To set the HUE control on a color set, leave as above but move the FUNCTION switch to PATTERN; adjust the hue (or tint) control on the set until the eighth bar in the pattern is cyan (blue-green). Moving the hue control in one direction should make the eighth bar turn bluer, while moving it in the other

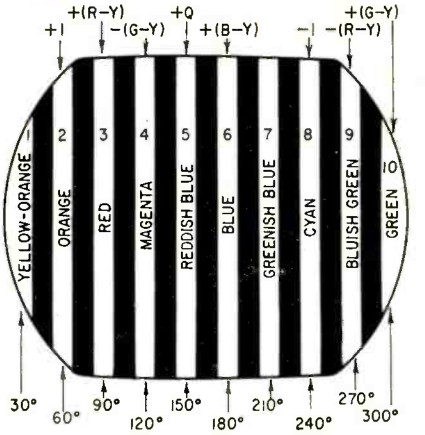


Fig. 2—Here's the color bar pattern the generator produces.

direction should make it turn greener.

To check color sync action, you can get valuable information by manipulating the CHROMA control on the WR-64A. "100%" represents normal color sync burst amplitude. To check for color-lock ability of the set, turn the

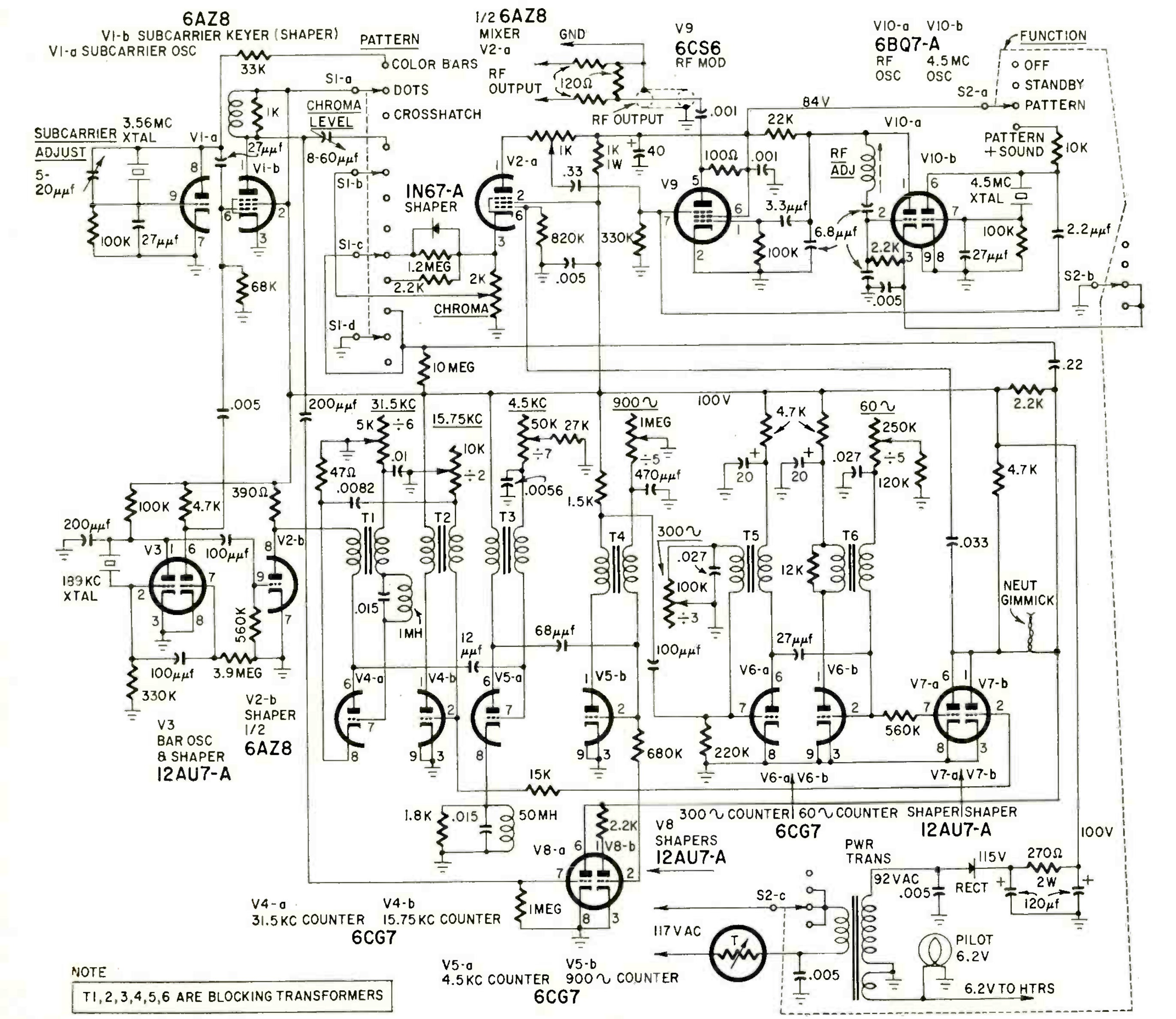


Fig. 1—Schematic of the RCA WR-64A.

CHROMA control slowly toward zero. The colors should become pale and finally disappear. Most receivers should hold the colors locked in until the colors fade away or until just before that. If the color loses color sync with only a small reduction in chroma amplitude, it indicates there is trouble, probably in the color sync section of the receiver.

To help diagnose troubles in the chroma section of a set, the CHROMA control can be used to increase the amplitude of the color sync up to 200%. This will help you to drive a signal through a weak or misaligned stage so that you can get some idea of which way to look for trouble.

When color bars are displayed on the screen, if the colors lap over into the blank spaces between the bars (colors don't fit), it probably indicates a defective delay line or incorrect alignment of the bandpass amplifiers.

All in all, the RCA WR-64A represents a distinct advance in instruments for servicing color receivers of all kinds. END

UNIJUNCTION PILOT LAMP

Transistor equipment designers generally run into the problem of providing a visual on–off indicator. A type 47 pilot lamp draws around 900 *milliwatts*—far more than the power consumed by many battery-powered transistor devices. Here is a simple

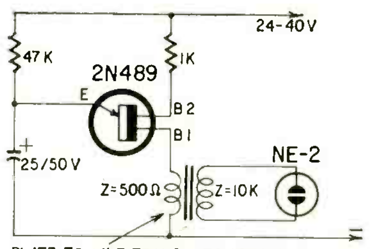
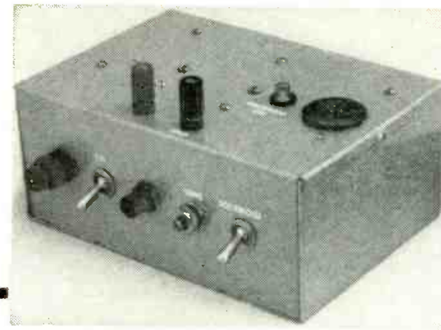


PLATE-TO-LINE TRANS=UTC SSO-3 OR EQUIV

low-power pilot-lamp circuit for transistorized equipment operating from 24–40-volt batteries. Power drain is reduced by using a flashing indicator with a short-duty cycle.

The circuit (see diagram) uses a 2N489 unijunction transistor as a low-frequency pulse generator. The generator output is stepped up by the transformer and applied to a NE-2 neon lamp, causing it to flash.

In operation, the capacitor charges through the 47,000-ohm resistor until the voltage across it reaches the critical value, which is from 0.51 to 0.62 times the supply voltage (this figure varies with the particular type of unijunction transistor used). When this voltage is reached, the transistor turns on and the capacitor discharges rapidly to ground through the transistor and transformer. The resulting stepped-up pulse fires the neon lamp. The indicator flashes about once each second and draws from 3.2 ma at 24 volts (77 mw) to 5.5 ma at 40 volts (220 mw). The light flash is just noticeable in a lighted room with a 24-volt supply and readily perceptible at 30 volts.—*Paul S. Lederer*



Sensor controls liquid levels

Two-transistor unit maintains the level of any conductive liquid

By S. A. ERCEG and N. J. CHERVENAK

Used with a sensing probe and a solenoid-operated valve, this device automatically regulates the level of a liquid in a container, prevents the accumulation of excess foam in a vat or performs any number of similar regulating jobs. Upon sensing a predetermined level of liquid or foam, the device applies 117 volts ac to the valve solenoid. Depending upon the particular application, the valve may be rigged to close when solenoid is energized and shut off the incoming flow of liquid to a container, or the valve may be rigged to open and allow the flow of an antifoam agent into a vat.

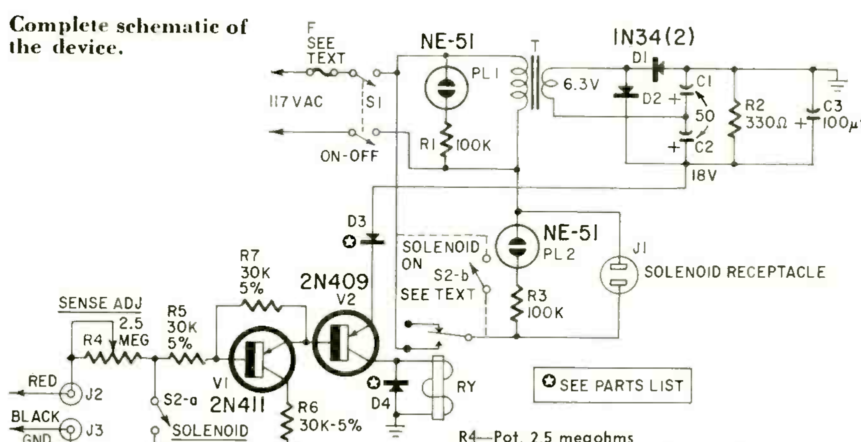
The sensing unit was developed for use in a pilot-plant operation to control the level of foam in a tall cylindrical tank. The contents of the tank are agitated by introducing compressed air at the bottom. Considerable foam is thus created and the height to which it rises must be controlled with a liquid antifoam material. The sensing unit is connected to a probe in the tank which detects the foam level when the probe contacts it. If the foam reaches the probe, the sensor causes a solenoid valve on a container of antifoam material to open so the material can flow into the tank. As soon as the material reduces the foam below the probe, contact is broken and the solenoid valve shuts off.

It was desired to start the entire operation several hours before personnel arrived in the morning. A timing system could turn on air to agitate the tank contents, but control of the foaming with minimal amounts of antifoam material was a problem until the sensing unit was installed.

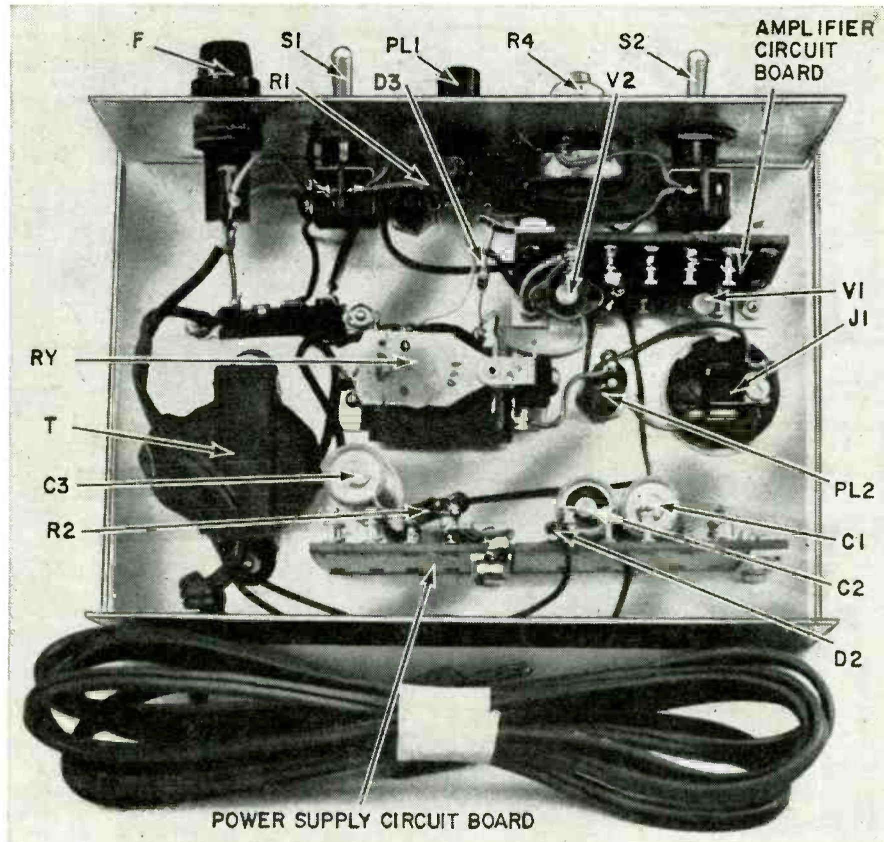
How it operates

The schematic is self-explanatory for the most part. The B-plus supply is noncritical. The approximate 18 volts dc provided by the filament transformer and simple voltage doubler does the job. When power switch S1 is closed, 117 volts ac energizes the power supply and is applied to an open contact on the relay and to one side of receptacle J1. A neon lamp indicates power on. The solenoid is plugged into receptacle J1. Black sensing jack J3 is connected to the liquid container which should be grounded. A sensing probe, insulated

Complete schematic of the device.



C1, C2—50 μf, 12 volts, electrolytic
C3—100 μf, 25 volts, electrolytic
D1, D2—1N34
D3, D4—General-purpose germanium diodes, 1N34 or equivalent
F—Fuse. See text.
J1—Chassis-mounted 125-volt ac receptacle
J2, J3—Binding posts
R1, R3—100,000 ohms, ½ watt
R2—330 ohms, 2 watt
R4—Pot, 2.5 megohms
R5, R6, R7—30,000 ohms, ½ watt, 5%
RY—Relay, Potter & Brumfield LM5, 2,500-ohm coil
S1, S2—Dpst toggles (see text)
T—6.3-volt filament transformer
V1—2N411
V2—2N409
PL1, PL2—neon lamps—NE-51
Terminal strip, as needed
Chassis to suit
Miscellaneous hardware
Circuit board, 10 terminals for power supply
Circuit board, 12 terminals for amplifier



Underchassis view of the instrument.

from the container and positioned to make contact with the liquid at the proper level, is connected to red sensing jack J2. When the liquid contacts the probe, the two-transistor amplifier is turned on. The relay is then energized and applies the 117 volts ac to J1 to energize the solenoid. A neon lamp then indicates that the solenoid is energized.

Diode D4 connected across the coil of the relay protects V2 by absorbing the voltage surge when the relay de-energizes. Resistor R7 and diode D3 provide temperature compensation for V1 and V2, respectively. The absence of either R7 or D3 may allow the transistor leakage current to build up enough to energize the relay prematurely (due to the negative temperature coefficient of the transistors).

Components and modifications

Major components requirements are very flexible. Any high-beta low-leakage (on the order of 2 or 3 microamps) transistors may be used. Transistors used in the circuit shown in the schematic are p-n-p types. If n-p-n transistors are used, simply reverse the output of the power supply and reverse the polarity of diodes D3 and D4.

Another consideration is that the fuse and relay be compatible with the power rating of the solenoid used. The relay contacts must be able to handle the current drain of the solenoid, and the fuse should be chosen accordingly. For example, if a 117-volt ac solenoid rated at 50 watts is used, its current drain is 50/117, or 0.43 amp. In this case, the relay contacts should be rated at 1 or 2 amps to insure long life, and a ½-amp fuse should be used. The relay used in the schematic can handle a solenoid with a current drain up to 2 amps with assurance of long life.

Switch S2 provides a means of manually energizing the relay and checking amplifier operation. Although not a part of the original design, an additional feature may be provided by using a three-position toggle switch for S2. In this case, the center position would be OFF, one ON position would function as S2-a shown in the schematic, and the other ON position would function to bypass the relay contacts as shown by the dotted line in the schematic. This switch may then be used to make a quick check of amplifier and relay operation and also to energize the solenoid through S2-b should the amplifier or relay fail.

Potentiometer R4 adjusts the sensitivity of the instrument. First adjust R4 fully counterclockwise, insert the sensing probe into the liquid, and then slowly adjust R4 clockwise until the relay energizes and the neon lamp glows.

Construction is completely a matter of choice and convenience. No component placement or heat sink requirements are critical. The schematic is easy to follow and the photographs show a suggested layout. The amplifier and power supply circuits are each wired on a separate circuit board. All other components are chassis-mounted with the exceptions of diode D4 across the relay coil and resistors R1 and R3 in series with the indicator lamps. END

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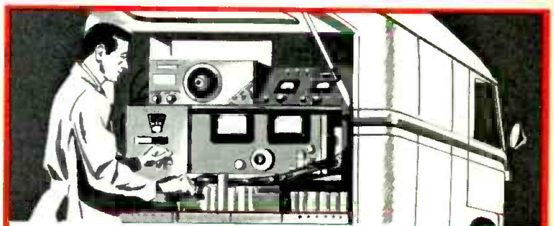

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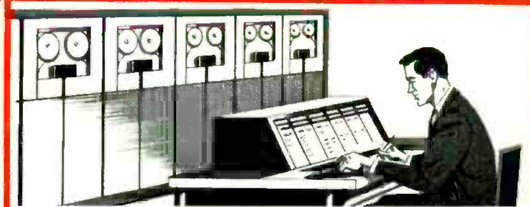

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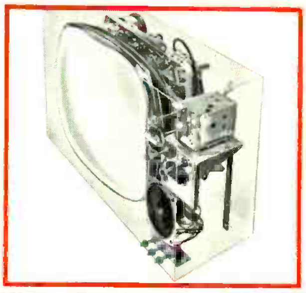

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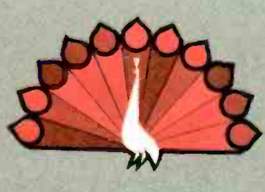

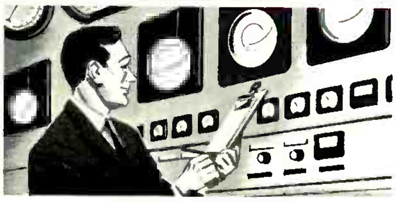

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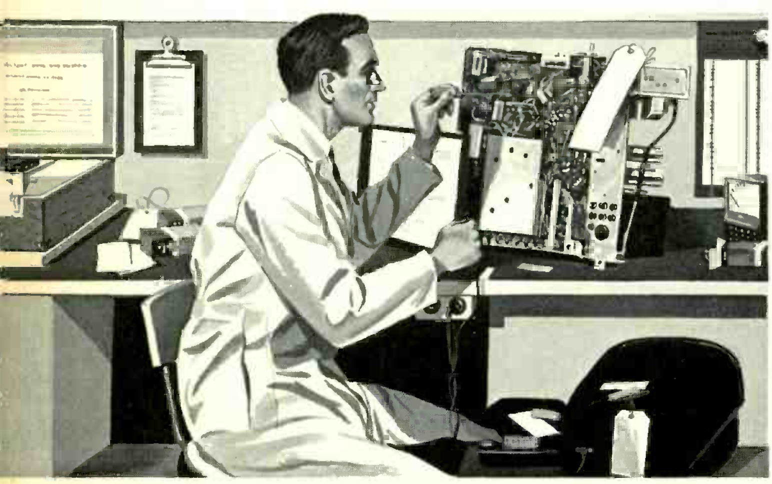

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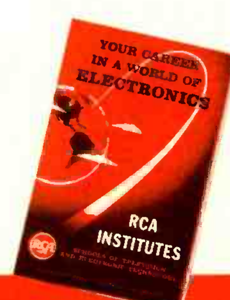

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By ED BUKSTEIN

from self-repeating timer to univibrator

Self-repeating timer: A time-delay circuit in which the relay contacts are used to recycle or restart the time delay. In the circuit shown in Fig. 27, capacitor C charges through resistor R, gradually increasing the positive potential at the grid. After a length of time, the positive potential at the grid increases enough to energize the relay. The relay contacts now close, discharging capacitor C. Since the grid is no longer positive, the relay de-energizes and the contacts open. Capacitor C now begins to charge again, and the time-delay cycle repeats itself.

Selsyn: A remote-positioning device combining both transformer and motor principles. The rotor of the selsyn is connected to the ac power line and, functioning as a primary, induces voltage in the stator windings. This voltage is applied through a connecting cable to the stator windings of another selsyn.

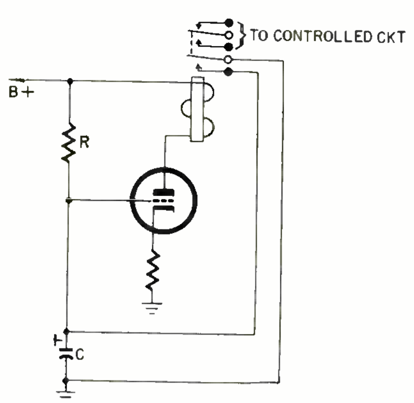


Fig. 27—The self-repeating timer recycles itself so that time delay is repeated over and over.

The resulting magnetic field established by the stator windings of the second selsyn causes the rotor to assume a position corresponding to that of the first selsyn. Therefore, one selsyn acts as a transmitter and the other as a receiver; the rotor of the receiver following any motion of the rotor of the transmitter.

Sequence timer: A succession of time-delay circuits so arranged that completion of the delay in one circuit causes the delay to begin in the following circuit. In the sequence timer in Fig. 28, the time delay in the first stage starts when the switch is opened to allow the capacitor to charge. When this capacitor has charged enough to energize the first relay, the relay contacts separate and remove the short from the capacitor in the second stage. The second capacitor now charges and the second-stage relay eventually becomes energized. The normally closed contacts now open and allow the capacitor in the third stage to charge. Three stages are shown in Fig. 28, but the circuit can be extended to a greater number. If desired, the circuit can be made self-repeating by using the contacts of the last relay to discharge the capacitor in the first stage.

Sequence timers are commonly used in resistance-welding controls to time the squeeze, weld and hold intervals (see Resistance welding).

Servomechanism: An automatic control system for maintaining some quantity at a constant value with respect to a reference quantity which may be constant or varying. In a strict sense, the term servomechanism applies when the controlled quantity is mechanical posi-

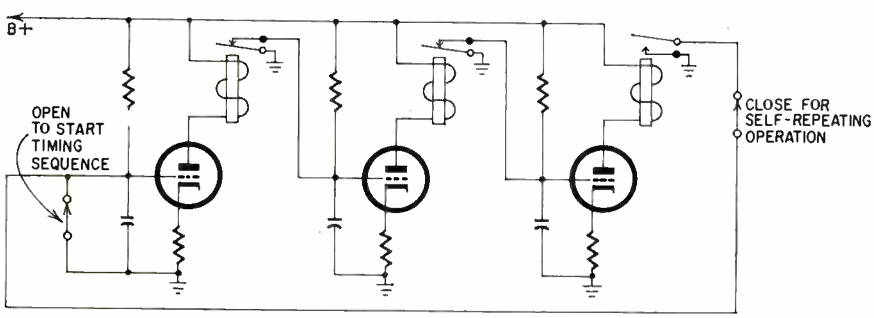


Fig. 28—Relays of sequence timer energize stage by stage. Last relay can be used to reset entire circuit.

tion, but the term is commonly used to describe any automatic control system.

Soft X-rays: X-rays of lesser penetrating power as compared to hard X-rays. The penetrating power is determined by the amount of voltage applied to the X-ray tube: the lower the voltage the lower the penetrating power. Soft X-rays, which are longer in wavelength than hard X-rays, are used for examining low-density materials such as wood, rubber, and plastics (see Hard X-rays).

Software—in the computer field, the mathematical and programming services are referred to as *software* in contrast to the equipment itself which is referred to as the *hardware.*

Spectral sensitivity: The color response of a light-sensitive device such as a phototube.

Spot welding: A form of resistance welding employing rod-shaped electrodes (see Resistance welding).

Strain gage: A transducer used to measure strain in mechanical structures. The gage consists of a length of resistance wire attached to the structure whose strain is to be measured. As a result of the strain, the wire is stretched and becomes longer and thinner. The resistance of the gage, therefore, increases and unbalances the bridge circuit in which it is connected. The output of the bridge is amplified and applied to a meter or an oscillograph recorder.

Stroboscope: A flashing light source used for studying balance and vibration in rotating or reciprocating machinery. The flashing rate is adjusted so that the machine is in the same position each time it is illuminated, making it appear stationary.

Thyratron: A hot cathode, gas- or vapor-filled tube having a control grid. Triode and tetrode thyratrons are used extensively in industry as grid-controlled rectifiers for motor-speed and welding-current controls (see Amplitude-controlled rectifier and Phase-controlled rectifier).

Thermistor: A type of resistor having a large temperature coefficient. The thermistor is used in temperature measurement and control applications.

Thermocouple: A temperature-to-voltage transducer consisting of two dissimilar metals. The output voltage of the thermocouple is dependent upon the temperature at the junction of the dissimilar metals.

Time-delay circuit: A relay circuit so designed that the relay becomes energized (or de-energized) a length of time after a switch is closed (or opened). (See Self-repeating timer and Sequence timer.)

Transducer: A component for converting a nonelectrical quantity (temperature, pressure, etc.) into an electrical quantity. The thermistor, for example, is a temperature-to-resistance converter, the photovoltaic cell is a light-to-voltage converter, etc. Transducers are useful in industrial instrumentation and control systems.

Univibrator: Same as *one-shot multivibrator.*

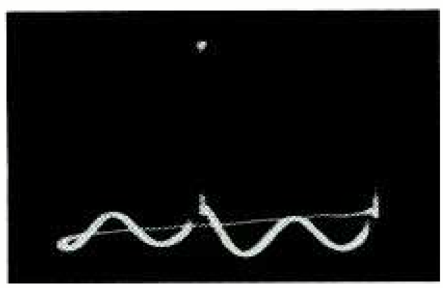
TO BE CONTINUED

What's Your EQ? *March Solutions*

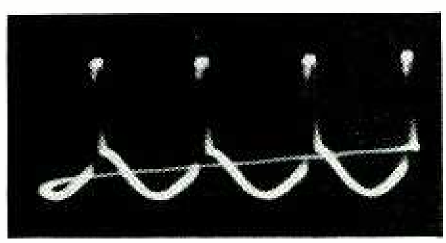
Half Speed TV

It sure does look as though a defective part should affect the dc voltages. However, R304, the 220,000-ohm resistor in the "output" plate of the 6SN7 multivibrator measured almost exactly 470,000 ohms instead of the normal 220,000! This was changing the time constant of that circuit so that the oscillator ran at half-speed. What about the dc voltages? We replaced the defective resistor and measured again, just to be certain: with either a good resistor or the bad one, we still got 120 volts on that plate, using a vtvm.

Explanation: due to the very small fraction of the time that this plate is conducting, the voltage drop (dc) was not enough to show up! However, with these symptoms, and with the oscillator operating under the conditions given, there are only *nine* parts, maximum, that could conceivably affect the operating frequency! We are assuming that the tube was changed first, which it was. It must be one of the few parts left in the circuit, and it was.

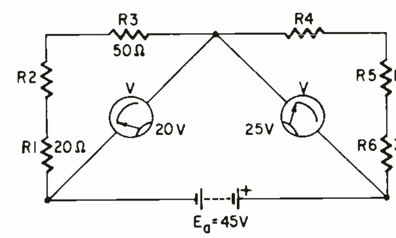


Waveform found on plate of Du Mont horizontal oscillator, pins 2 and 4. Too many wiggles for the number of spikes! Last month we showed you the correct waveform by mistake.
(See Mar., p. 57).



This is what it ought to look like! One wiggle per spike. This happens to be the one shown on the schematic, too!

Applied Voltage



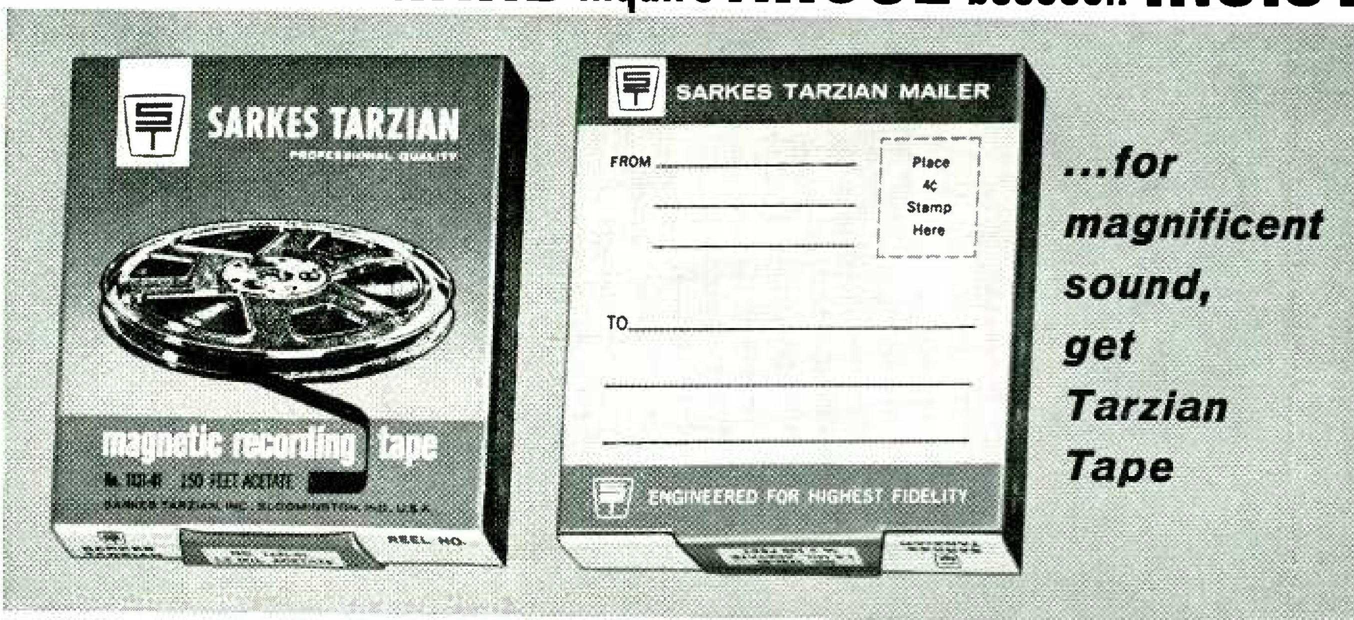
R3 equals R5 + R6, and will drop the same voltage. Therefore the voltage dropped across R3 and R4 will equal the voltage dropped across R4, R5 and R6. Thus it is clear that E_a is 45 volts.

What's the Component?

The component is an electrolytic (or other high-capacitance) capacitor. With the meter set for resistance, he charges the capacitor. He then switches to read voltage, and reads the voltage on the capacitor. This gives the internal battery voltage of the resistance range to which the meter was set.

"I worked on it until I finally forgot what it was I started to build."

LOOK ask DEMAND inquire ARGUE beseech INSIST



To earn a 3" reel of tape...

be a surveyor for Tarzian

Tarzian Tape has been advertised since December of 1960 in publications dealers are presumed to read...since February of 1961 in publications you are presumed to read. Tape quality is excellent—our engineers say, our users say. Sales are good, but would be better if more dealers carried the line. The line is 1½ mil and 1 mil acetate tape, and 1 mil Mylar* tape, in 3", 5" and 7" reels. The price is competitive.

If you have tried Tarzian Tape or if you would like to try Tarzian Tape, here's how to get a 3-inch reel of it for no money, down or otherwise. Just ask your dealer for Tarzian Tape. If he has it, check the box and ask him what dealer publications he reads. If he does not carry it, check the box and ask him why not, and what dealer publications he reads. If he says he's never heard of it, by all means ask him what dealer publications he reads.

Send us your name and address and his name and address, and his answers and a verification by any dealer employee. We'll send you a self-mailing box (as illustrated) of 3" 1½ mil acetate professional quality Tarzian Tape. The coupon is for your convenience. Use it as a guide if you'd rather reply on some other piece of paper.

**DuPont trademark for polyester film*

Sarkes Tarzian, Inc., Dept. FLI
Magnetic Tape Division,
E. Hillside Drive, Bloomington, Indiana

Send me a 3-inch reel of 1½ mil acetate Tarzian Tape in return for the survey work shown below:

Dealer Name: ______

Address: ______

______

Dealer does carry Tarzian Tape ☐
Dealer does not carry Tarzian Tape ☐ Why not?

______

______

He reads these dealer publications:

______

______

______

Dealer to sign this verification: The raw tape user named below got the answers shown above from me.

______

User name ______

Address ______

______

SARKES TARZIAN, Inc.

World's Leading Manufacturers of TV and FM Tuners • Closed Circuit TV Systems • Broadcast Equipment • Air Trimmers • FM Radios • Magnetic Recording Tape • Semiconductor Devices

MAGNETIC TAPE DIVISION • BLOOMINGTON, INDIANA

Export: Ad Auriema, Inc., N.Y. • In Canada, Cross Canada Electronics, Waterloo, Ont.

Measure Torque With Electronics

All it takes is the right transducer and a 2-transistor circuit

By A. V. J. MARTIN

UP to now, no really simple and practical method of measuring positive and negative torque with any precision has been available. This has been even more true of simultaneous evaluation of torque and rotating speed—that is, power.

In most torque measurement methods, practical installation is delicate because the torque detector or transducer rotates with the shaft. Then the signal coming from the transducer must be sent to fixed instruments. This is frequently done with a brush and slip-ring arrangement, which presents a number of difficulties.

In the proposed system, torque between a driving shaft and a driven shaft is detected by a deformable coupling part between shafts. This part can be made of elastic bars (Fig. 1), which take a helicoidal distortion which is function of the torque. The distance between the two end pieces varies with torque and all we have to do is measure the distance variation to find the torque.

The mechanical arrangement shown in Fig. 1 is one of the simplest possible methods. There are a number of variations designed to avoid axial forces on the shafts, increase precision, improve linearity, etc. The basic principle is to transform a torque variation into a length variation, and to measure the change in length.

Precision length measurement is comparatively easy. But in this case the parts rotate, so new methods or variants of known methods are needed. In one proposed form, the length variation produces an axial displacement of a disc which rotates in front of a fixed-position detector. The output of the detector gives the torque by direct reading. The exact details of the method vary somewhat with the particular application.

For example, in Fig. 2, the rotating and axially moving part is a ferrite-cone magnet. It has alternate N and S poles as shown in Fig. 3, and rotates in front of two magnetic cores carrying windings. The alternating energy produced in the windings by the rotating ferrite ring varies inversely with the air gap between ferrite and magnetic cores. Consequently, this energy is a function of the axial position of the ferrite cone, that is of the torque. In this way, the output signal of the device can be calibrated in terms of torque.

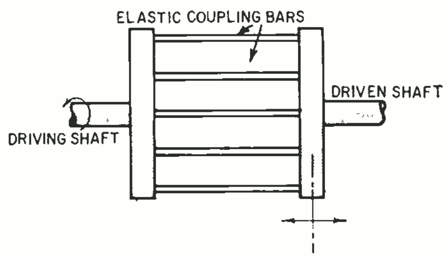


Fig. 1—Torque is transformed into an axial variation of length by elastic coupling bars.

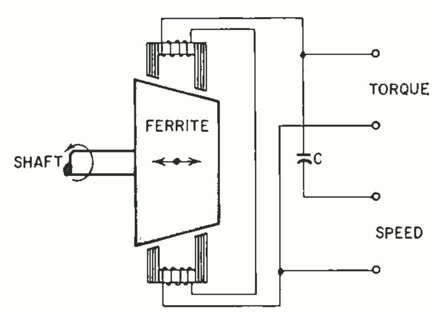


Fig. 2—Displacement detector using a ferrite cone.

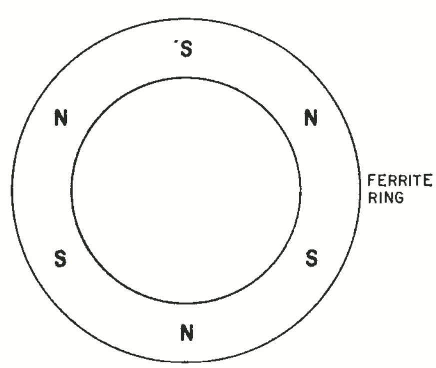


Fig. 3—Alternate poles on ferrite magnet.

By using an extra pair of output connections and a capacitor, the frequency of the signal produced can also be measured directly, giving the rotating speed of the shaft too. Both measurements can be combined in a suitable meter to give a product reading which indicates transmitted power.

The output signal from the device may be large enough to control—without additional amplification—rugged measuring instruments or automatic regulation systems.

In another arrangement (Fig. 4), the axial displacement of a disk is transformed into a capacitance variation. This in turn can be transformed into a frequency variation with the circuit of Fig. 5. The frequency variation can then be processed by standard circuits, depending on the type of application, and used for measurement, regulation, etc. The same principle could be used with an inductance variation. Note that all the proposed arrangements give an indication which is independent of parasitic rotation effects and, in particular, of buckling.

Fig. 6 shows, in somewhat simplified form, a torque measuring instrument that uses only two European transistors. The US equivalents are:

OC76—2N188
OC72—2N188-A

One transistor is a low-frequency oscillator producing a 100-cycle signal with a base-to-emitter coupling. The output signal across the secondary winding of the transformer is applied to displacement detecting coil L, as indicated before. The variable signal, carrying the torque-variation information, is applied to the base of the second transistor, which detects and amplifies it. A meter in the collector circuit reads torque directly. END

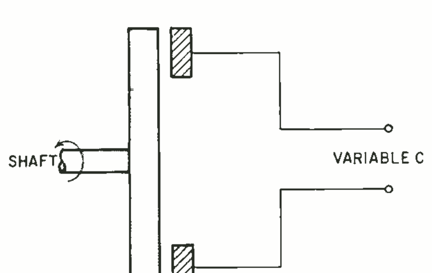


Fig. 4—Capacitance variation type of displacement detector.

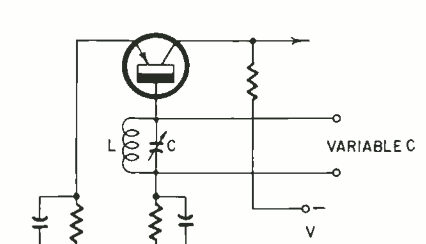


Fig. 5—Variable frequency oscillator.

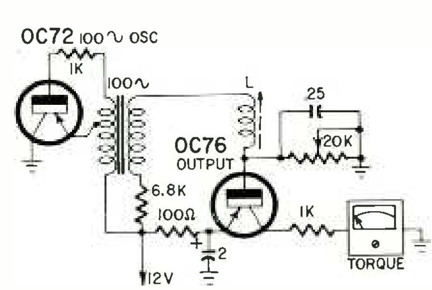


Fig. 6—Transistor torque measuring instrument.

Dedication hall setup just before meeting. Note speakers suspended from cables.

Unique speaker arrangement beats high ambient noise

PA Under Adverse Conditions

By MILTON I. RAVICH*

I WAS recently asked to set up a public-address system for dedication ceremonies of a large steam plant. Normally such an assignment is no problem, but as steam plants do not have large assembly halls, it was necessary to use a 60 x 120-foot room with a 40-foot ceiling and smooth concrete walls. To make matters worse, it adjoined a room in which two 180-megawatt generators were merrily running 24 hours per day. This meant installing a public-address system suitable for amplifying speeches and remarks of various dignitaries in a room where it normally was impossible to converse with a person 5 feet away.

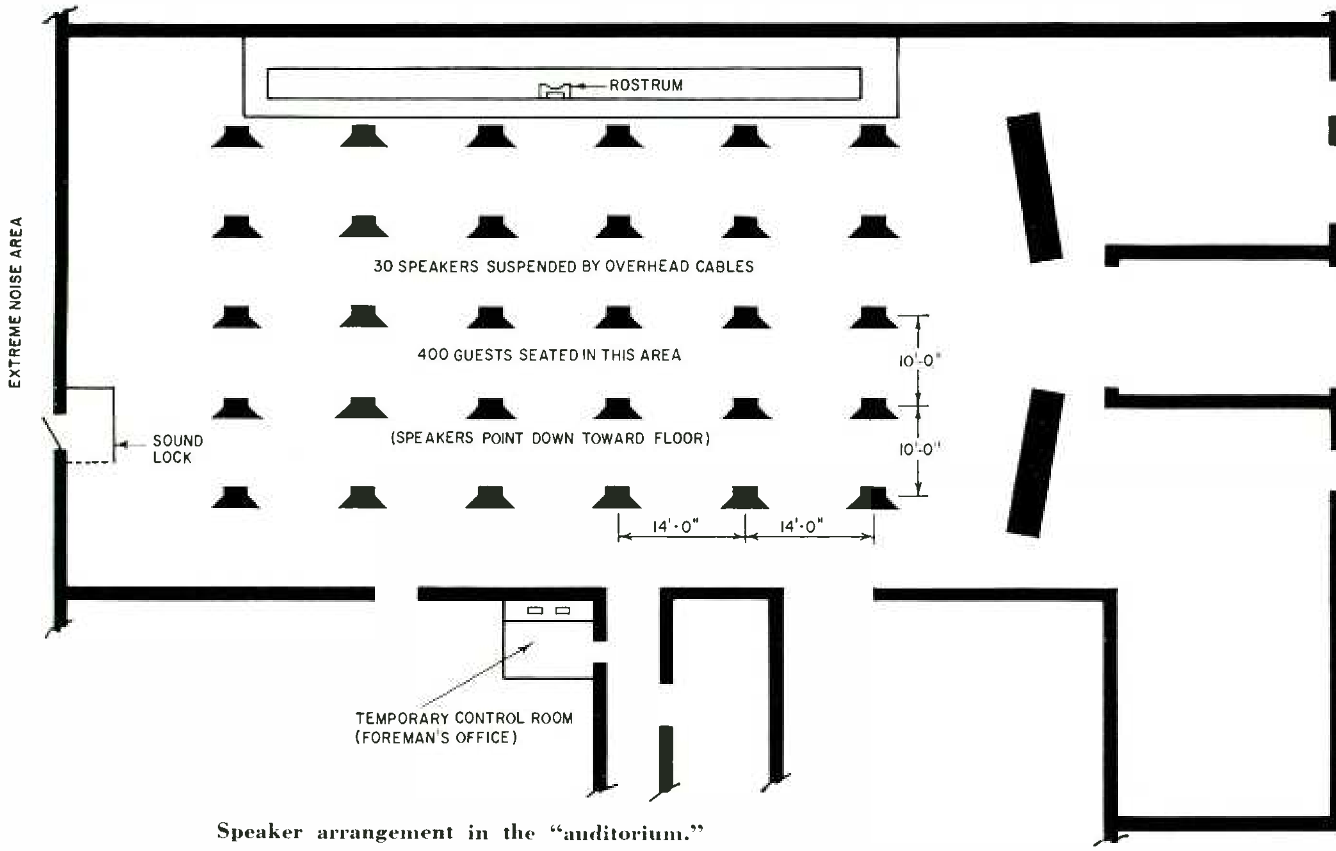
Preliminary tests with trumpet speakers on the sides of the speaker's table proved futile. If the sound level was raised anywhere near that necessary to override the noise, reverberation effects made speech unintelligible in most of the area. Standing in front of a directional speaker and no more than 15 to 18 feet away, one could hear speech and understand, if one concentrated. At this point I decided to install 30 8-inch speakers mounted on 2 x 2-foot wood baffles above the heads of the audience.

This method of using multiple overhead speakers, although costly to install, is the only one I know to combat trying acoustical conditions. It has been used many times to provide excellent speech re-enforcement to an audience of 500 people in a concrete-lined room. A number of years ago I used this same method, but with 60 speakers suspended over the heads of an audience of 10,000, to provide sound re-enforcement for a stage show held directly in front of a racetrack grandstand. Most race tracks and many sporting areas have a cluster of speakers strategically located, and many observers wondered why we did not make use of the already available facilities. However, it is quite a different matter to understand the words of a slow-talking race announcer who

*Superintendent of Communications, Los Angeles Department of Water & Power.

Speaker's view of rostrum. Microphones are arranged to be very close to speaker's lips. Note prompter unit to right of rostrum.

Temporary control room in foreman's office.



Speaker arrangement in the "auditorium."

lets each word reverberate itself out as against the rapid patter of a professional entertainer.

Speaker setup

In the steam-plant dedication job, we strung ⅜-inch steel cables under tension across the 60-foot room width. Speakers were hung in cradlelike fashion from the messenger cable. Speaker spacing is shown in the accompanying sketch. Based on an assumed ear height for the average seated guest of 4 feet from the floor, and an average speaker height of 12 feet, the closest guest would be 8 feet from a speaker. The farthest guest (seated midway between four speakers) would be 12 feet from any speaker. All 30 speakers were identical, 8-ohm, 8-inch, heavy slug construction. Speakers were phased and all connected in series to the 250-ohm output tap of a standard 20-watt amplifier.

After the speakers were installed, we worked on reducing the level of the residual noise from the generators in the next room. We got about 10 heavy painter's drop cloths measuring 12 x 15 feet and hung them strategically on walls adjacent to the generator room and high-pressure gas feed line. Next, tests were made at off peak hours with the nearest generator running at reduced load. Since the dedication ceremonies were to be held at an off-peak power time of day, it was known arrangements could be made to operate in this fashion if necessary. Reducing power to half load drastically reduced residual noise, but any further reduction in load made less than 1 db difference in the residual noise.

After taking these measures, speech originated by talking closely into an Electro-Voice type 664 noise-cancelling microphone could be understood throughout the area, but left much to be desired. We felt that when decorative 12-foot drapes were hung on two sides of the room and an audience seated at tables the sound would be much improved. This proved to be true. It is far safer to get understandable PA without an audience than to get mediocre results and plan on the presence of people to reduce reverberation.

Final arrangements

On the day of the dedication, two microphones were set up at the speaker's table and attached to the rostrum. In the future we are planning on building our own rostrum with microphone fittings built in. Supplying furniture may seem far afield from PA work, but should it mean the speaker will be even one inch closer to the microphone, it is well worth the effort. Many would argue that better fidelity will be obtained if people speak some distance away from the microphone. All the fidelity in the world does you no good if you are working on the verge of feedback, which is exactly where you will be working when speakers are permitted to talk where and how they please.

We also built an inexpensive prompter unit consisting of three simple lamps marked:

OK
CLOSER TO MIKE
TALK LOUDER

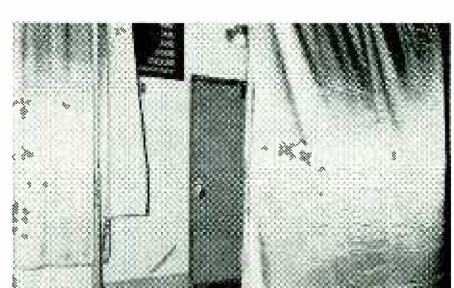
This unit was operated by pushbuttons from an improvised control room in a foreman's office that looked out on our makeshift auditorium. Another 3-lamp prompter was placed in front of the amplifier operator. This unit was labeled:

RAISE
OK
LOWER

An observer out on the auditorium floor operated the unit by pushbuttons.

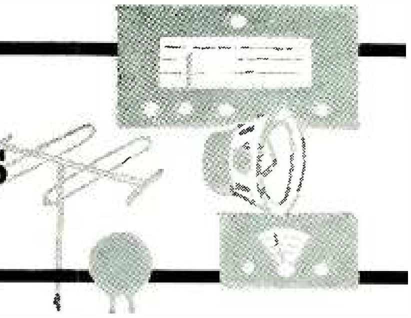
These simple units greatly aided us in holding the actual volume of the program as heard by the audience as constant as possible. An occasional blink of the "OK" lights gave the speaker and the amplifier operator reassurance things were actually OK.

The end result was a public-address system that was clearly heard by all 400 people. The multiple speakers operated at low level (less than ¼ watt of audio ran all 30 speakers) re-enforced the voice just enough to make listeners think they were actually hearing the person at the rostrum speak directly to them. The sound seemed to come from everywhere. Standing directly under a speaker you still could not be sure which speaker you were hearing. END

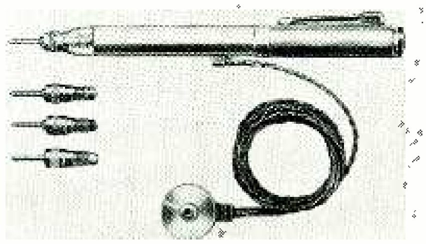


Sound lock made from canvas drop cloths traps sound when door is opened.

NEW PRODUCTS

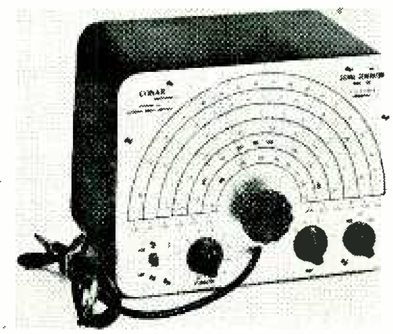


PEN-SIZE SIGNAL TRACER locates defective circuits and components in radio and audio equipment. Detects hum, oscillations, ground loop, breaks in pc boards. All-transistor *Stethotracer* also used as preamp for oscilloscope or voltmeter. Earphone, cord, plug, 3 attenu-



ator probes, one rf detector–demodulator crystal diode probe, ground clip lead and battery.—**Don Bosco Electronics, Inc.**, Littell Rd., Hanover, N.J.

SIGNAL GENERATOR KIT, *model 280*. Oscillator circuitry: preset, tuned rf coils on low bands, ceramic trimmers on high bands. Range: 170 kc to 60 mc in six bands; 60 mc to 120 mc on harmonics. Planetary drive tuning capacitor with 6:1 ratio, solid-state power supply. Output signal: unmodulated rf, modulated rf, 400 cycle af. Single output cable. Tubes: 6BE6, 12AU7. Front controls: High–low output, band selector—6 bands, output selector—"Mod-Rf-Aud".

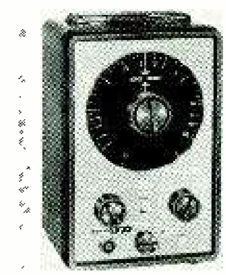


—**Conar Instruments**, Div. National Radio Institute, 3939 Wisconsin Ave., Washington 16, D.C.

POWER RESISTOR DECADE BOX. *model 250*. Rack-mounted, provides resistor of any re-

quired ohmages 1-999,999, in 1-ohm increments. Used as standard resistance in active circuits or to determine resistances in operating circuits. Power rating 225 watts at 1,000 volts maximum. Click-in detent bar knobs, 2 sets identical terminals.—**Clarostat Mfg. Co., Inc.**, Dover, N.H.

CAPACITOR TESTER, *model 995*. Measures 0.1 to 50 $\mu\mu$ at $\pm 10\%$ accuracy, in or out of circuit. RC balance control calibrated in RC product for 0.6–10.5, 7.0–infinity. RC product for out-of-circuit capacitors can be translated into dissipation or power factor. Short tests: in or out-of-circuit with shunt resistance low as 1 ohm, reliable up to 2,000 μf, test frequency 60 cycles, maximum test voltage 6.3. Open tests: 15-$\mu\mu$f capacitors, in or out of circuit. Shunt resistance low as 35 ohms for capacitors over 250 $\mu\mu$f, minimum 7,000 ohms for 15 $\mu\mu$f. Test frequency 19 mc. Transformer-operated,



fuse-protected. Operates on ac line voltages 105–130, 60 cycles, 8 watts. Tube complement: one 6C4, one EM84/6FG6.—**Eico Electronic Instrument Co., Inc. (Eico)**, 33-00 Northern Blvd., Long Island City 1, N.Y.

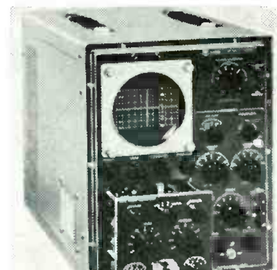
VTVM KIT, *model 202*. 6-inch 400-μa meter. 11-meg input impedance, ac–dc volts to 1,500, ac peak-to-peak to 2,000 volts any waveform 30 cycles–5 mc without extra probes. Direct resistance measurements 0.2 ohm–1,000 meg, decibel scale range −10 to +15, db readings to +58 db. Zero-center scale. 12AU7 balanced push-pull dc amplifier, two 9006 peak-to-peak voltage rectifiers. 1% zero-temperature-coefficient multiplier resistors. Probes: common, acv–ohms,

shielded dc with 1-meg isolating resistor. Selenium rectifier, transformer-operated power supply at 110–120 vac. 60 cycles, one 1.5 volt battery included.—**Lafayette Radio Electronic Corp.**, 111 Jericho Turnpike, Syosset, N.Y.

TUBE TESTER. Tests all new 12-pin compactrons, nuvistors, Novars and 10-pin tubes, plus octal, loctal, miniature and 9-pin tubes

for shorts, leakages, intermittents and quality. **Model 213**, bakelite case: **Model 213P** (illus.), wood case. Wired or kit.—**Electronic Measurements Corp.**, 625 Broadway, New York 12, N.Y.

LAB SCOPE KIT. Catalog no. *83 YZ 945*. Steel-girder type construction modular printed circuitry. Calibrated vertical amplifiers, horizontal sweep circuits. Trigger and amplifier circuits dc-coupled throughout. Dual-trace preamp. Vertical system sensitivity: 50 mv/cm–20 v/cm. Horizontal amp response dc–2.5 mc, 3 db down, sensitivity 0.1 volt/cm–1 volt/cm. Attenuator 10:1 multiplier vernier control. Horizontal system has calibrated sweep times 0.5

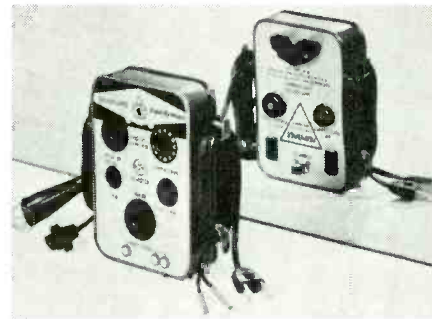


sec/cm–50 nsec/cm, 30 ranges. Built-in voltage calibrator gives 1-kc square wave 10 mv–50 volts peak to peak.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

SIGNAL TRACER, *model ST-22*. Handles all receiver or amplifier signal levels, measures

amplifier gain stage by stage. Substitute speaker for testing receivers and amplifiers detached from own speaker systems. Output terminals for oscilloscope and vtvm. Wattmeter circuit checks power drain of equipment under test over 36–500-watt range. Noise test circuit, test amplifier (may be used as PA amplifier), two way af–rf shielded probe with built-in selector switch.—**Precision Apparatus Co., Inc.**, 70-31 84th St., Glendale 27, N.Y.

TV SERVICE AID. *Handyman, model HM119.* Combination filament checker, fuse checker, ac trouble light, TV cheater cord with on–off switch, continuity and voltage checker, dual power extension cord, pin straightener.

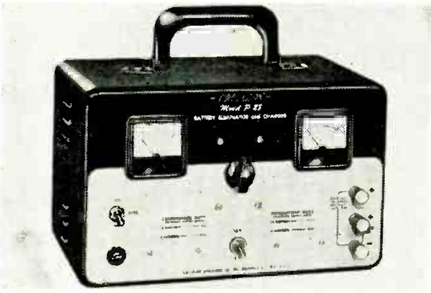


Tests all tubes including nuvistors, Novars, compactrons, 10-pins, picture tubes. Built-In plugs for soldering irons, test equipment, etc.—**Sencore, Inc.**, 426 S. Westgate Dr., Addison, Ill.

DECADE CAPACITOR, *model 1904*, for determination of capacitor values in experimental

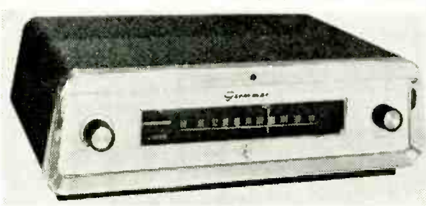
circuitry and use in tuned circuits, filters, etc. Range .0001 to .111 μf in steps of .0001 mf $\pm 1\%$ accuracy. All capacitors silvered mica, resistance more than 100,000 meg at 500 volts dc. Voltage rating of overall unit 350 dc, 500 intermittent, 1,000 test. Capacitor power factor .001%.—**Precision Apparatus Co., Inc.**, 70-31 84th St., Glendale 27, N. Y.

BATTERY ELIMINATOR/CHARGER, *model P-28*, for 6-12 volt apparatus. Panel-mounted extractor fuse post, built-in thermo-relay, 2 meters for simultaneously monitoring voltage



and current. Output current capacity, 6-volt range: 10 amps dc continuous, 20 amps dc intermittent 12-volt range: 6 amps dc continuous, 12 amps dc intermittent. Special low-ripple output capacity 5 amps dc continuous, both ranges. Variable output 0–8 volts, 0–16 volts dc. Power requirements: 117 volts 50–60 cycles, 150 watts full load.—**Precision Apparatus Co., Inc.**, 70-31 84th St., Glendale 27, N.Y.

FM STEREO TUNER, *model 101GTM*. Needs no adapter. Subchassis construction, 3-gang tuning unit, cascade rf, triode mixer, 2 wideband i.f., 2 limiter stages, ratio detector,

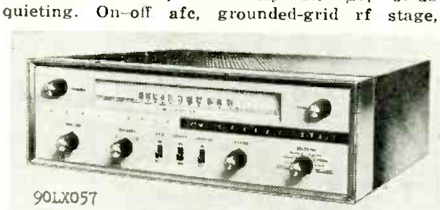


flywheel tuning and Magic Bar tuning indicator. Silicon power supply.—**Grommes**, Div. of Precision Electronics, 9101 King St., Franklin Park, Ill.

STEREO TAPE RECORDER, *model MP-410-A*. 2-track stereo, 4-track monaural record and playback. 2 tape heads, 2 preamps, 2 power amps, 2 built-in stereo speakers with separate

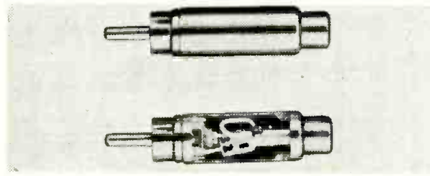
volume controls, recording-level indicator for each channel, splicing groove, headphone plug. Outlets for external amplifiers, speaker. Inputs for all sound sources. One interlocking switch plays all speeds.—**AmeLux Electronics Corp.**, 60 E. 42 St., New York, N.Y.

STEREO FM TUNER/AMP, *model STA-7*. Direct reception of stereo FM multiplex from FM stations. 24-watt stereo amplifier. 14 tubes in tuner section, sensitivity 2.5 μv, 30-db quieting. On–off afc, grounded-grid rf stage,



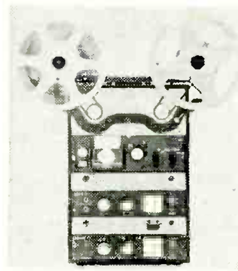
ratio detector, third-channel output, full range of controls. Amplifier section response 20–20,000 cycles ± 1 db, may be used as stereo or mono amplifier by using built-in input jacks. Output terminals for 4-, 8- and 16-ohm speakers, output jack for stereo headphones.—**Radio Shack Corp.**, 730 Commonwealth Ave., Boston 17, Mass.

AUDIO EQUALIZER, *model 323A*. For mono or stereo ceramic phono cartridges. Plugs into magnetic input of amplifier without modifi-



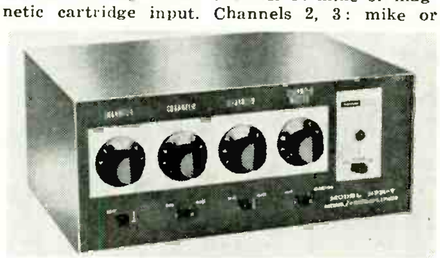
cation. Converts to velocity response for RIAA equalization.—**Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago 30, Ill.

10½-INCH REEL ADAPTER. 12 hours hi-fi, 3 hours stereo record and playback. Fits manufacturer's **model 990** stereo tape recorder,



199D tape deck and 191 and 192 tape recorders. Wow and flutter 0.5% maximum.—**Roberts Electronics, Inc.**, 5920 Bowcroft St., Los Angeles 16, Calif.

MIXER–PREAMP, *model DPR-7*. Applies dc on all tube filaments. 5 low-level high-gain inputs, two high-level. Channel 1: mike or magnetic cartridge input. Channels 2, 3: mike or



input from tuner or tape recorder, crystal or ceramic phono player, all controlled from front panel. Channel 4: mike input, convertible to master volume control for entire mixer.—**Harman-Kardon, Inc.**, Ames Court, Plainview, N.Y.

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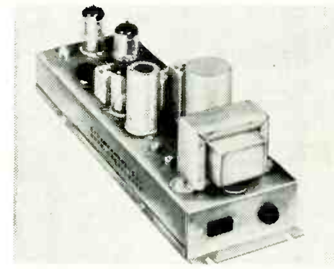

of installation. 15-kc steep rolloff, low-pass filter—**Fisher Radio Corp.**, 21-21 44th Drive, Long Island City 1, N. Y.

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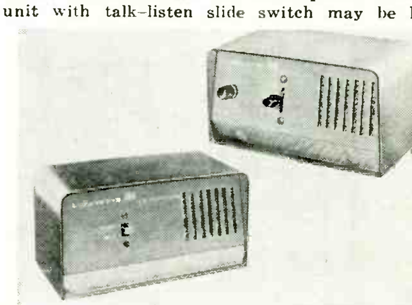

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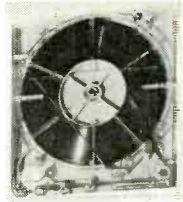

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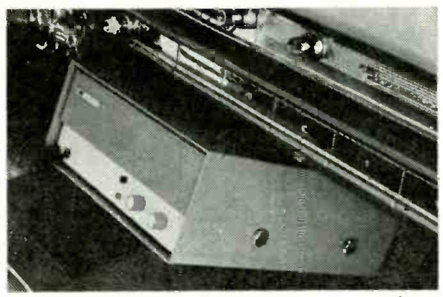

transmitter-receiver. *Model TA508* rf amplifier, 30 watts for base-station or repeater use. Power supplies transistorized or 117 volts ac.—**Kaar Engineering Corp.**, 2995 Middlefield Rd., Palo Alto, Calif.

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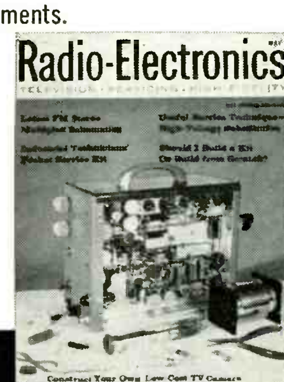

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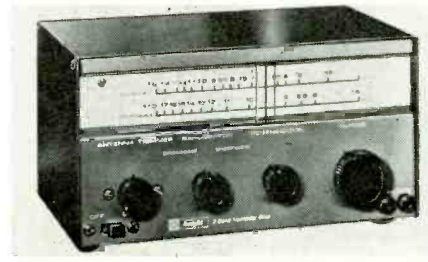

scale for tuning international SW and amateur broadcasts on 20-meter band.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

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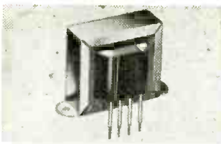

put filter power transformer: Delivers 45 volts dc. Primary impedance 117 volts, 50/60 cycles ac, secondary 80 volts ac, center-tapped. Secondary current 1.2 amps dc.—**Stancor Electronics, Inc., 3501 Addison St., Chicago 18, Ill.**

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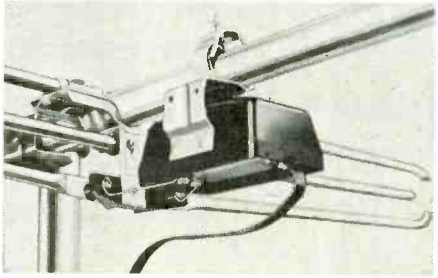

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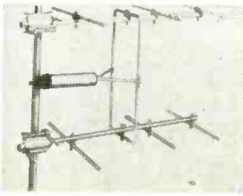

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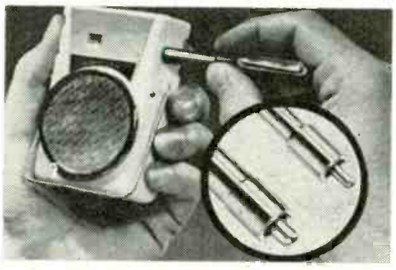

pin, for ¼" OD spanner nut; *model TW140*—with .140" guide pin for 5/16" OD spanner nut.—**Xcelite, Inc., Orchard Park, N.Y.**

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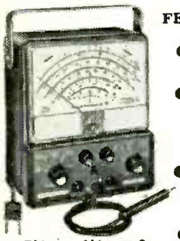

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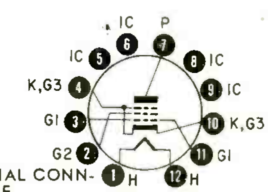
NEW TUBES and SEMI-CONDUCTORS

TUBES ARE BACK IN THE DRIVER'S SEAT, at least for this month. We've a compactron horizontal output tube, three "universal" picture-tube replacements and a medium-mu twin triode for relay-control use. On the semi-conductor end are a series of industrial power transistors and a group of silicon rectifiers.

6GE5

A compactron device for use as



IC=INTERNAL CONN-
DO NOT USE

6GE5

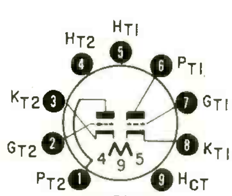
the horizontal deflection amplifier in television receivers. The tube is a single-ended unit 1 3/16 inches shorter than the 6DQ6-B it is intended to replace.

Maximum ratings of the G-E 6GE5 compactron are:

V_P (supply)	770
(peak positive pulse)	6,500
(peak negative pulse)	1,500
V_{G2}	220
V_{G1} (peak negative)	330
P_P (watts)	17.5
P_{G2} (watts)	3.5
I_K (dc ma)	175
(peak)	550

12FV7

A medium-mu twin triode of the 9-pin miniature type designed specifically for use as a relay control tube in remote-control tuning units of TV receivers. The tube is specially processed for long periods of operation under standby (plate-current cutoff) conditions. Its tapped heater can be operated at either 12.6 volts 450 ma or 6.3 volts 900 ma.



12FV7

Maximum ratings of the RCA 12FV7 in relay-control service are:

V_P	300
V_G (positive bias value)	0
I_K (ma)	30
P_P (watts when "on" time exceeds 30 seconds in any 2-minute period)	2.5
(watts when "on" time does not exceed 30 seconds in any 2-minute period)	4.5

Typical operating characteristics with a 5,000-ohm relay unit are:

V_P (supply)	100
I_P (zero bias ma)	36
R_G (megohms)	2.2
V_G (for 1 ma I_P)	−16

"Universal" picture tubes

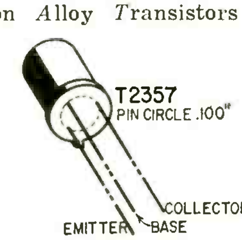
These new tubes (21CBP4-A, 24AEP4, and 17DKP4) can replace 20 popular types now in use. Made by Sylvania, they are claimed to cut dealer inventory greatly. The tubes do not require an ion-trap magnet.

Here is a list of the "universals" and the types they can replace:

"Universal" Type	*Replaces*
Type 21CBP4-A	21FLP4
	21ALP4A)
	21ALP4B)
	21ATP4)
	21ATP4A)
	21BAP4
	21BNP4
	21BTP4
	21CBP4)
	21CBP4A)
	21CBP4B
	21CMP4
Type 24AEP4	24DP4A)
	24YP4
	24ZP4
	24AEP4
	24ANP4
Type 17DKP4	17DKP4
	17DTP4
	17DLP4

T2357

This single type number represents a matched pair of p-n-p *S*ilicon *P*recision *A*lloy *T*ransistors (SPAT)



intended for use in low-level chopper applications.

Maximum ratings of the Philco T2357 transistor are:

V_{CBO}	30
V_{EBO}	30
V_{ECO}	30
I_C (ma)	50
P_{total} (mw)	150

Electrical characteristics at 25°C:

f_T (gain bandwidth product)	6.5 mc
C_{ob} (output capacitance)	9 $\mu\mu f$

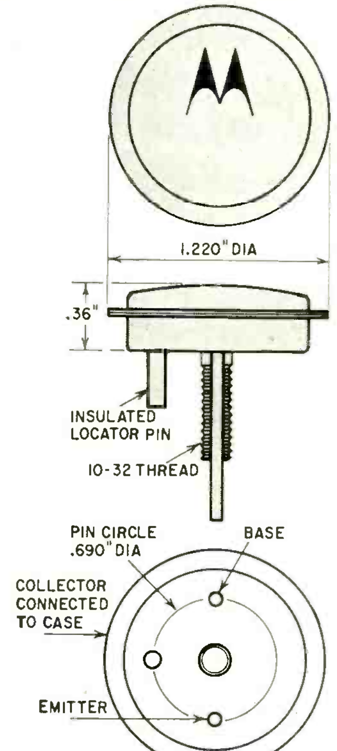
10C5 through 10C100

A series of 2-amp flangeless silicon diffused-junction rectifiers with voltage capabilities from 50 to 1,000 prv, and a maximum peak surge current of 60 amps, these units are made by International Rectifier. Thanks to a precision-controlled IR diffusion process, they have very low reverse leakage (5 μa

at rated prv) and very low forward voltage drop (0.95 volt at 3 amps).

MP500-A through MP507-A

A series of industrial power transistors for high-current applications. These p-n-p germanium units are for circuits requiring high gain and extremely low saturation voltage.

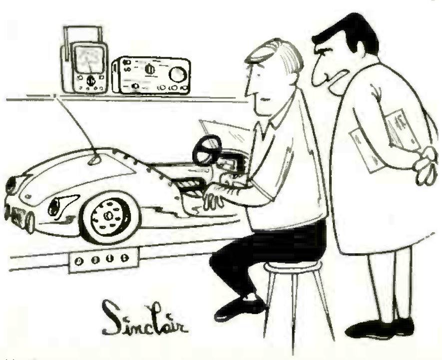


MP500 THROUGH MP507

Maximum ratings of these Motorola transistors are:

	MP500-A MP504-A	MP501-A MP505-A	MP502-A MP506-A	MP503-A MP507-A
V_{CBO}	45	60	75	90
V_{CES}	45	60	75	90
V_{CEO}	30	45	60	75
V_{EBO}	25	30	40	45
I_C (amps)	60	60	60	60
P_{total} (watts)	170	170	170	170

END



"We generally pull car radios, Feeney."

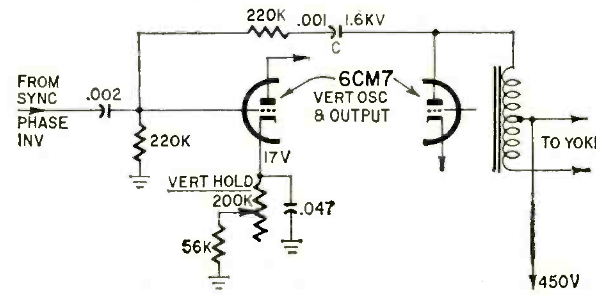
Technotes

FOCUS CONTROL BURNOUT

Several RCA 800 series color receivers may come to the shop with the focus control burnt out. Experience shows that this often happens because the black voltage wire from the picture tube socket to R122 has been pinched under the compartment cover of the high-voltage cage. This causes arcing that results in the focus control burning out. When reinstalling the high-voltage compartment cover, make sure that this lead is placed in the cutout in the cover provided for it, and not under the cover itself.—*RCA Television Service Tips.*

ADMIRAL 14YP3D

A common complaint on this set is sound OK and a single horizontal line across the center of the screen. You'll usually find the trouble in the vertical sync section. Capacitor



C shorts, allowing a large portion of the boosted B-plus voltage to appear on the grid and cathode of the vertical oscillator. This cuts the tube off and kills vertical sweep. Replacing the capacitor is the obvious solution.—*Dee Bramlett, Jr.*

CHECK 6CD6-GA OPERATION

In some RCA KCS68 and KCS81 television chassis, the 6CD6-GA beam-power tube has failed because of improper operation of the horizontal deflection circuit.

Since "plate emission" may cause the 6CD6-GA to fail in some chassis when it is operated above the maximum allowable peak negative voltage of 1,500, RCA recommends that you use the device outlined in Fig. 1 to measure the peak negative voltage of this tube.

Connect an 1B3-GT, a 500-$\mu\mu f$ ceramic capacitor and a 1.5-volt battery as shown.

Remove power from the TV chassis. Connect the lead from the filament of the 1B3 to the plate of the 6CD6. Then connect the lead from the capacitor to the TV chassis under test.

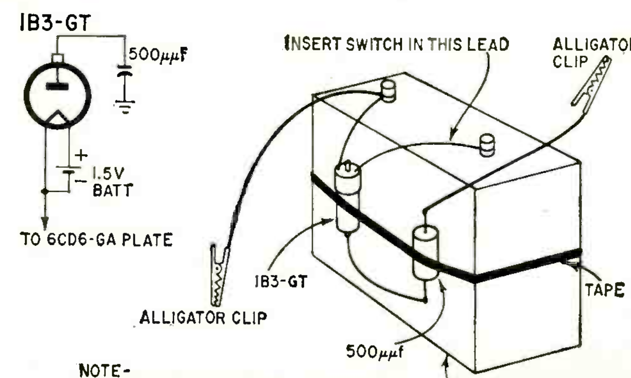


Fig. 1

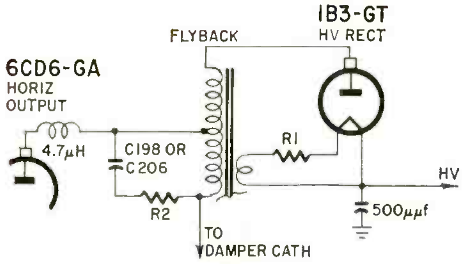


Fig. 2

Apply power to the TV chassis. Picture must be in sync.

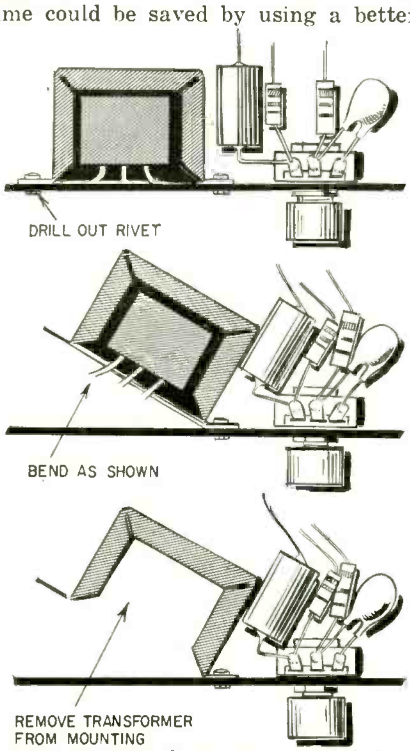
Using a vtvm and a high-voltage probe, measure the voltage on the plate of the 1B3 in the test device. It should not exceed 1,500 volts.

RCA further recommends:

If the voltage measured exceeds 1,500, then connect a wire wound 5,000-ohm, 5-watt, 10% resistor (R2 in Fig. 2) to capacitor C198 (KCS81) or capacitor C206 (KCS68) of the horizontal deflection circuit.—*RCA Service News*

TRANSFORMER REPLACEMENT

Sometimes we run into the problem of replacing a small audio or vertical output transformer where it is either almost impossible to drill out the rivets without damaging parts, or time could be saved by using a better approach.



When using an exact replacement or a unit having similar dimensions, try this method: Drill out the closest or easiest to get at rivet, leaving room to get at it. Next, remove the strap around the core of the transformer, as in the diagram, and do the same for the replacement. Then replace the new transformer, less mounting strap, into the old transformer strap. Last, fasten the mounting strap back in place with a nut, washer and screw where the rivet was drilled out.—*George P. Oberto* END

WE BUY INDUSTRIAL TECHNOTES

RADIO-ELECTRONICS wants Industrial Technotes. These should cover equipment (including closed-circuit television) actually used in industrial work, or technotes on counters, controls and other apparatus whose users are largely industrial. Unillustrated Technotes pay $5; circuit diagrams raise the price to $9 and acceptable photos are worth $7 each. Send your technotes from industry to Technotes Editor, RADIO-ELECTRONICS, 154 W. 14th St., New York 11, N. Y.

TECHNICIANS' NEWS

INDIANA REPORTS

Kokomo—RTSEA members discussed the possibility of compiling a list of dead-beat customers for distribution among all members. The list would warn individual technicians who might otherwise get stuck and make possible unified refusal to do any servicing until earlier bills had been paid. Until the dead-beat paid his past-due bills, no one would repair his set.

St. Joseph Valley—ARTS elected new officers. The new president is Lew Woods; vice president, Bill Rapport; secretary, Russ Bills; Treasurer, Dick Tepe, and Sergeant at Arms, Ralph Zeller.

Indianapolis—ITTA reduced its initiation fee to $10 to spark a membership drive and has instituted a job placement committee to serve members and nonmembers.

Dubois County—SIETA is pushing for better attendance. A program has been set up to give additional instruction in the use of test equipment, particularly the oscilloscope.

WISCONSIN CIRCUIT

Jefferson-Dodge County — Dues were increased retroactive to the 1961 convention. Frank Sherman was accepted as a new association member. Educational films from the University of Michigan will be obtained for showings at TESA meetings.

Milwaukee — Jerry Hall commented on state association activities. The more than 20 attending members were in favor of joining the state association.

ARTSD ELECTION RESULTS

Columbus, Ohio—The Associated Radio & Television Service Dealers met at the Nationwide Inn and elected new officers for 1962. When the vote had been taken, the new president was Jack Voigt; vice president, Frank Shannon; recording secretary, Walt Driscoll; corresponding secretary, Rex Rice and treasurer, Paul Boyer.

DO-IT-YOURSELF TV REPAIRS

Portland, Ore.—New trend in TV repairs: rent space and equipment to the customer so he can make his own repairs. O'Brien's TV & Appliances set up the following system:

The customer can call for pickup and delivery, if he wishes, for $1.50. He can rent space at the shop for $1 for the first 2 hours; get a basic kit of hand tools for 50¢ an hour; check tubes and get a half hour of troubleshooting free and replace needed parts himself.

HOUSEWIVES' PEEVES

Housewives, asked about their pet peeves regarding service technicians, had several. The wise technician will try to avoid these more common causes of irritation in dealing with women:

"A technician I called in once was a terrible gossip. He told me about my neighbor down the street who hadn't paid her bill. I thought that if he told me about her, he would just as soon tell others some bit of gossip about me. I never called him again."

"My pet peeve is the noisy technician. He always seems to arrive just after I put the children to bed for their afternoon nap. He stomps in the house, drops his tool box on the floor with a thud, and talks in a loud voice that can be heard all the way down the street. I realize a technician has to make some noise, but some of them overdo it!"

"I don't like the know-it-all who says he can't explain the trouble to me because I wouldn't know what he was talking about anyway. What he doesn't realize is that I've been using TV for quite some time. I may know a lot more than he gives me credit for."—*Philco Service-Businessman*

CUSTOMERS PAID FOR TV TROUBLES

Boston, Mass.—An independent TV distributor, Shawmut's TV, is offering to pay his customers for their TV troubles. Here's how it works: You buy a Motorola TV set from Shawmut's. If during the first year any tube or part fails, they will pay you $1 and make the repair free. If the picture tube fails, they will replace it and give you $5. If the power transformer fails, they will give you a comparable new Motorola TV.

The firm points out that the replacement of tubes and parts is covered by the Motorola guarantee and that the installation and monetary contribution are Shawmut's own free offer.

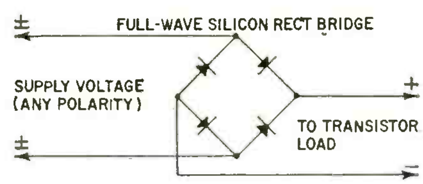
COLOR TV FOR TSA

Detroit—RCA's training center was filled with 85 independent technicians from the Television Service Association of Michigan not too long ago. They were there to sit in on a service meeting for color TV. Alignment and other adjustments were demonstrated during the session. Future meetings will cover convergence, setup procedures and other facets of color TV. END

NOTEWORTHY CIRCUITS

BRIDGE SAVES TRANSISTORS

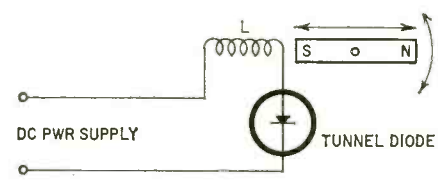
Incorrect polarity can damage transistors and electrolytic capacitors. In experimental setups where supply leads may be connected and disconnected any number of times, it is easy to make a mistake. When experimenting with transistors, I eliminate the possibility of damaging components with a simple full-wave silicon rectifier bridge. When the bridge is connected between the supply and the load circuit as shown, power supply polarity is unimportant. Just remember to leave the bridge connected to the load circuit until the tests are completed.

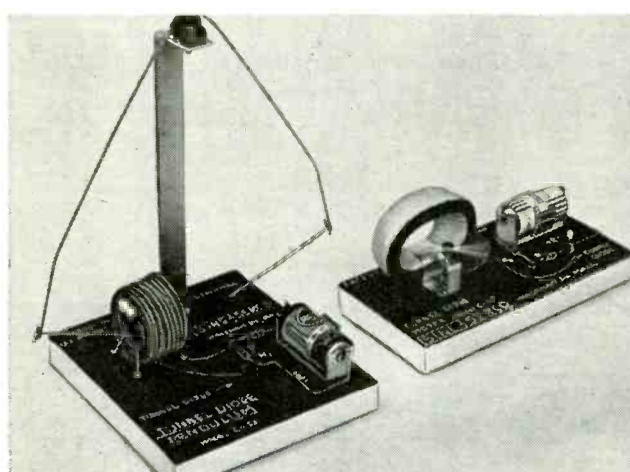


The rectifiers are selected to handle the voltage and current drawn by the load.—*Herbert E. Pasch*

ELECTRONIC MOTOR USES TUNNEL DIODE

This new electronic dc motor uses a tunnel diode, bar magnet and two-terminal coil to provide either rotary or pendulumlike reciprocating motion. It is designed to replace the more complex transistorized motors in electric watches and clocks. The circuit (covered by patent application) is shown in the diagram. Two models, made for educational purposes by Sine-Ser Co. (Waltham 54, Mass.), are shown in the photo.

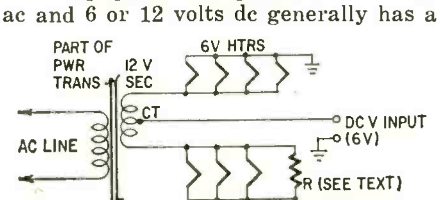




There are no moving parts to require maintenance. The pendulum model starts by itself. The rotary model requires a slight push on the magnet to get it started.—*Dr. H. E. Stockman*

SIMPLIFIED SWITCHING FOR AC–DC EQUIPMENT

Equipment designed for 117 volts ac and 6 or 12 volts dc generally has a complex circuit for switching the heater string from one source to the other. Here is a circuit that does away with all complicated switching.

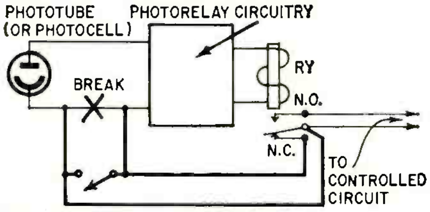


For a 6-volt dc/117-volt ac circuit, the wiring is as follows: A 12-volt center-tapped filament winding is used, and the tubes are connected from each side to ground. The current drain on each side is equalized by a resistor (R) on one side, if necessary. On ac, the 12 volts is impressed across the two strings in series, and the tubes each receive 6 volts. On dc, the voltage is applied between transformer center tap and ground. Since the resistance of the transformer winding is low, there is hardly any voltage drop and the two strings are effectively connected in parallel across the source.

For 12-volt operation, use a 24-volt center-tapped transformer and 12-volt tubes in two parallel strings as shown in the diagram.—*Matthew Fichtenbaum, WA2UFD*

PHOTORELAY MODIFICATION

This modification will lock in a photocell or phototube relay when the light beam is momentarily interrupted. Rather than using a separate or more complex relay, the standard single-pole double-throw relay, wired as shown, will usually work. A toggle switch may be used to override this feature and, by momentarily setting it to "override," reset the relay. Watch for leakage between the controlled circuit and the photorelay input.—*Richard Koplow* END



NOTE-DARK LINES ARE ADDED WIRES

50 Years Ago

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Electrical Experimenter	1913
Radio News	1919
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Practical Electrics	1921
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some larger libraries still have copies of Modern Electrics on file for interested readers.

In April, 1912, *Modern Electronics*

Stopping Trains by Wireless, by Frank C. Perkins.

Apparatus for Testing Detector Minerals, by our Paris correspondent.

The Poulsen System, by Dean Farran.

New Fessenden Station in Brooklyn.

Mercury Transmitting Condenser, by Stuart R. Ward.

A Silicon Detector, by C. W. Seaman.

A Good Electrolytic Detector, by Lewis C. Mumford.

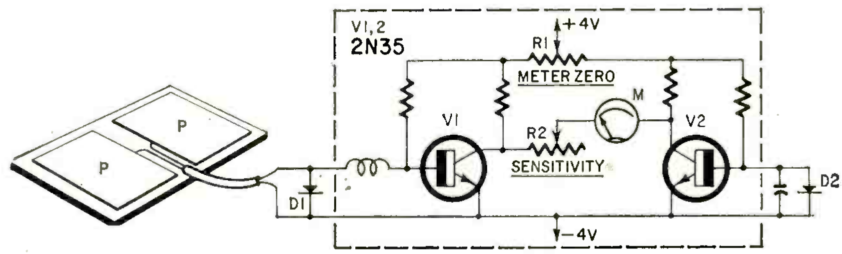
new PATENTS

SPY RADIO DETECTOR

Patent No. 2,963,576

Oleg C. Enikeieff, Silver Springs, Md. (Assigned to Harry C. Miller Co., Rochester, N.Y.)

This device can detect hidden transmitters. Being untuned, it can pick up local radiation over a wide range of frequencies.



Two flat plates (P), 6 or 8 inches square, are etched or printed side by side on a panel. Radiation picked up by them is rectified by D1 and passed through an rf choke to V1 as a negative signal. It will reduce collector flow as indicated by meter M.

V2 and D2 are not energized by the rf. They are used only to balance out the meter current. Initially, and with no rf signal, R1 is adjusted for a meter zero. Resistor R2 controls the meter's sensitivity.

PRINTED-WIRING VARIABLE RESISTOR

Patent No. 2,970,244

Mérritt L. Beverly, Torrance, Calif., and Manfred Kahn, Williamstown, Mass. (Assigned to Sprague Electric Co.)

The resistor (R) is shown on an assembly (Fig. 1). Fig. 2 shows details of the rotor and wiper.

It consists of a flat barrel fitted into a sleeve, both of metal, with a groove to keep them in place. A screwdriver slot is used to drive the barrel. At the bottom of the barrel is a spring-metal wiper. It maintains pressure on a printed-circuit resistive coating (not shown) similar to that in a standard potentiometer.

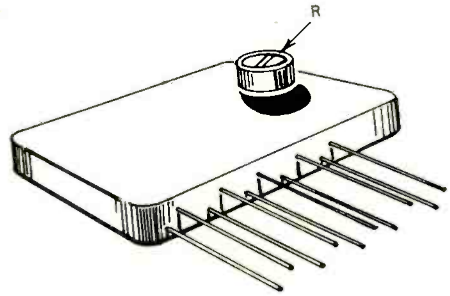


Fig. 1

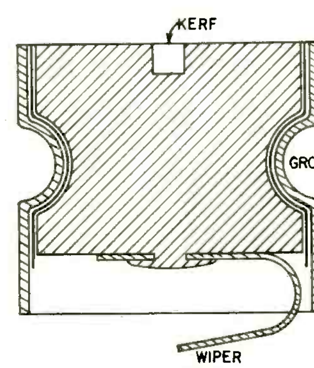


Fig. 2

MEASURING THIN METAL DEPOSITS

Patent No. 2,967,934

Pierre Pascal Martinelli, Paris, France. (Assigned to Commissariat a l'Energie Atomique)

The metal is bombarded by beta rays which cause it to give off X-rays. These are detected by a photomultiplier and indicated by a pulse counter (Fig. 1). The frequencies at which the X-rays peak are a characteristic of the particular metal. The intensity of radiation rises with the deposit thickness.

A screen eliminates any beta rays that might be present, while passing the X-rays. The filter (between amplifier and counter) is variable and may be set for the desired band. END

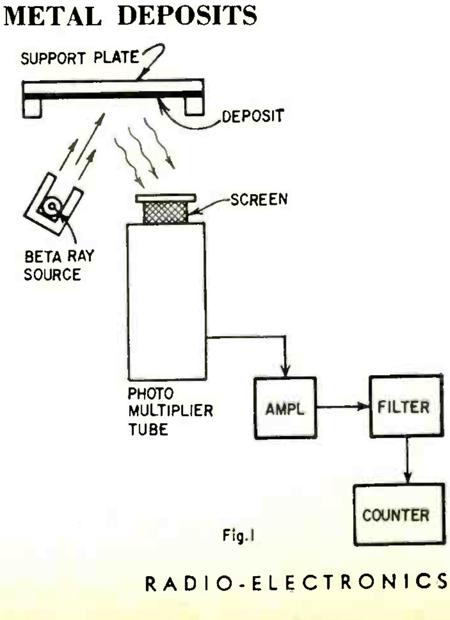
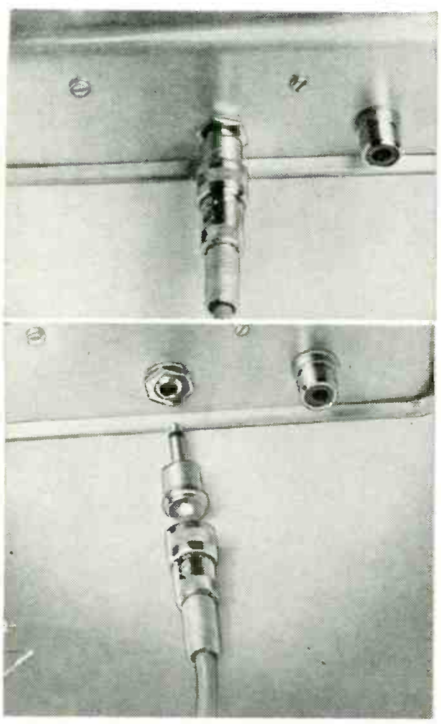


Fig. 1

CONNECTOR ADAPTER

This little adapter lets you connect a miniature mike connector to a miniature phone jack quickly. Remove the cable-protecting spring from a Switchcraft 5501M miniature mike connector, and saw off the connector to a length of about ½ inch. Take a short length of hookup wire and solder one end to the center lug of a miniature phone plug. Insert the threaded shank of the phone plug into the end of the mike connector, allowing the wire to pass through the connector and the eyelet.



Join the phone plug and mike connector securely with a couple drops of solder. Clip off the excess wire and solder the end into the eyelet in the mike connector. The photo shows the completed adapter all set to join a miniature phono jack to a mike connector.

A coupling ring slipped onto the adapter allows it to take either a female or male mike connector.—*Art Trauffer*

OIL ELECTRIC CLOCKS

In some clock radios the motor is a sealed unit. When it needs oiling, it becomes rather noisy. Oiling a motor inside a sealed case is a problem, but one that can be solved.

Remove the sealed unit and hold

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it over a 100-watt bulb for a few minutes. Now put a few drops of fine oil on and around the gear section. Soon bubbles will appear as the heat drives the air out of the sealed case. Then turn off the lamp. As the unit cools, the oil will be drawn inside to the motor. Repeat this several times. Now the motor will run noiselessly.—*A. von Zook*

HANDY SNOUT

To give that bottle of tape recorder cleaning solvent a long handy snout, just insert a pipe cleaner into the applicator lid. Not only does this make

application easier, the pipe cleaner lets you brush away dust and dirt too.—*Chester A. Clifford*

AUTOSWITCH FOR AUDIO SYSTEM

The diagram shows an autoswitch circuit I have been using for several years. It requires no relay, unlike many such systems. Instead, all I use is a dpdt switch wired so that it transfers the amplifier transformer primary from

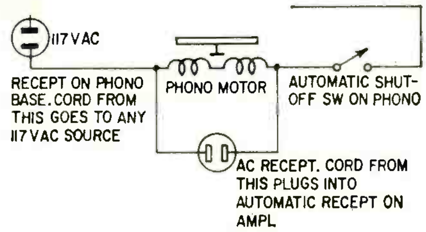


Fig.1

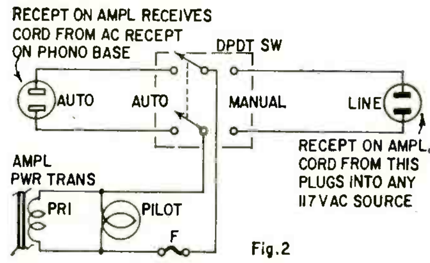


Fig.2

manual operation (used when the program source is a tuner) to automatic operation (when records are being played).—*Maxwell E. Lait*

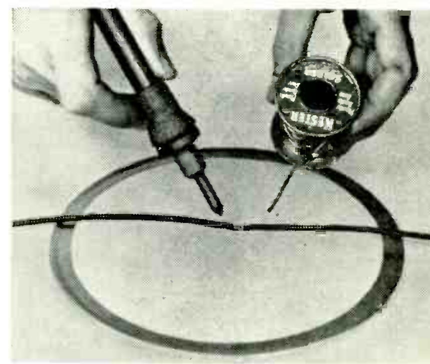
BAD TUBES SOMETIMES GOOD

Ordinary tube checkers are usually pretty accurate when it comes to detecting open filaments, low emission, internal shorts and gas. But the readings they give are not always conclusive evidence that a given tube is bad for all circuits. An ordinary tube checker cannot subject a given tube to all of its operational conditions. So the average service technician resorts to the substitution method as the most reliable test.

That is not always accurate either. Many times I have found tubes which would not work in one circuit will work very satisfactory in another. Instead of discarding these doubtful tubes, I save them for installation in circuits where they can be used. I label the doubtful ones to avoid unnecessary confusion.—*John A. Comstock*

STOVE PAD SIMPLIFIES SOLDERING

Don't leave burned benches behind you after soldering jobs. Borrow a stove burner pad from the kitchen. A round asbestos pad like the one pictured is cheap protection against hot



iron or gun scarred bench tops. The pad also acts as a good catch-all for drops of hot solder and wire clippings.—*John A. Comstock* END

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TUBE AND TRANSISTOR HANDBOOK. *De Muiderkring N. V., Bussum, Netherlands. 4½ x 8½ in. 401 pp. $4.00.*

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BASIC RADIO COURSE, by John T. Frye. *Gernsback Library, Inc., 154 W. 14 St., New York, N. Y. 5½ x 8½ in. 224 pp. $4.10.*

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An electret (piece of dielectric material with a permanent positive charge on one face and a permanent negative charge on the other) is traditionally produced by cooling the melted dielectric substance in a powerful electric field. A more recent method consists of subjecting the dielectric to strong illumination in an electric field. This book describes electrets made by that process, discusses interesting equipment for measuring the charge, possible uses in photography and theories underlying the photoelectret phenomenon. A bibliography of some 140 references is given.

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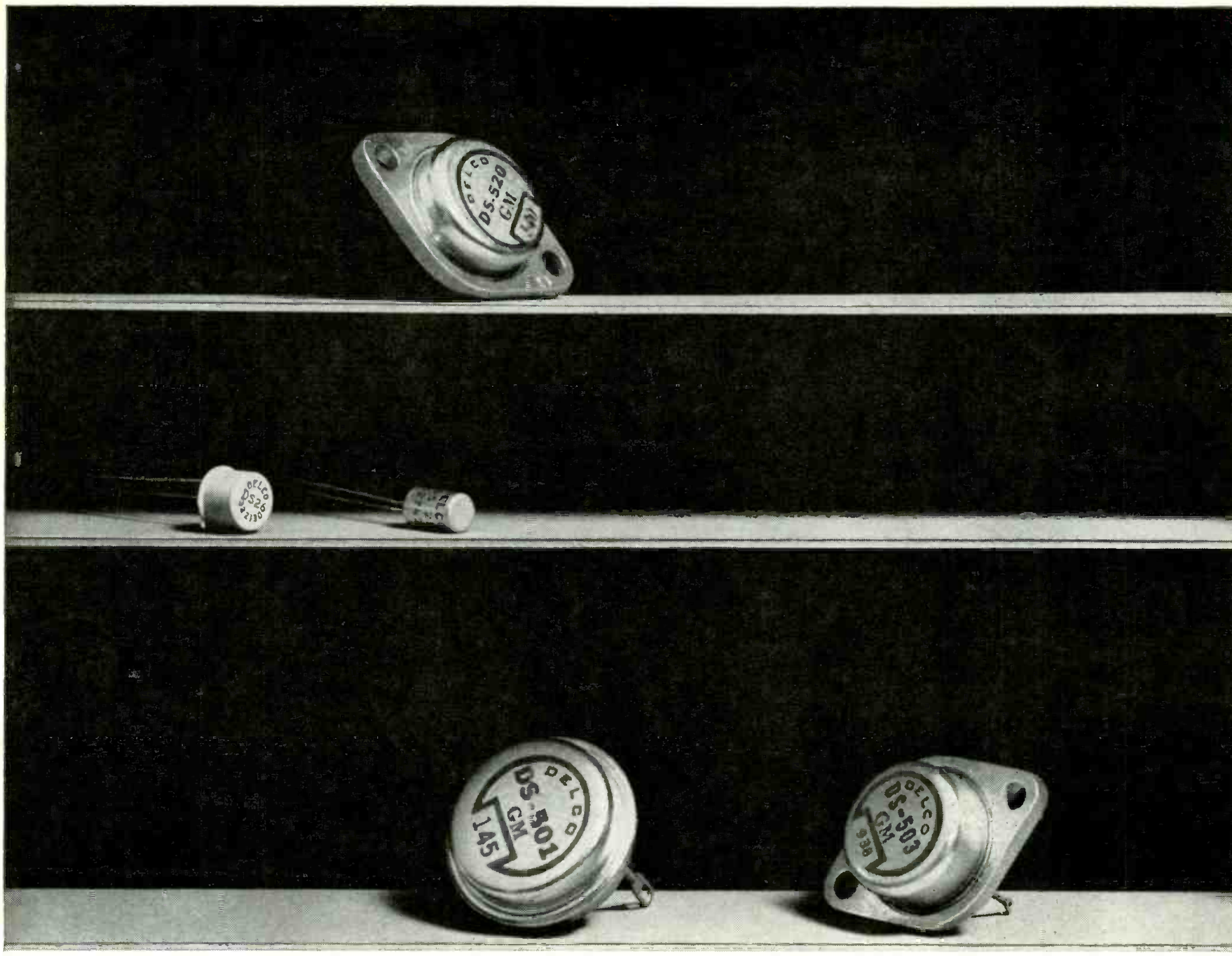
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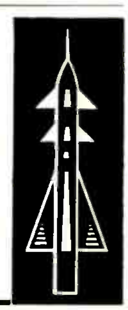

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___3BE6	.52	___6AK5	.95	___6CG8	.77	___6T8	.85	___12BF6	.44	___12X4	.38	___36AM3*	.36
___3BN6	.76	___6AL5	.47	___6CK4*	.70	___6U8	.83	___12BH7	.77	___17AX4	.67	___50B5	.60
___3BU8	.78	___6AM8	.78	___6CL8	.79	___6VG6T	.54	___12BK5	1.00	___17BQ6	1.09	___50C5	.53
___3BY6	.55	___6AQ5	.53	___6CM6	.64	___6W4	.60	___12BL6	.56	___17DQ6	1.06	___50EH5	.55
___3BZ6	.55	___6AR5	.55	___6CM7	.66	___6W6	.71	___12BQ6	1.06	___17W6	.70	___50L6	.61
___3CB6	.54	___6AS5	.60	___6CM8*	.90	___6X4	.39	___12BR7	.74	___18FW6*	.49	___70L7	.97
___3CS6	.52	___6AS6	.80	___6CN7	.65	___6X5GT	.53	___12BV7	.78	___18FY6*	.50	___7025	.69
___3DG4*	.85	___6AT6	.43	___6CQ8	.84	___6X8	.80	___12BY7	.77	___18FX6*	.53	___807	.70
___3DK6*	.60	___6AT8	.79	___6CR6	.51	___7A8	.68	___12BZ7	.75	___19AU4	.83	___117Z3	.61
___3DT6	.50	___6AU4	.82	___6CS6	.57	___7AU7	.61	___12C5	.56	___19BG6	1.39		
___3Q4	.63	___6AU6	.52	___6CS7	.69	___7B6	.69	___12CN5	.56				
___3Q5	.80	___6AU7	.61	___6CU5	.58	___7EY8*	.73	___12CR6	.54				
___3S4	.61	___6AU8	.87	___6CU6	1.08	___7F8	.90	___12CU5	.58				
___3V4	.58	___6AV6	.41	___6CY5*	.70	___7N7	.90	___12CU6	1.06				
___4BQ7	1.01	___6AW8	.90	___6CY7	.71	___7S7	1.01	___12CX6	.54				
___4BZ7	.96	___6AX4	.66	___6DA4*	.68	___7Y4	.69	___12D4*	.69				
___4BZ8	1.10	___6AX5	.74	___6DB5	.69	___8AU8	.83	___12DB5	.69				
___4CS6	.61	___6AX7	.64	___6DB6	.51	___8AW8	.93	___12DE8	.75				
___4DT6	.55	___6AX8*	.92	___6DE6	.58	___8BQ5	.60	___12DL8	.85				
___5AM8	.79	___6BA6	.50	___6DG6	.59	___8CG7	.62	___12DQ6	1.04				
___5AN8	.86	___6BA8	.88	___6DK6	.59	___8CM7	.68	___12DS7	.79				
___5AQ5	.52	___6BC5	.61	___6DN6	1.55	___8CN7	.97	___12DT5*	.76				
___5AS8*	.86	___6BC7	.94	___6DQ6	1.10	___8CS7	.74	___12DT7*	.79				
___5AT8	.80	___6BC8	.97	___6DT6	.53	___8CX8	.93	___12DT8*	.79				
___5AV8	1.01	___6BD5	1.25	___6DT8*	.79	___8EB8	.94	___12DU7	1.01				
___5BC8	.79	___6BE6	.55	___6EA8	.79	___8SN7	.66	___12DW8*	.89				
___5BE8	.83	___6BF5	.90	___6EB5*	.72	___9CL8	.79	___12DZ6	.56				
___5BK7	.82	___6BF6	.44	___6EB8	.94	___11CY7	.75	___12ED5	.69				
___5BQ7	.97	___6BG6	1.66	___6EM5*	.76	___12A4	.60	___12EG6	.54				
___5BR8	.79	___6BH6	.65	___6EM7	.82	___12AB5	.55	___12EK6	.56				
___5BT8*	.83	___6BH8	.87	___6EU8	.79	___12AC6	.49	___12EL6	.50				
___5CG8	.76	___6BJ6	.62	___6EW6	.57	___12AD6	.57	___12EM6	.79				

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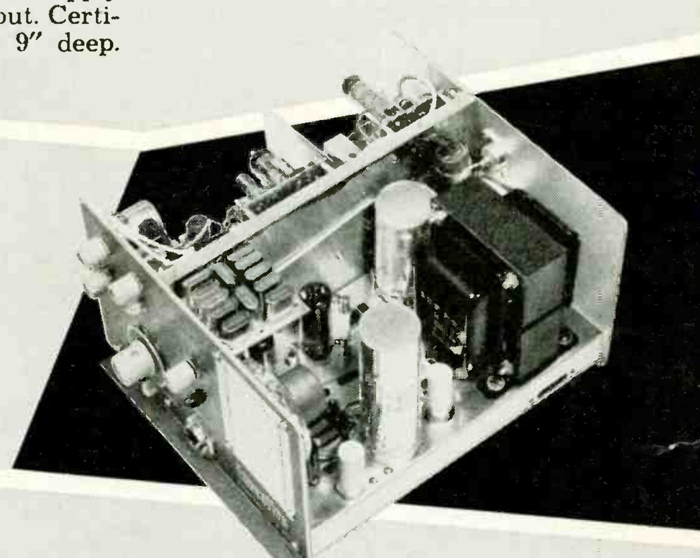

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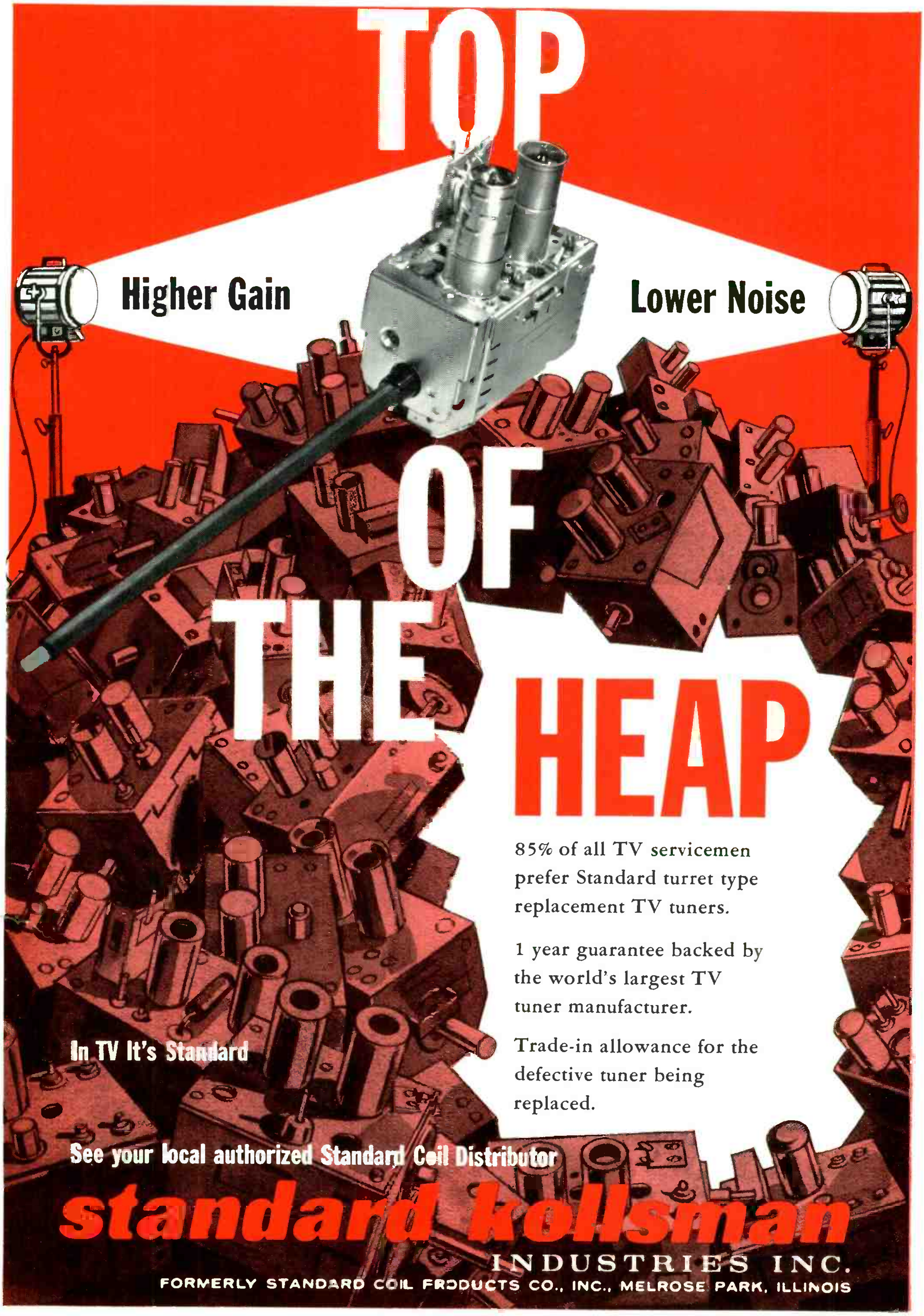
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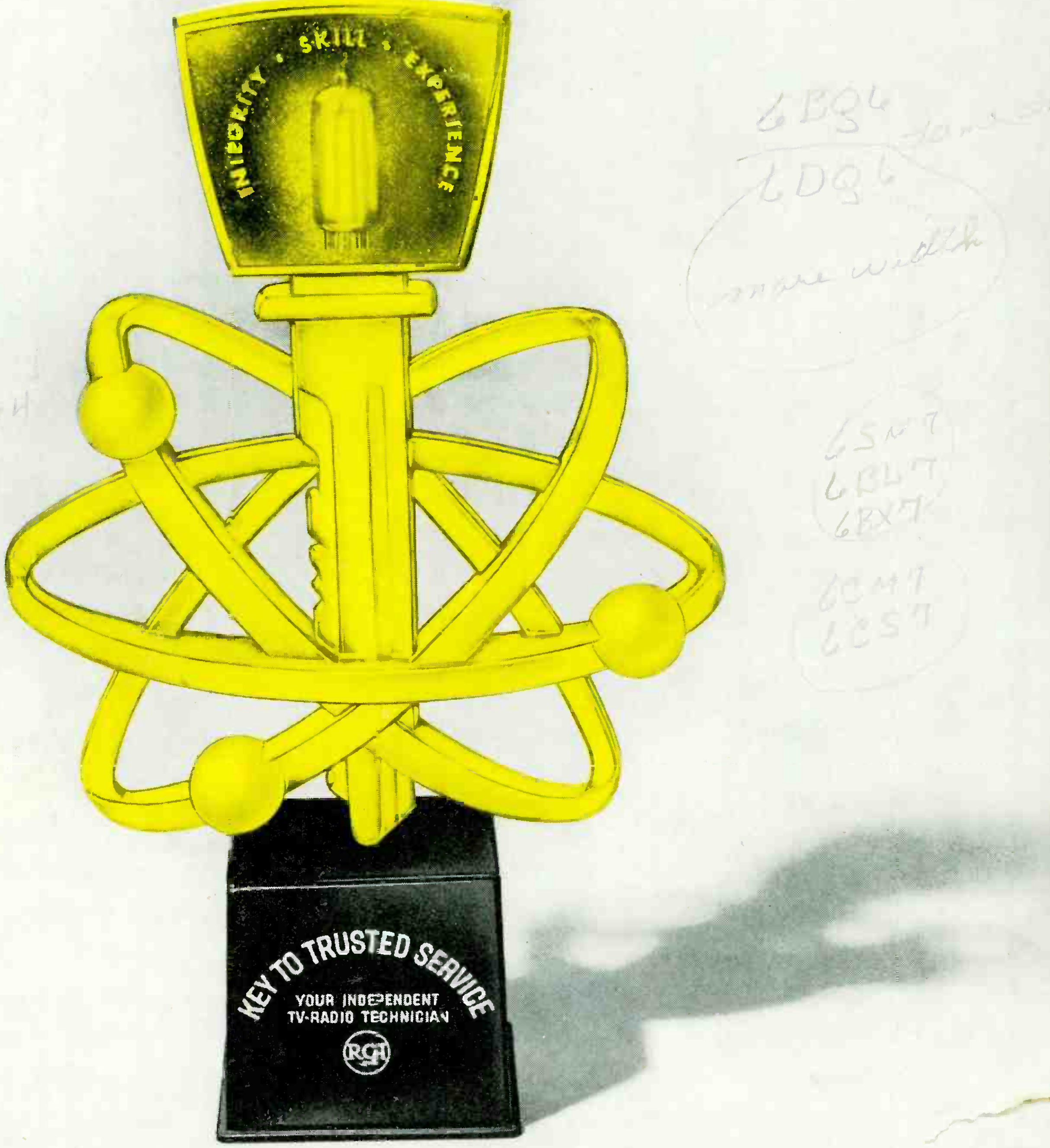

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