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50c

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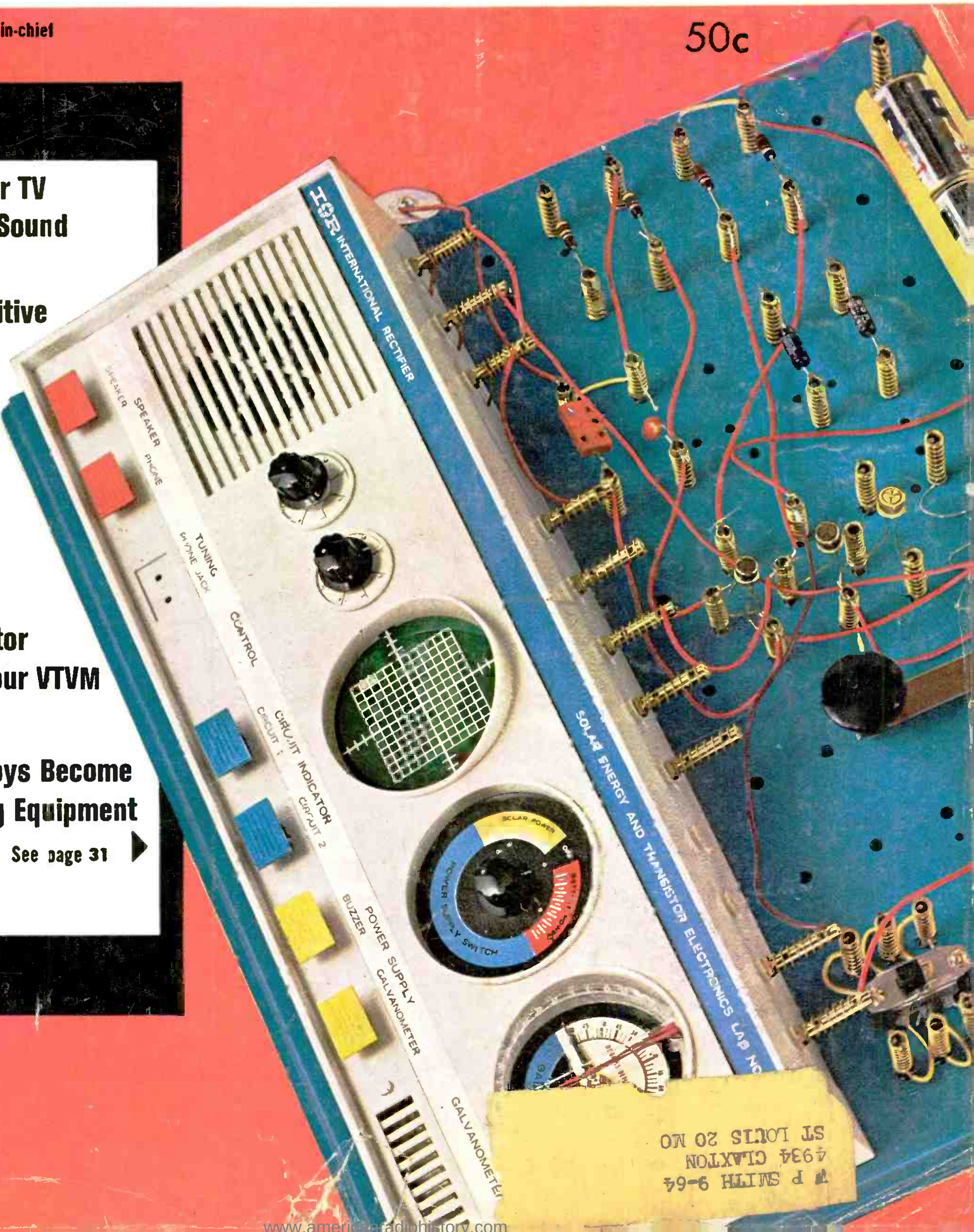
See page 31



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APRIL 1963
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(More on page 31)

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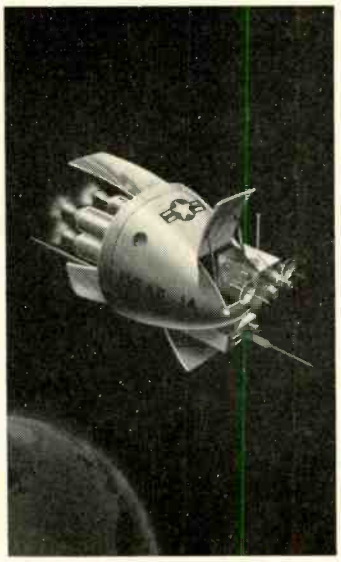

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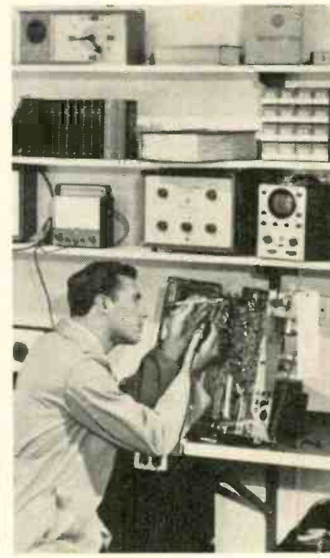

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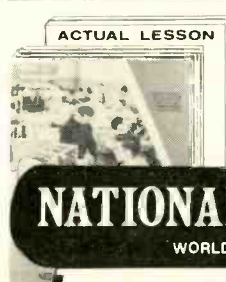

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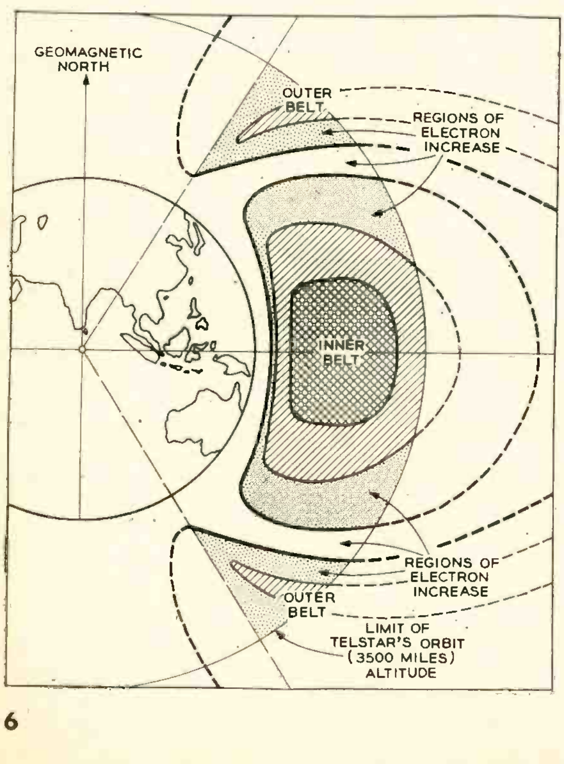
News Briefs

Telstar Reports on Van Allen Belts

A "slot-cutting mechanism" between the inner and outer Van Allen belts works to decrease the number of electrons in the area more rapidly than ordinary decay would account for. This was told to the American Physical Society by Walter L. Brown of the Bell Laboratories Semiconductor Research Dept. He said that immediately after the Russian high-altitude nuclear tests of Oct. 22 and 28, the gap or slot between the two Van Allen belts was nearly filled up with energetic electrons, the increase of electrons in the gap being greater than that in the belts themselves.

Before the tests, there were about 3 million electrons per centimeter per second on the magnetic field line crossing the equator at 4,500 miles altitude. After the second explosion, the number had increased to some 500 million electrons. When Telstar first went into orbit in July, shortly after the Starfish test, the flux of electrons at the peak of the Van Allen belt was even higher—about 800 million electrons per square centimeter per second. From that time to October, electron intensity in the slot between the two belts showed a decay rate to the date of the Russian tests.

The nature of the mechanism that appears to be at work, cutting the slot between the two Van Allen belts, is still unknown—in fact, scientists do not know why there are two belts instead of a single broad one.



Increase in electron activity in the Van Allen belts is shown by the dotted area. (Only the regions actually traversed by Telstar are shaded.) The heavier shading indicates greater electron intensity inside the belts, and the crosshatched region is the area that had an electron flux of 800 million per square centimeter per second in July.

Nanosecond Photography With New Image Tube

A new image-converter tube, designed as a high-speed light shutter for special electronic cameras, greatly increases the speed at which multiframe photographs of extremely high-speed activity can be made. Exposures can be as short as one two-hundred-millionth of a second, according to C. E. Burnett, of the RCA Industrial Tube Products Dept. The new tube is used for such things as the study of lasers, exploding wires and gaseous charges.

The event or action is focused by a fast objective lens on the photocathode of the 10-inch-long, 4-inch-diameter tube. The light releases electrons from the photocathode, which are attracted toward the fluorescent screen at the opposite end of the tube. On their way, they go through an electron gating grid, which can be charged either to stop the electrons coming from the cathode or to permit them to travel toward the screen. The grid also serves as a focusing electrode. The fine-grain, aluminum-backed screen can provide an increase in radiant energy of as much as 50 times the energy applied to the photocathode. Spectral response of the tube (RCA-4449) is from about 3,000 to 6,500 angstroms. The flat photocathode has a minimum useful diameter of 1.37 inches. Exposure times as short as 5 nanoseconds result in little loss in resolution. Minimum useful diameter of the screen is 3 inches.

TIROS Makes TV Pictures of Earth's Cloud Cover

TIROS—*T*elevision *I*nfra-*R*ed *O*bservation *S*atellite—transmitted more than 203,000 TV pictures of the earth's cloud cover through the end of 1962, NASA discloses. The TIROS meteorological system was developed, tested and produced by RCA for NASA under the direction of Goddard Space Flight Center. Since April 1960, six TIROS satellites have been successfully launched and orbited in six tries. They have logged 1,157 days of useful life, reporting on ice floes, giving advance warning of hurricanes and other weather phenomena, and supplying data for intragovernmental use. Some have been used in launch support of deep-space probes like Mariner and Ranger. TIROS V and VI, still operating, are supplying operational weather data and serving as vehicles for further research.

The record shows, say RCA engineers, that TV space observations are feasible and that longevity in space is possible. NASA cites TIROS

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COMING

IN THE MAY ISSUE OF RADIO-ELECTRONICS

Build an All-Transistor Hi-Fi Amplifier — 10 watts with 8 transistors.

What Is a Dry Cell? — A battery engineer tells about modern mercury, carbon-zinc and alkaline batteries.

Handling the Color TV Customer — The customer can be the critical component in a color TV installation.

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Storm vortex is shown in this TV picture taken by TIROS V on Dec. 5, 1962. A dangerous formation is shown, with an unusual swirling mass of clouds.

as an example of the use of space for peaceful purposes.

Now—The X-Ray Vidicon

A vidicon camera tube that can be used to detect flaws inside 1/8-inch-thick metal casings is now being sold by the Machlett Laboratories, Inc., an affiliate of Raytheon. How it can be used to check electronic parts is shown in the photos. The open circuit in the diode appears very clearly. The new tube is also extremely useful in medical studies, as well as in some nondestructive testing applications.

The new tube, labeled ML-589, uses an X-ray-sensitive layer as its sensor element, instead of the light-sensitive, photoconductive layer of ordinary vidicons. Interchangeable with standard vidicons, it is 1 inch in diameter and 6 inches long. It requires

(Continued on page 12)

CALENDAR OF EVENTS

Electronics Industries Assoc. Spring Conference, Mar. 20–22; Statler Hilton Hotel, Washington, D.C.

1963 IEEE Convention, Mar. 25–28: Waldorf-Astoria Hotel and Coliseum, New York.

SSB Amateur Radio Association 12th Annual SSB Dinner and Hamfest, Mar. 26: Hotel Statler Hilton, New York.

High Fidelity Music Show, Institute of High Fidelity, Apr. 2–7: Ambassador Hotel Cottages, Los Angeles, Calif.

Symposium on Optical Masers, sponsored by IEEE, **Optical Society of America and U.S. Defense Research** Agencies, Apr. 16–18; Waldorf-Astoria Hotel, New York.

Convention of the British Institution of Radio Engineers, Apr. 16–20; University of Southampton, England.

Southwestern IRE Conference and Electronics Show (SWIRECO), Apr. 17–19; Dallas, Tex.

SMPTE Convention, Apr. 21–26 (exhibits Apr. 22–25): Traymore Hotel, Atlantic City, N.J.

Electronic Components Conference (IEEE sponsored), May 7–9: International Inn, Washington, D.C.

1963 National Telemetering Conference, May 20–22: Hilton Hotel, Albuquerque, N.M.

Electronic Parts Distributors Show, May 20–22: Conrad Hilton Hotel, Chicago. RADIO-ELECTRONICS and GERNSBACK LIBRARY will be in Booth 4501, West Hall, and Rm. 655.

Third International Television Symposium, May 20–24: Montreux, Switerland.

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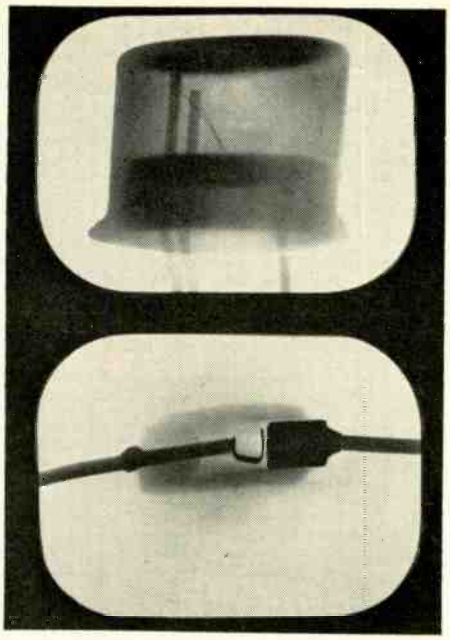


(Continued from page 8)

an adequate source of X-ray "light". The detailed resolution is comparable to that of fine-grade, high-contrast radiographic film, making the tube suitable for high-resolution applications and magnification up to 50X.

MHD Generator Uses Superconductive Materials

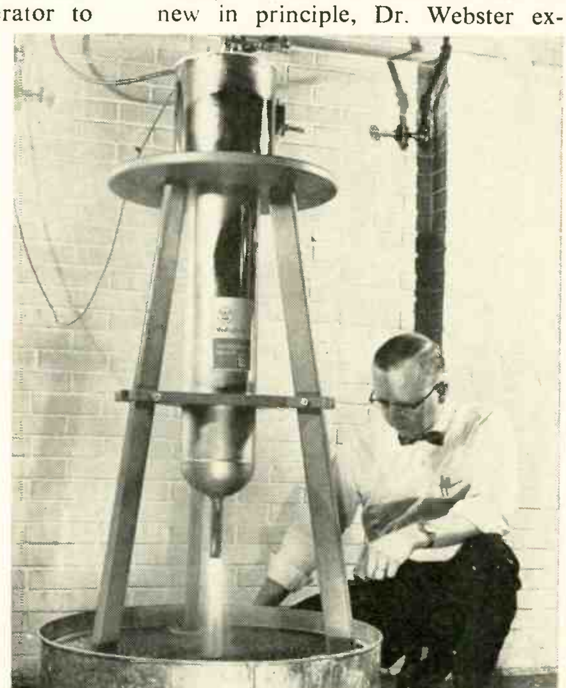
Practical use of *m*agneto*h*ydro*d*ynamic (MHD) electric power generation was brought closer by a new generator which uses a superconducting magnet, say scientists of the Westinghouse Research Laboratory. Magnetohydrodynamic generation is the production of electricity by passing a stream of white-hot gas through the field of a strong magnet.

The magnet has to be so strong that until now it required practically all the output of the generator to power it. Using a superconducting magnet, which needs almost no electric power whatever to produce a field far stronger than that of the electromagnets ordinarily used, reduces costs tremendously and eliminates tons of weight from even a small experimental machine.

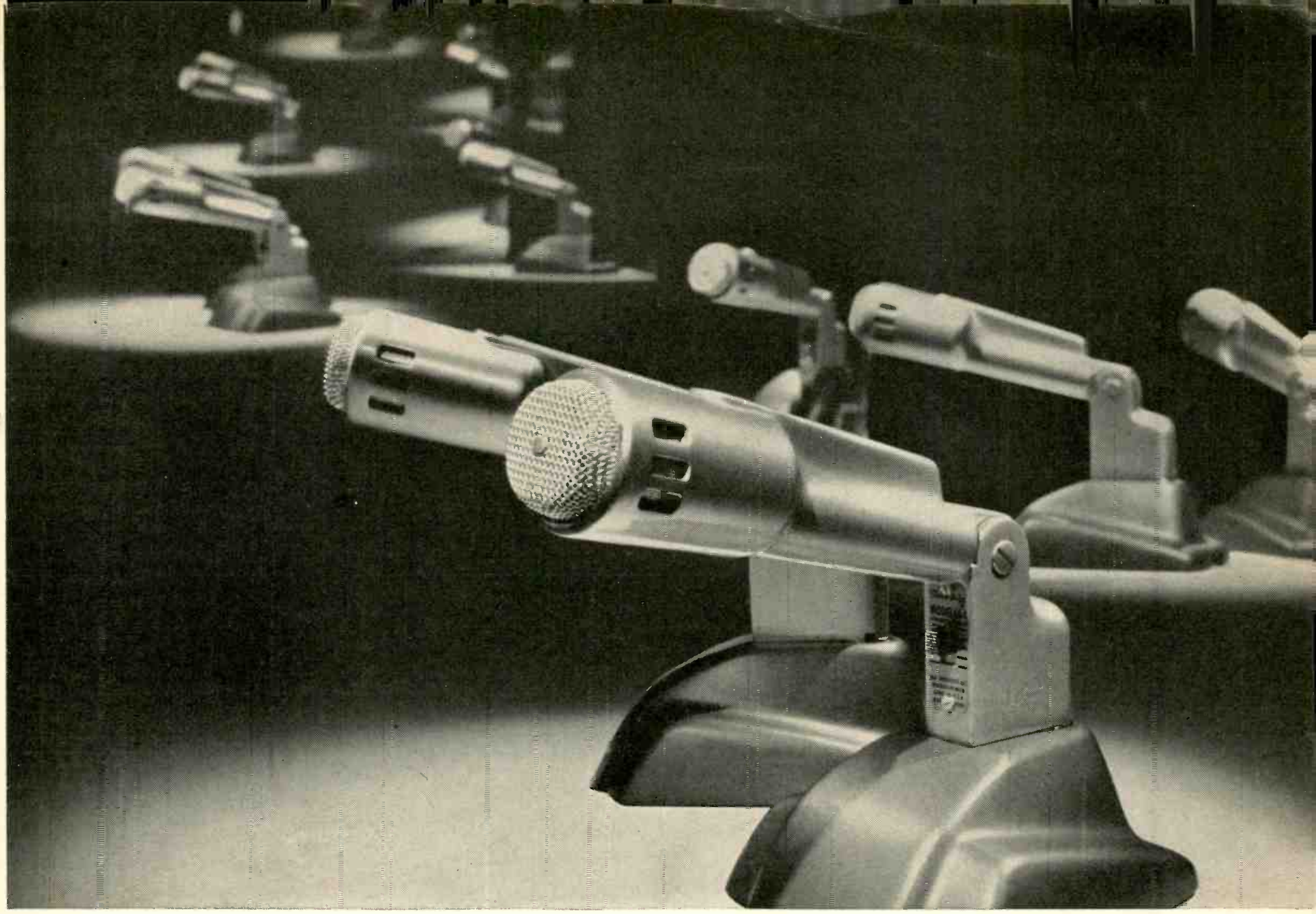
The production of a superconducting magnet with its magnetic field in air outside the bath of liquid helium—only 7° above absolute zero—was announced as a scientific triumph by Westinghouse only a month previous. Now, only an inch away from the liquid helium bath at this fantastically low temperature, the hot gases of the generator stream through the magnet's field at 4,500°F higher than the boiling point of aluminum or copper.

New Device Combines Tube and Transistor Features

RCA has announced the development of a "revolutionary solid-state element, combining the best properties of transistors and vacuum tubes." Called a metal oxide semiconductor transistor, it is described as an "insulated-gate, field-effect transistor, made of silicon and capable of amplifying electric voltages," by Dr. William M. Webster, director of RCA Laboratories electronic research program. "By varying the input voltage on the insulated gate," said Dr. Webster, "the device as a whole can be made to switch, amplify or otherwise regulate its output of electric current in a manner analogous to a pentode vacuum tube." In conventional transistors, he explained, similar results are achieved by varying the input current. While voltage-control led transistors are not new in principle, Dr. Webster ex-



The new Westinghouse superconducting MHD generator.



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Voice of America Doubles Its Power

The world's largest and most powerful short-wave radio station went on the air Feb. 8, when US Information Agency's Voice of America opened its new facilities at Greenville, N.C. USIA Director Edward R. Murrow gave the inaugural address.

With a total output of 4,800,000 watts, equal to the power of 96 top-strength commercial stations, the Greenville facilities double VOA's power. Marked by a forest of antennas, some as high as 400 feet, the 6,000-acre plant includes one receiver site and two transmitter locations. Construction took 3 years and cost $23 million.

The new plant enables VOA to broadcast more clearly to Latin America, Europe and Africa, and will support new stations planned for the future in five areas. It is considered the most important single component in a program to strengthen the Voice of America, letting it compete more effectively with Radio Moscow and Radio Peking.

MPATI Asks More Channels

The Midwest Program for Airborne Television Instruction has asked for six permanent uhf channels, proposing to transform the project from its present experimental basis to a regular operation broadcasting 180 hours per week. The program has been operating for a year and a half, with two separate programs—on channels 72 and 76—transmitted simultaneously from a plane flying over Montpelier, Ind., and sending lessons received in six states, over an area holding more than 7 million students. The proposed six-channel system will make more efficient coverage possible and lower the cost per student hour.

First TV Transmission Over Laser Beam

The first transmission of television on a microwave-modulated laser beam was demonstrated Feb. 20 at the General Telephone & Electronics Laboratories, Bayside, N. Y.

Two new developments made the breakthrough possible. The first: an electro-optic modulator, a metallic cylinder not more than about 2 inches in diameter and 2 inches long, with holes in the ends and a small potassium dihydrogen phosphate (KDP) crystal at its center. The second is a microwave photodetector developed by the Microwave Devices Div. of Sylvania.

In the demonstration, the video signal from an ordinary TV receiver was fed to a traveling-wave tube that was being driven at the same time at 3,000 megacycles by a klystron oscillator. The TV-modulated 3,000-mc signal was amplified and applied through a waveguide to the modulator, which is a resonant cavity at 3,000 mc. The beam from a gas laser passed through the holes in the ends of the cavity and through the crystal at its center, emerging from the cavity as an intensity-modulated optical carrier containing the microwave signal and the television information that was impressed on it.

The laser beam was then directed onto the photodetector, a special type of traveling-wave guide with a photosensitive cathode. The laser light striking the cathode produced an electron beam containing the microwave subcarrier and the video information. The tube's output was further amplified and fed to a video detector, thence to a TV monitor for display.

It was pointed out by Dr. Lee L. Davenport, president of GT & E, that the system was probably several years from practical application, but that the ultimate possibilities were fantastic. More than 160 TV channels or 100,000 telephone channels could be carried on a single laser beam, he said, as compared with 10 TV channels or 6,000 simultaneous telephone conversations possible with the best microwave systems of today.

English Slant on Educational TV

Charley Bayley, 80, of Blackpool, England, credits television with helping him get an education. "I got so sick of the programs," he said, "that one night I shut the thing down and signed up at a night school." That happened 5 years ago, and now he has certificates of proficiency in English, French, mathematics and Latin. END

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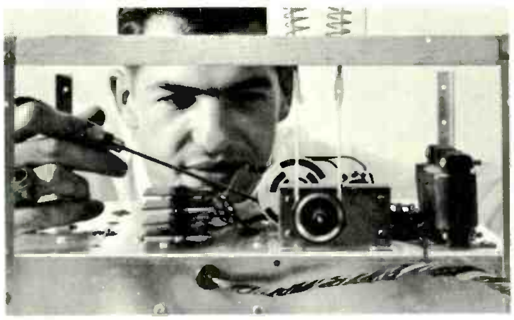

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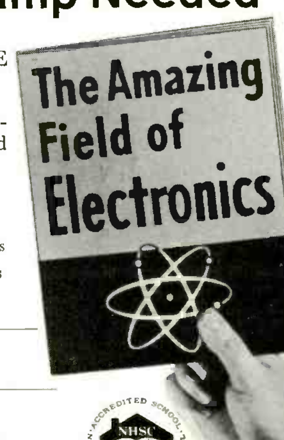

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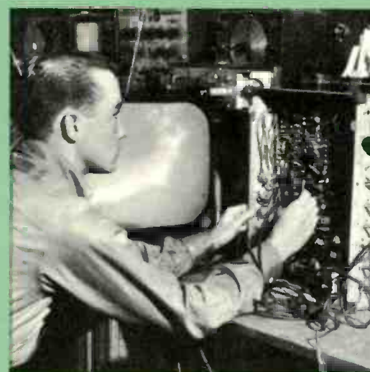

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Correspondence

This is a Shortage?

Dear Editor:

Re "Technician Shortage Worsens," page 66, February 1963:

I am a graduate of the Electronic Training Center of Allentown, Pennslyvania, having completed a one-year course in radio-TV-electronics that included a smattering of color TV. I have enrolled in Capital Radio Engineering Institute's extension course (units 1—6).

The article interested me and my fellow students for we have found employment in our chosen field to be very scarce indeed. The last time a firm sent recruiters to ETC was over 15 months ago. I have registered with three employment agencies, but no luck yet. I have six years of military experience, 25 weeks training in Carrier, a year of college, and the year of technical school.

Where is the employment?

Philadelphia papers show dozens of $100-a-week-to-start ads, but when I follow them up they turn out to be come-ons, and what they really want is a man who will commute 100 miles a day for $45 a week, to replace someone who asked for a raise. The Western Electric plant here has 3,000 applicants and no openings. Local TV dealers fish for crack benchmen and offer $50 a week. Several acquaintances have given up and found work in other fields.

This is a shortage?

RODNEY D. SQUIRES
Allentown, Pa.

No Shortage in R.I.

Dear Editor:

This letter pertains to your article "Technician Shortage Worsens" in the February 1963 issue of RADIO-ELECTRONICS (page 66).

I am a graduate of a two-year school. I have an FCC first-class radiotelephone license with radar endorsement. When I graduated in September 1961 I was called up during the Berlin crisis (October). With the 107th Signal Co. I received good military experience in operating and repairing radio relays. Since August 1962, when I was released, I have not been working. It's been six long months, and I am not alone. There is nothing in Rhode Island and most of Massachusetts—I've tried every company within a 50-mile radius. The state employment office tells me I have to move, there is nothing here, but I can't—my father is disabled.

If you know of any companies looking for electronic technicians, please send them to R.I. We technicians are dying here.

JAMES DERDERIAN
Providence, R.I.

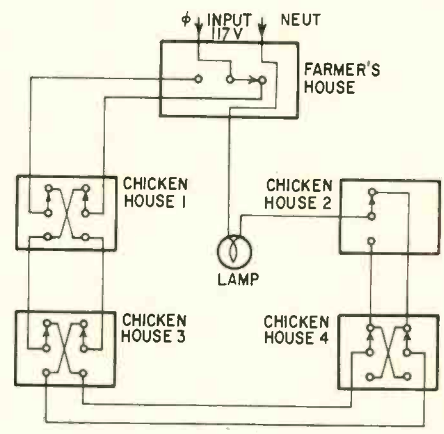
Deadly Chicken House?

Dear Editor:

In "What's your EQ?", February 1963 (page 47), I found two errors.

1. In the questions, spst switches were called for, but in the answer you used spdt switches.

2. The Electrical Code states that the neutral wire should not be switched unless the hot wire is opened at the



same time. Also, the lamp shell must be connected to the neutral. Neither condition is met in the answer.

The corrected diagram shows a hookup used often in wiring three-way and four-way switches.

NORMAN L. CURL
Basking Ridge, N.J.

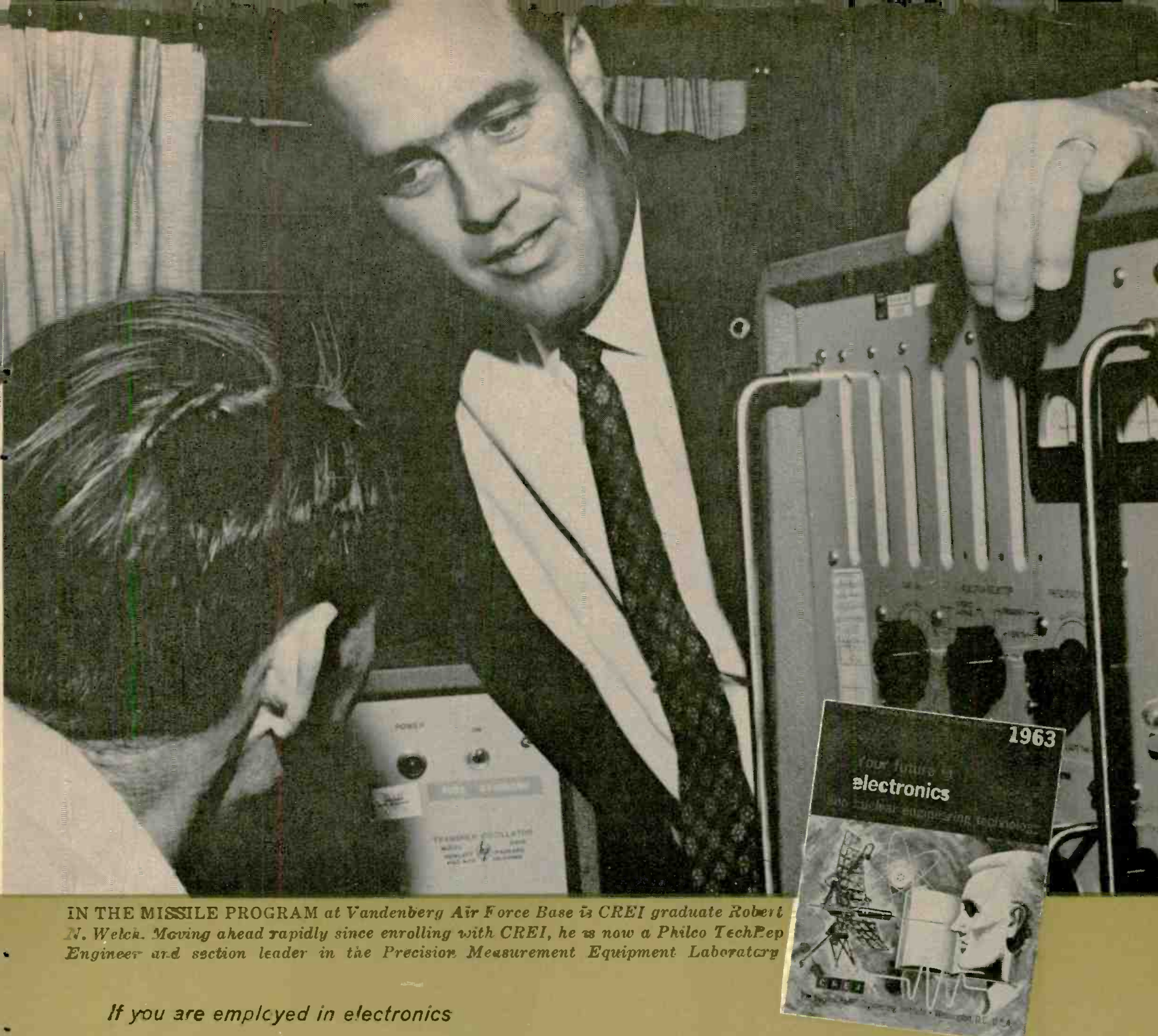
Snug Motor is Real Answer

Dear Editor:

I note that in the Correspondence section of the February 1963 issue (p. 21), that at least two readers spotted the needless complication of the "Start Your Car Fast" article in the December 1962 issue. I had every intention of writing something like "Why do it the hard way?"

Mr. Paul L. Esmay's letter proposing an spdt relay to switch the ignition to the auxiliary battery is what I was going to propose except I would provide a separate pair of contacts to return the auxiliary battery to the main battery so that it can be kept charged.

Unfortunately, there is more to starting a cold motor than merely providing a hot spark. Liquid fuel lies in the intake manifold and fails to vaporize effectively. Crankcase oil turns to



IN THE MISSILE PROGRAM at Vandenberg Air Force Base is CREI graduate Robert N. Welch. Moving ahead rapidly since enrolling with CREI, he is now a Philco TechRep Engineer and section leader in the Precision Measurement Equipment Laboratory

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43

molasses to overload the starter severely.

The solution to the whole starting problem is simply heat. If you have no heated garage, cover the grille with an old quilt or blanket. Then spread an electric blanket over the whole hood and plug it in. Come morning, the whole motor is warm enough for a fast start. Occasionally add a pint of alcohol to the gas tank to pick up any condensed water in the fuel system. Also add about ½ pint of motor ether to each 5 gallons of gas to provide one fuel component which will vaporize when cold. I have even used the electric blanket idea to keep an aircraft motor warm.

H. B. CONANT
Lincoln, Neb.

Diode Limits Speed

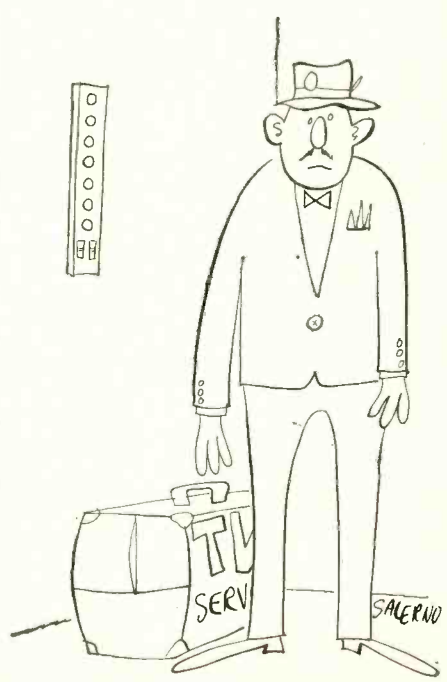
Dear Editor:

Mr. Ronald Ives presented an interesting solution to what can be an annoying problem, in his article "Contact Load Multipliers" (Feb. 1963, page 40). He stated that operational speed is limited by the relay to about 22 counts a second. The circuit, not the relay, is the limiting factor here. While limiting inductive kick, the diode across the winding of the relay is causing it to release slowly, by providing a current flow through the winding in the reverse direction.

Perhaps a better solution would be to replace the diode with a series R-C net. This, too, would protect the transistor, but without the slow release.

Both the R-C net and the diode have applications in telephone-switching circuits at Western Electric where I am employed.

BARRY BROWN
Columbus, Ohio



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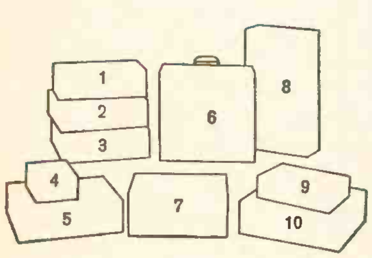

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THE ELECTRONIC REVOLUTION

... The Great Accomplishments of Electronics Are Still to Come ...

THE modern world has witnessed many technical revolutions in the past, all similar in their basic effects on man —unemployment, often of long duration. Yet the upheaval, after it had run its course, usually proved a blessing in disguise: the world in general improved after every such revolution. Wages rose, often sharply, and the workers found their employment in new spheres generated by the very revolution that started it all.

One of the first revolutions, often called the classic one, began in 1733. It is known as the Textile Revolution. It was brought about by the *flying shuttle* in England, quickly followed by the *spinning jenny* and the *roller spinning frame*. These inventions threw tens of thousands of adult handworkers out of work when incredibly faster machines took over. In some cases, even more children than adults lost their gainful occupation, because child labor was the order of the day.

Quickly, other equally formidable revolutions occurred, dislocating the entire industrial world. Steam power, doing away with backbreaking man-power, had its beginning in 1769, and changed the world fundamentally.

Railways, engineering, electricity, all helped to usher in the Industrial Revolution, which is still continuing today.

In the meanwhile, the world's population did not stand still. It was only a scant 750 million in the 1700's. Today we have more than 3 billion, an expansion fostered to a large extent by the very technical revolutions that broke down the world's frontiers: canals, steamships, railroads, communication, airplanes and others.

And now the Electronic Revolution, the new giant, is advancing with incredible speed into every human endeavor.

It might be said that it started in the early 1920's, with the invention of the dial phone, first successfully demonstrated in Sweden. In 1920, the American Telephone & Telegraph Co. had only manual operators, a total of 228,900 employees. There were 8,000,000 phones at that time. Then it turned to automation—the dial telephone system—eliminating nearly all hand-switchboard operators. Today, AT&T employs 731,569 workers (as of November 1962) and it has more than 67,676,000 phones (as of September 1962)! Such a quantity of phones could not be handled by manual operators—the phenomenal growth of the telephone industry has been made possible by electronics. But automation, instead of decreasing the number of employees, has vastly increased it. More skilled and specialized jobs have been opened up by electronics than were eliminated when electronic circuits and devices replaced operators.*

As the above example clearly indicates, we can also speak of the Electronic Automated Revolution. because very frequently one goes with the other. Indeed, today they are often inseparable. Industrial electronics and automation can not possibly exist without each other.

Let us only think of a single example, the transistor. In the beginning, in the early '50's, they were laboratory-made by hand. The price was above $10 each. Today, when they are made by automated assembly lines, the price for a much better product is as low as 33¢ each, in quantities. It will be even lower in the near future.

The electronic computer invasion into practically every type of business is only now beginning. It is still one of electronics' foremost sophisticated and expensive items of manufacture; computers are not as yet completely made and assembled by automated means. They are also still much too complicated, and many are far too bulky and difficult to program. In the not-too-distant future, simplified, compact computers, many types selling for less than $100, will be in every bookkeeping department and business office. Automation and microminiaturization are the keys to future computers.

The "Instant Newspaper," of which we spoke editorially last month, is on the immediate horizon. It will automate the newspaper into every home by radio facsimile. It will do away with physical distribution of bulky newspapers. This will be a *gradual* revolution, spread over many years, until homes have acquired what we call their *Rafar* receivers. It will save hundreds of thousands of tons of expensive newsprint paper, and release many thousands of press operators who will be readily absorbed by the printing industry.

The recent breakthrough of the laser and maser, still in their infancy, will have exploded into a vast industry during the next decade. These versatile newcomers are capable of the most fantastic achievements that even today require courage to believe.

We quote from the staid *Journal of the Stanford Research Institute* (No. 3, Vol. VI, 1962):

> "Thus, crystals can not only transmit light in whatever portion of the spectrum we desire; they can also generate light and control it and detect it and mix it. Perhaps in the future they will also remember light, because a crystal can be made with certain impurities that are sensitive to particular wavelengths of light. It is conceivable that it could remember an image observable only by light in a very narrow band of wavelength and a different image detectable by different wavelengths. Thus a crystal could conceivably be made that would have in it a number of different images, each visible only with illumination of the proper color. For example, it might be possible to store all of the pages of a book in a crystal."

The present writer, last December, in his *Forecast 1963*, predicted the following, all based on laser development:

> Anno 2088: The moon is now the world's largest and most efficient power house. This year it surpassed the earth as a generator of electricity. The surface of the moon is now studded with solar plants of titanic dimensions. Many of these installations measure 75 to 100 miles in diameter. The solar plants are low structures, their tops covered unbrokenly with thermoelectron cells that convert solar radiation into electric current at an efficiency of 86%. Because the moon has no clouds and is in a vacuum, the power generation goes on practically uninterruptedly on both sides of the moon. All plants are 100% automated.
>
> The power is sent earthward via highly efficient electron *Teledynes* (i.e. laser-means) with a loss of less than 1½% of the generated power.

—*H.G.*

* See also January 1960, RADIO-ELECTRONICS, "Automation in Electronics."

Try fixed bias in all stages

Hi-fi amplifier system with a 30-watt output

By GLEN R. TRAVIS

Ready to build a new audio amplifier? If so, here is one that will fill the bill. It is a 4-tube 30-watt amplifier with matching 2-tube preamp. Fixed bias added to time-tested circuits increases gain and stability and lowers distortion and hum levels.

During the past few years, I've analyzed audio amplifier circuits and often wondered why the performance of a tube in a particular circuit falls short of what is promised in the tube manuals. To find the answer, I ran tests and plotted my own tube curves. When my curves closely resembled those in the tube manual, I realized that the difference in performance must be in the actual circuit. Fixed bias is used when running tube curves. Why then, I asked myself, aren't amplifier circuits designed to use a tube as it is tested—with fixed bias?

To get the answer, I added fixed bias to my favorite amplifier. The circuit with fixed bias throughout is shown in the schematic. Fixed bias improved listening qualities and amplifier performance more than any other single change I've ever tried. The greatest improvement was increased gain. Another improvement was reduced hum. With fixed bias, both heater and cathode are at ground potential. A third noticeable improvement is stability. The music sounds solid. The signal voltage does not change the bias on the grid of the tube as it does with cathode bias.

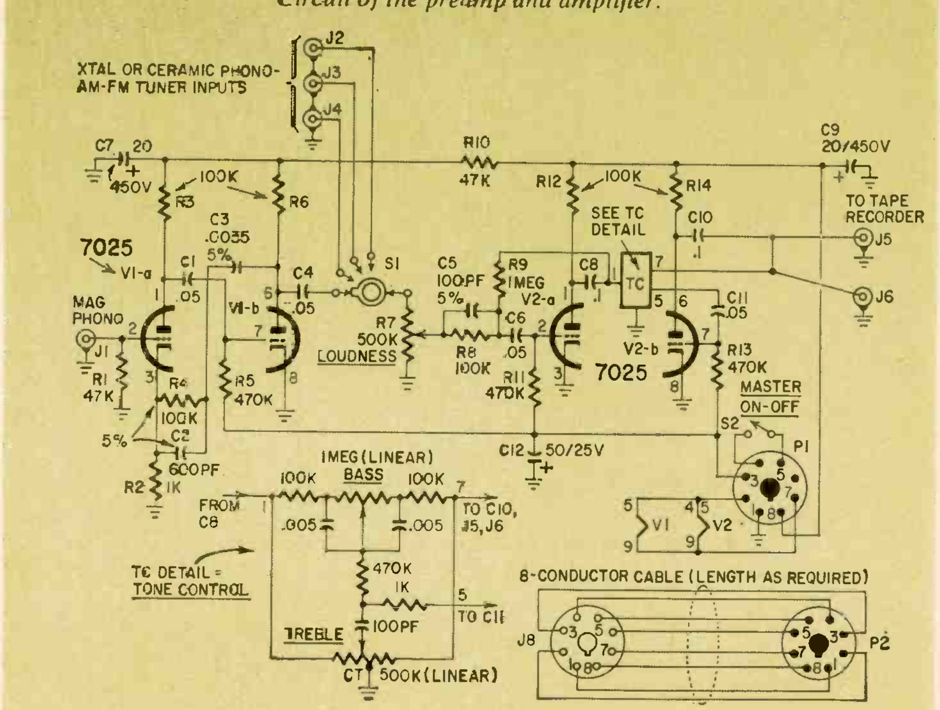
Increased gain, lower distortion, reduced hum and inherent stability are the reasons for designing this different and better amplifier, better because it is closer to the perfectionist's goal. All the circuits have been in use for several years but the change to fixed bias makes it possible to combine them into the simple and effective circuit shown in the diagram. This fixed-bias concept can be incorporated into almost all existing amplifiers.

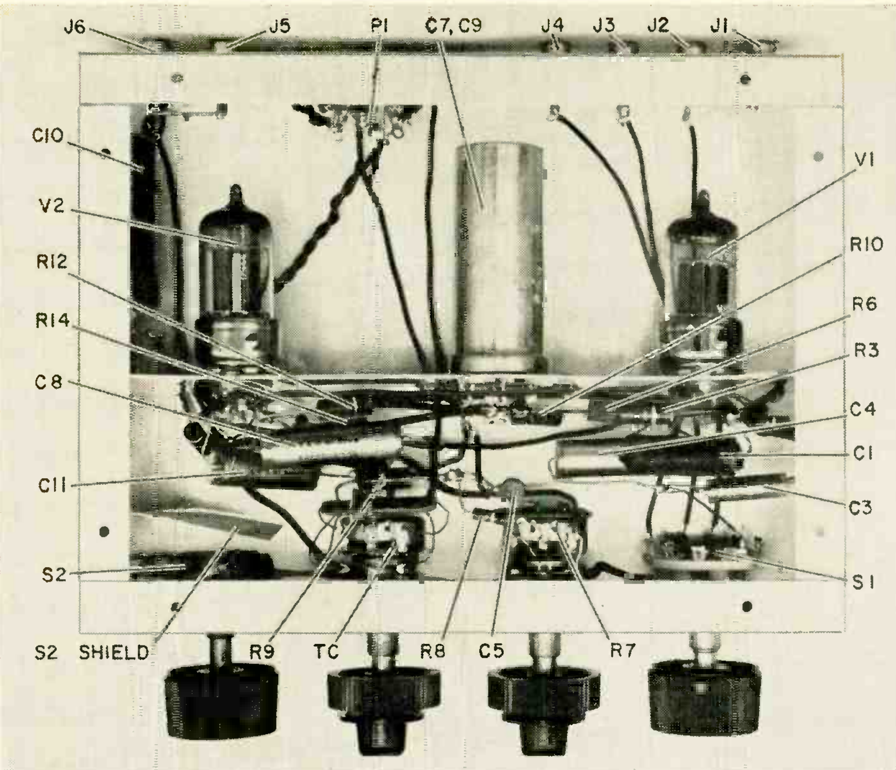
Circuit description

The phonograph preamp (for magnetic cartridge) uses a 7025 dual triode with record equalization through plate-to-cathode feedback. If a frequency test record is available, select R1 to give the best treble response for your particular phono cartridge. The equalization curve is RIAA without bass rolloff to 30 cycles. The extra bass available when bass rolloff is not used gives greater depth to organ music and bass drums. The amplifier is stable and is not driven into low-frequency oscillation by this extended bass boost. (The turntable must be quiet and the speaker and cabinet combination good.) The tone control can be used as a rumble filter if low-frequency noise exists. Adding other equalization curves is a matter of personal taste.

Crystal or ceramic cartridges with equalizer adapters can be plugged into J1. If equalizers are not available, plug

Circuit of the preamp and amplifier.





Inside the preamp. The bottom cover has been removed.

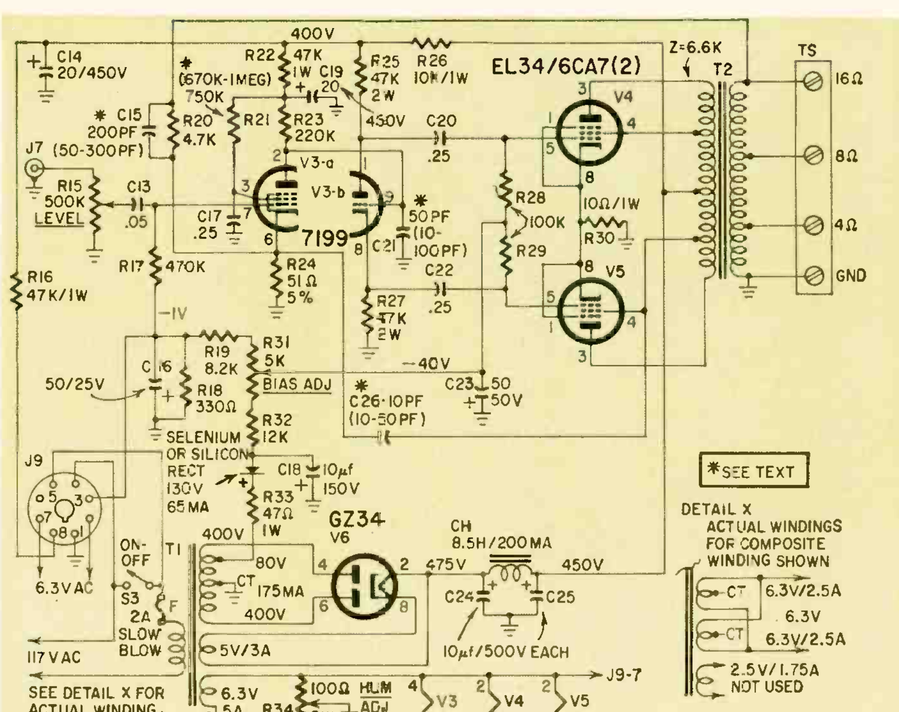
BENCH TESTED

This amplifier and preamp were checked in RADIO-ELECTRONICS' West Coast test facilities and found to have the exceptional performance claimed by the author. Frequency response is within 2 db from 20 to 40,000 cycles. Power output 30 watts. Maximum IM distortion 0.5%. Total harmonic distortion less than 1% for all frequencies above 50 cycles; rises to 2% at 20 cycles.

the cartridge into J2, J3 or J4 and use the tone controls for equalization.

The Baxandall-type tone-control network can be purchased as Centralab part No. C3-300 or made up as shown in the schematic. A loudness control, Centralab part No. C2-100, can be used in place of R7 to compensate for bass and treble hearing loss at lower than normal volume-level settings. Resistor R8 and capacitor C5 keep frequency response to V2-a constant regardless of volume-control setting. Feedback resistor R9 reduces V2-a's output impedance for the tone-control circuit. Distortion and any noise generated by V2-a are also reduced. Treble loss between the preamp and amplifier chassis is negligible.

The amplifier itself requires only 0.5-volt input to deliver its full 30- to 35-watt output. A separate volume (LEVEL) control on the amplifier chassis limits the output level and allows more gradual control of volume by the preamp. The amplifier circuit is similar to that used by many manufacturers, with the exception of the fixed bias on the grid of driver stage V3-a. For minimum distortion, the specific value of R21 should be set with a sine-wave generator and a scope or a harmonic distortion meter. C13 is small to keep unwanted low frequencies out of the am-



R1, R10—47,000 ohms
R2—1,000 ohms
R3, R6, R8 R12, R14, R28, R29—100,000 ohms
R4—100,000 ohms, 5%
R5, R11, R13, R17—470,000 ohms
R7, R15—pot, 500,00 ohms
R9—1 megohm
R16, R22—47,000 ohms, 1 watt
R18—330 ohms,
R19—8,200 ohms
R20—4,700 ohms
R21—750,000 ohms (see text)
R23—220,000 ohms
R24—51 ohms. 5%
R25, R27—47,000 ohms, 2 watts
R26—10,000 ohms, 1 watt
R30—10 ohms, 1 watt
R31—pot, 5,000 ohms, linear
R32—12,000 ohms
R33—47 ohms, 1 watt
R34—pot, 100 ohms, 5 watts, linear
All resistors ½-watt, 10%
C1, C4, C6, C11, C13—.05 µf
C2—600 pf, 5%
C3—.0035 µf, 5%
C5—100 pf, 5%, ceramic
C7, C9, C14, C19—20 µf, 450 volts, electrolytic
C8, C10—0.1 µf
C12, C16—50 µf, 25 volts, electrolytic
C15—200 pf
C17, C20, C22—0.25 µf
C18—10 µf, 150 volts, electrolytic
C21—50 pf see text
C23—50 µf, 50 volts, electrolytic
C24, C25—10 µf, 500 volts, electrolytic
C26—10 pf
CH—8.5 henries, 200 ma
F—2 amps, 250 volts, slow-blow type
J1, J2, J3, J4, J5, J6, J7—phono jacks
J8—female octal connector, cable type
J9—female octal connector, chassis type
P1—male octal connector, chassis type
P2—male octal connector, cable type
RECT—selenium, 65 ma, 130 volts
S1—single-pole 4-position rotary
S2—spst rotary
S3—spst toggle
T1—power transformer: primary 117 volts ac; secondary; 800 volts ct, 175 ma, plus 80-volt bias tap; 5 volts, 3 amps; 6.3 volts, 2.5 amps; 6.3 volts, 2.5 amps; 2.5 volts, 1.75 amps (Stancor P-4004 or equivalent)
T2—output transformer: primary 6,600 ohms, Ultra-Linear tapped; secondary, 4, 8, 16 ohms (Acrosound TO-300 or Dynaco A-420, or equivalent)
TC—tone control, Centralab C3-300 or equivalent. See schematic
TS—terminal strip, 4 lugs
V1, V2—7025
V3—7199
V4, V5—EL34/6CA7
V6—GZ34
Fuse holder
Tube sockets, 9-pin miniature (3)
Tube sockets, octal (3)
Preamp chassis, 6 x 8 x 2 inches
Amplifier chassis, 7 x 11 x 2 inches
Preamp subchassis, 1⅜ x 9-inch aluminum strip
Miscellaneous hardware

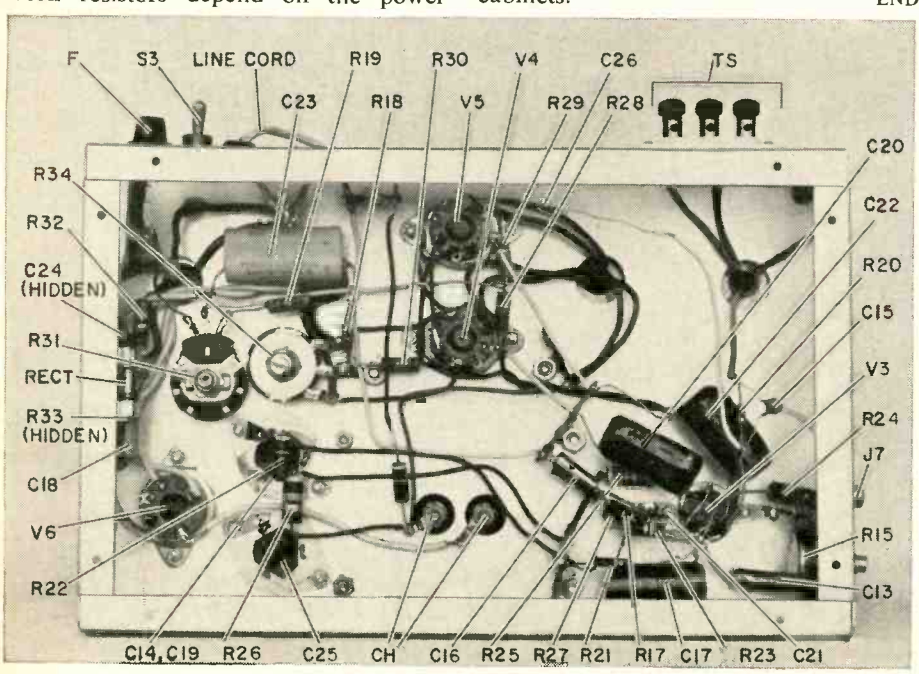
Closeup of the amplifier.

plifier and speaker system. Fifteen db of voltage feedback is introduced to V3-a through R20. R30 provides a point to measure the current through the two output tubes. A measurement of 1.20 volts across R30 indicates a current of 120 ma. This is the current when the bias is set to 40 volts and the plate voltage is 450. Use a square-wave generator and scope to determine the values of C15, C21, and C26. Pick the values that give the best 10-kc square wave. The several output transformers used during the development of this circuit required different capacitor values for the best sine- and square-wave response. The ranges of values for these capacitors are shown in parenthesis on the diagram. If a filament center tap is part of the transformer winding, ground the center tap and eliminate R34. It may not be needed for minimum hum. If an 80-volt bias tap is not part of the high-voltage winding, the bias supply can be taken from either side of the high-voltage winding through a 120,000- to 150,000-ohm 2-watt carbon resistor. The exact values of the bias network resistors depend on the power transformer used. A choke in the power supply is the easiest way to reduce hum in the plate-supply circuit. The frequency response of the amplifier itself will vary from below 20 cycles to the upper limit of the output transformer, which can be from 20 to 100 kc.

Construction

No ground bus is used. Each circuit ground is made to the nearest chassis tie point. Chassis tie points must be solid. Hum picked up from the ac circuits can be minimized if all ac lead pairs are twisted together and dressed close to the chassis. If possible, check the value and condition or every component before installation. Several holes in the top of the chassis will aid in cooling the output and rectifier tubes. Separate chassis construction makes the amplifier more flexible.

In my own system I use a Fairchild cartridge, a Presto turntable, the amplifier described in this article and four 15-inch full-range Stephens speakers with two tweeters mounted in two friction-loaded 10-cubic-foot cabinets. END



Underchassis view of the amplifier.

Is There an Answer?

A recent article in the local paper was headlined "Fined $200.00 on Charge of TV Repair Fraud." As usual, the headlines covered almost as much space as the article itself and gave very little information except the bare facts.

The time and work involved in this conviction and fine is a thing to behold. The case first came to light when the customer called in a TV service man to check her set after spending a large amount for service without getting satisfaction. Among the work paid for was replacement of the horizontal output transformer. A glance showed that this was not done. The county sheriff was informed and the man was picked up and charged with fraud. At this point, the sheriff called in two local TESA members to act as expert witnesses and to examine the set.

So far so good. Now to prove the case in court. This case went through an arraignment, a preliminary hearing, a grand jury investigation, and, if the man had not pleaded guilty at this point, it would have gone to a jury trial.

As to time and money involved: At the preliminary hearing, which took most of one day:

Judge, customer, Assistant County Attorney, 3 TV service technicians, 1 other witness.

At the Grand Jury investigation (one half day):

6 jurors, 3 TV service technicians, Assistant County Attorney, customer, 1 court clerk.

In addition to the above, time was spent by clerks typing subpoenas, it took time and transportation to serve them, and the Grand Jury and witnesses had to be paid for their time. All this and all the other paper work involved in such a case—and then the customer's set was held as evidence for 6 weeks.

All this was done to prove a man charged a woman $15 too much. But there is no way to prevent this man from continuing to do business!

What is the answer? Our State Legislature will not give the cities and towns the right to protect themselves with some type of license. Our State Tax Commission turns a deaf ear to our plea to issue tax permits to ALL retail operators. The distribution processes have broken down to the point where almost anyone can obtain parts at "wholesale". The advertising media will accept *bait* ads from almost anyone. . . . The public will continue to try to "save money" or get something for nothing.

Is there an answer? The only one that comes to mind is for legitimate shop owners to bind together into a strong association and meet problems head-on with every means.—*Reprinted from TSA Service News, Seattle, Wash.*

Unusual Squelch Troubles

By ARNOLD W. WIEGERT

THE BENDIX 28 SERIES OF FM TWO-WAY radios uses the model 16-RS-1 receiver chassis. It has two tubes. One is an rf amplifier, the other a multiplier for the local oscillator and first mixer. The rest of the circuit is transistorized and divided into printed-circuit boards—local oscillator, first i.f. amplifiers, second i.f. amplifier, and the squelch and audio driver. All are easily accessible for servicing. An 8-watt class-B transistor amplifier is the final audio stage.

We had five of these sets in operation for over a year and a half as fixed base stations. During all this time, the only thing to give us trouble in the receiver was the squelch circuit, or at least that's what it seemed to be from the symptoms.

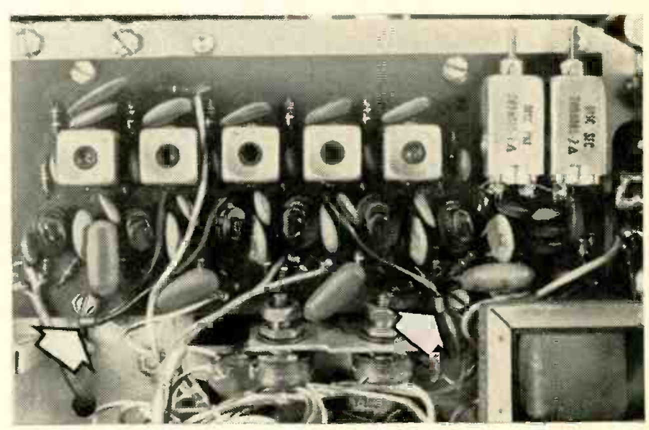
On two sets the complaint was very slow squelch action. It took about 10–15 seconds after receiving a signal before the squelch would cut off. On the first one, all voltages in the squelch circuit checked good and the trouble seemed to be low input to the noise amplifier. Instead of 0.65 volt, the meter showed only 0.4 volt at the discriminator output. After about 5 seconds the voltage started to rise slowly until it reached 0.65 volt and the squelch cut off. Voltage checks in the second i.f. board seemed to indicate poor power supply regulation. With the squelch open, supply voltage to the second i.f. was about 10.5 volts and jumped to 12.5 volts as soon as the squelch cut off. At those voltages this is quite a drop, but a different set worked just perfectly with the same change. (This drop is due to the heavy drain of the class-B output stage when amplifying the noise.)

Several hours later we noticed that the voltage at Q204's emitter (Fig. 1) changed slowly as the noise at the discriminator came up. Checking the transistor showed its leakage was a bit too high. Replacing it with a good one cleared up all our troubles. The second set showed the same symptoms, but this time it was Q205. Again a new transistor cured the set. So watch those jumping voltages and don't let them fool you into a wild goose chase.

The third set came into the shop with erratic squelch action. Sometimes the squelch cut off right after receiving a signal, sometimes it would stay on for minutes or hours and nothing would help. Everything worked fine up to the noise amplifier. Voltage checks around Q251 (Fig. 2) showed that the bias had changed enough to cut the transistor off completely. Remembering the article on Ultra-Kaps in the January 1961 issue of RADIO-ELECTRONICS, C254 (1-μf 3-volt Ultra-Kap) was not even suspected. But after every other part was found to be good, we finally tested C254 and found it was practically shorted. Replacing it with a 10-μf electrolytic, because we had no exact replacement at the time, cleared all problems and the set has been working fine ever since.

You will have to watch out for one thing when working on the second i.f. board in these sets. If you have to get at the back side while the set is operating, make sure that the two lugs under the bottom mounting screws as well as the ground strip on the back are grounded. The best and easiest way is to take two nuts and thread them over the mounting screws. Then run a short jumper from there to ground. After you are finished, make sure the mounting screws are good and tight again. Otherwise you are heading for more trouble, again with the squelch. It will be very erratic. Sometimes the squelch will cut off, sometimes it won't until you bang the radio or somebody walks around the room. The reason is simply that the wires attached to the two lugs are actually short ground connections for the ground system in the printed-circuit board and, unless they are securely grounded, all kinds of troubles develop. One of them is low noise output from the discriminator and intermittent squelch due to a drop in gain in the sound i.f. amplifiers.

All these troubles appeared in the summer and we suspect that high temperatures had something to do with it. They kept us busy for many an hour and we hope that these tips will help to make life easier for some readers with similar problems. END



Lugs under two lower printed-board mounting screws (arrows) must be grounded securely.

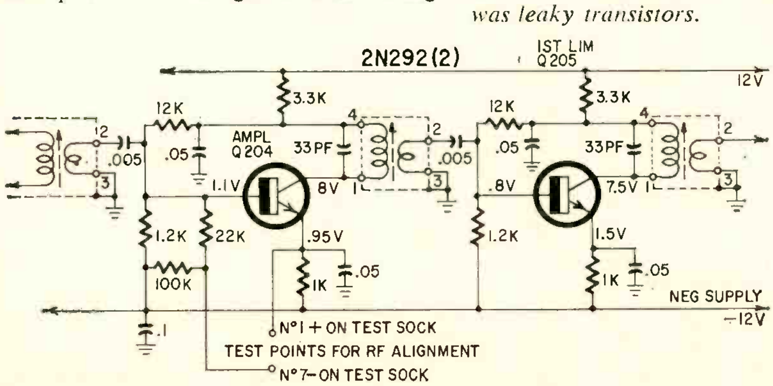


Fig. 1—Circuit of second i.f. amplifier board. Trouble here was leaky transistors.

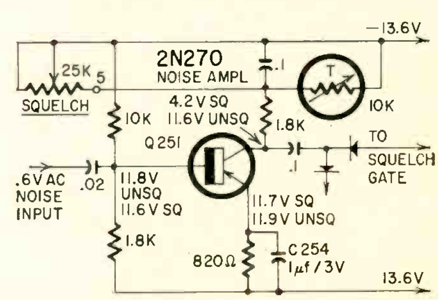


Fig. 2—Noise amplifier circuit in the Bendix 16RS-1.

watch out for TRANSIENTS

They can put a sudden end to meters and rectifiers

By E. H. LEFTWICH*

FOR MANY YEARS, I WENT MERRILY about my work checking circuit voltages with a vom or vtvm. In every case, I connected one meter lead to ground or chassis and checked through the circuits, holding the other meter lead (insulated prod) in my hand. All went well.

Recently, I checked the high-voltage secondary of a 1,000-volt power transformer for no-load output. Because I was somewhat afraid of holding one lead in my hand, I connected both leads of my vtvm to the transformer secondary terminals, and set the meter range switch to 1,400-volt position (ac).

So, I plugged the transformer primary into the ac line—and jumped back! Lights in the shop went dim—like a dead short circuit—the meter needle flipped over and hit the post, and I heard a "sizzling" noise in the meter—all this in the fraction of a second it took to jerk the plug out of the ac line socket. I pulled the meter chassis out of the case and found that the range switch had arced across the 1,400-volt ac contacts, burning them off. The "burnout-proof" meter movement was fortunately not damaged.

Next, because I was "hard-headed" and unbelieving, I connected my vom the same way—to the high-voltage secondary terminals. I set the range switch for the 5,000-volt ac scale. I plugged in the transformer primary to the ac line as before—and as before, I jumped back. Again, the shop lights dimmed, fire flashed and smoke rose from the vom case. I snatched the plug from the ac line socket again. I removed the vom from its case and inspected the damage. The meter needle had struck the post so hard that it was bent over in the shape of a sawtooth wave. Coil turns on the lower meter-movement spring were welded together, and the range switch contacts in the 5,000-volt ac circuit were burned off. In addition, a resistor in the circuit had exploded and burned to a fine white powder!

I was now in a sorry position. Both my meters had blown and there was work to be done in the shop. I ordered replacement parts for the meters, but could not afford to wait for them to arrive. So, I bought a new, top quality vom and reasoned that later I could "work off" the repaired meters (at a ridiculously low price) to some associates.

Now, I was smart. I didn't know why the meters had blown—but I had learned the hard way. I wasn't taking any chances with the *new* meter! So, I dragged out a transformer with a rated secondary voltage of only 400. (Here, again, the instruction manual furnished with the new meter read CAUTION—ALWAYS CONNECT THE METER LEADS *FIRST* BEFORE TURNING ON THE POWER.) For this test, I again connected the test leads to the 400-volt secondary terminals of the transformer, and set the meter range switch to the 1,600-volt position (ac). "Surely," I reasoned, "there will be no trouble this time—with only 400 volts in the circuit." I was wrong! When I plugged the transformer primary into the ac line socket, the shop lights dimmed *slightly* (about the same as though a 1,000-watt electric heater had been connected) and the meter needle flopped gently against the post. Instantly, I pulled the plug out of the ac line socket, and this time the meter was not damaged.

Here, I had a transformer secondary rated at only 400 volts, yet the meter needle had pinned the post on the 1,600-volt scale. How was this possible? "Okay," you might say, "what about the peak voltage?" But, this would not explain the phenomenon because $1.77 \times 400 = 708$ peak volts, and this would not pin the meter needle to the post on the 1,600-volt scale. Conferences with a number of friends resulted in various theories, none of which appeared logical: "surge voltage"; "defective or incorrectly rated transformers"; "magnetic-field current buildup"; "*impossible*—could not happen; if meter range is 5,000-volts ac, then meter should take 1,000 volts ac without blowing."

Finally, with the assistance of an electronics design specialist I know, and reference to a comprehensive book on transformers† the phenomenon was explained. Briefly, a transformer, when not loaded, constitutes what is essentially a resonant-tuned circuit (Fig. 1).

Analysis of transient effects at an input of only 100 volts indicated a voltage as high as 22,600 volts rms at the secondary terminals of a transformer! Because of this, you must safeguard your test instruments. The following two rules will protect you and your test gear:

1. *Do not connect meter leads to a transformer before power is turned on unless the secondary is shunted by a reasonable load (5,000 to 50,000 ohms).*
2. *If you want to check the actual ac output of an unloaded transformer secondary, turn on the primary power FIRST, use the high-voltage test probe in one hand and put your free hand in your pocket.* (When primary power is turned on before the test leads are connected, no meter damage will result, assuming that the proper meter scale is used.)

These two simple rules apply principally to ac voltages, except for instantaneous make-and-break circuits where a battery is used. In ac power

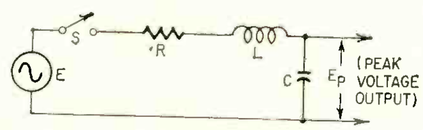


Fig. 1—Simplified circuit represents the input primary of an unloaded transformer.

*Advanced design, Ryan Electronics, Ryan Aeronautical Co.

† Lee, Reuben. *Electronic Transformers and Circuits,* Wiley, 1947.

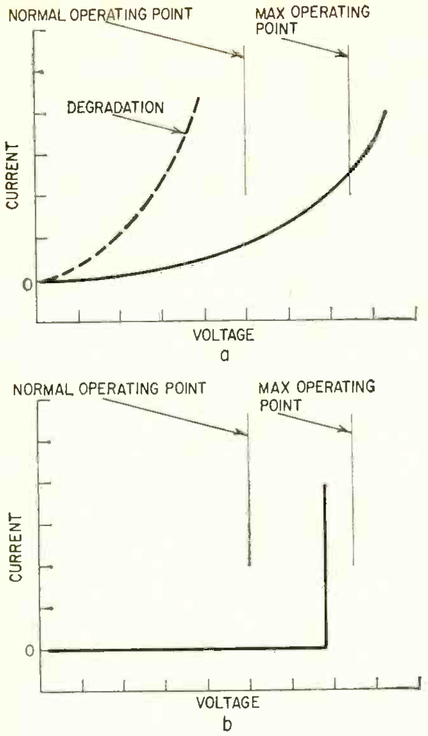


Fig. 2—The difference between ordinary semiconductor diodes (a) and diodes designed for transient suppression.

supplies, the filter and bleeder resistor provide the load, and it is, of course, safe to connect the meter leads either before or after primary power is turned on.

TV circuit problems

Transients in TV power supply circuits often exceed silicon rectifier ratings, causing frequent breakdowns and recurrent headaches for the service technician. This problem is not restricted to silicon rectifiers, but also occurs, to a lesser extent, with germanium rectifiers.

The low interelectrode capacitance and high reverse resistance of such rectifiers are normally satisfactory for blocking a continuous voltage, but instantaneous high-voltage transients can destroy the rectifier in a few microseconds. These transients usually occur the instant the line voltage is applied to the transformer primary, or the instant the line voltage is cut off. For example, the technician could leave the TV on and operating normally in the owner's home. Then, when the owner turns off the set, a transient overvoltage could blow one or more rectifiers. The next time the set is turned on the service technician has a call-back.

A peak inverse voltage (PIV) many times the normal reverse voltage can appear across a rectifier because of this on-off switching. Although there is, in effect, what might be considered an inductive load on the transformer secondary, the reverse characteristics of the rectifier do not have a low enough impedance damping (discharge) effect to handle these transients.

Possible solutions

The obvious solution is to replace the silicon rectifiers with types which can handle the transient voltages. Happily, some silicon rectifiers have good avalanche breakdown characteristics. These diodes have, in effect, "self-damping" qualities. That is, they are "harder" types which have an abrupt voltage-current curve rather than a slowly rising one (Fig. 2). This *gradual* relationship between voltage and current is often due to surface effects which are related to premature failure.

Surface effects (leakage paths) result from inadequate cleaning of the diode surfaces during manufacture. The initial "dirt" (moisture contamination) remaining on the surfaces tends to increase gradually with time and use. The actual self-life of a "dirty diode" is therefore lessened also.

Silicon diodes having satisfactory characteristics for transient suppression or handling instantaneous overvoltages are available from Rheem Manufacturing Co., Mountain View, Calif. Fairchild Camera & Engineering Co., also in Mountain View, makes similar types. These diodes can be used as direct replacements for 1N457, -458, -459, -461, -462, -463 and -464. I recommend that 1N2069, 1N2070 and 1N2071 diodes used in TV power supplies be replaced by 1N2614 or equivalent types. In addition, there is the G-E selenium Thyrector diode§ designed specifically for transient-voltage suppression.

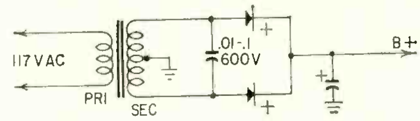


Fig. 3—One way to protect diodes is to add a .01- to 0.1-μf capacitor across the transformer secondary.

As an alternate solution you can connect a .01- to 0.1-μf disk ceramic damping capacitor across the secondary of the power transformer *ahead* of the rectifiers as shown in Fig. 3. Its voltage rating must be higher than the secondary peak-to-peak voltage.

Other methods which have been used successfully are:

1. Opening and closing the transformer secondary *after* the primary voltage has been turned on. (This can be done with a relay.)
2. As a temporary measure, protect existing rectifiers with fuses (rated to handle the current) in series with the rectifiers. [This may not always work since a silicon rectifier will often burn out before the fuse.—*Editor*] END

§ Complete data on the Thyrector and its application appear in G-E *Application Note 200.5*, available from General Electric, Rectifier Components Dept., W. Genessee St., Auburn, N. Y.

Electronic Ear Brings Sound to the Deaf

Last November, a neurosurgeon implanted an artificial electronic "ear" into the skull of a 46-year-old woman, deaf from birth. Now she can hear sounds, distinguish words, and soon should be able to understand them.

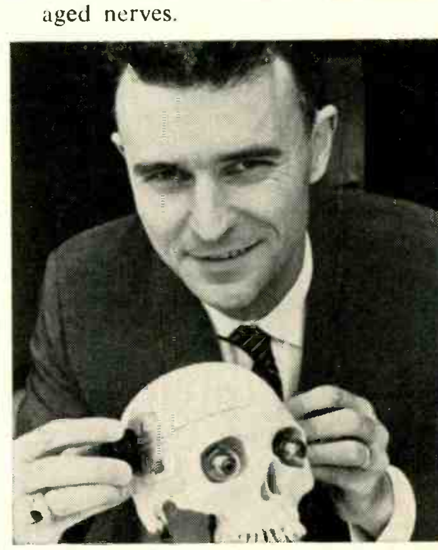
The device was developed by Dr. James Doyle, of General Data Corp., Orange, Calif. Dr. Doyle's brother, John B. Doyle, Jr., of USC Medical School, was the neurosurgeon who performed the operation.

The system's microphone picks up audio signals, then an analog-to-digital converter changes them into digital signals understood by the brain. The transmitter is worn in a headset, and a receptor unit inside the head is coupled to the acoustic nerve, which passes signals to the brain. The four channels in the converter and receptor unit, with a range of 200-600 pulses per second, offer a sound range of 500-2,500 cycles—adequate for speech and some music.

General Data Corp. has been working on the device for 2 years. It is designed for use where the acoustic nerve is unimpaired but the inner and outer ear are defective. About 3 million Americans suffer from this condition, which makes an ordinary hearing aid useless.

The next "ear", says Dr. Doyle, will be much thinner, and will be implanted under the skin instead of recessed in the skull. Further research, requiring 6 months to a year, is needed before it can be marketed.

Success of the "ear" has encouraged Dr. Doyle to plan artificial "eyes", like tiny TV sets, and electronic circuitry to replace polio-damaged nerves.



Dr. Doyle demonstrates the electronic ear on a plastic skull.

BUILD a signal injector into your vtvm

Audio oscillator makes a useful accessory for signal tracing

By HAROLD REED

When you equip your vtvm with this little device, you automatically have a continuous 1,000-cycle signal-tracing sine wave without need for a separate audio oscillator. It may be built into other test equipment if desired.

An audio oscillator is indispensable in servicing amplifiers or audio systems. In many instances spot-checking at a single frequency will localize the trouble in an electronic system. In these cases it is unnecessary to set up the relatively large variable audio signal generator on an already overcrowded work bench, or to take it on service calls.

The circuit uses a phase-shift oscillator. It has often been said that transistor phase-shift oscillators have not been given the consideration they deserve nor are they widely used. Here is one way to make good, practical use of this circuit. It provides the service technician with another basic tool for rapid servicing.

The phase-shift oscillator is an R–C circuit. Therefore, no transformer is required for feedback to sustain oscillation. Since a 180° phase reversal is necessary between the transistor stage's input and output, the common-emitter configuration is used. The cascaded R–C feedback network between collector and base provides the additional 180° phase shift needed to make the circuit oscillate.

The feedback network results in considerable signal loss. A transistor with enough gain to overcome the circuit losses is required. The 2N35 satisfies this requirement and is a low-cost type.

Base bias and stabilization are provided by resistor R4. The value of this resistor affects starting of oscillation, distortion and output level. The 620,000 ohms shown in the schematic was found optimum for this 2N35. This resulted in a maximum output of 5 volts across a 47,000-ohm load resistor with 0.3% distortion. Frequency measured 1,075 cycles. Starting of oscillation is instantaneous and output level is steady.

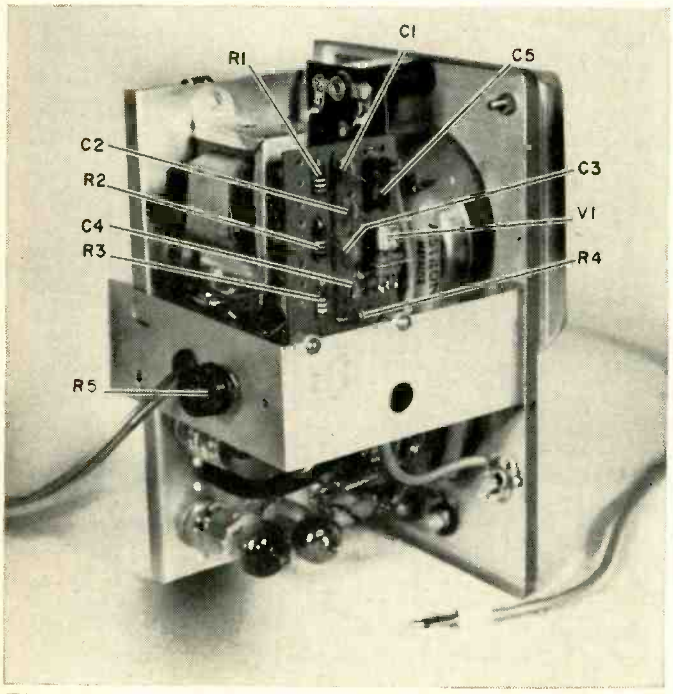
A potentiometer can be used temporarily for R4 and adjusted for optimum results for any particular transistor. Distortion varies somewhat as loading is varied. Signal output from the oscillator is taken from potentiometer R5 in the collector circuit, through capacitor C5.

Other inexpensive transistors were tried in the circuit and, although they worked well, best results were had with the 2N35. Note that only n-p-n types can be used if the power supply B-minus is grounded as shown in the schematic.

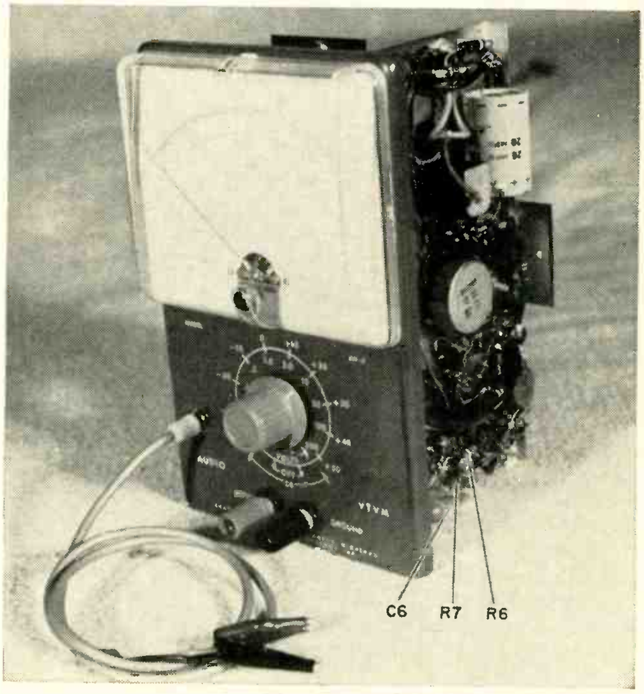
Power source

Power for the oscillator presents no problem and may be supplied by any unit into which the device is built. The dc potential needed is from 20 to 25 volts and the current drain is just 0.5 ma. This voltage may be obtained with a simple voltage divider consisting of two resistors connected across any available power supply.

I built the oscillator into a Heathkit model AV-3 audio vtvm. The re-



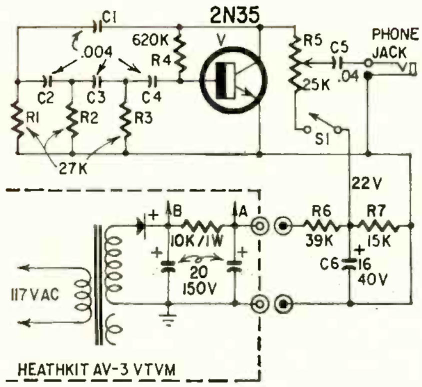
The injector is built on its own subchassis, bolted to the vtvm frame.



The two additional resistors and filter capacitor are at bottom right quired supply voltage was obtained as shown in the diagram. This same arrangement may be applied when using any other test instruments. Resistors R6 and R7 should then be selected to obtain the correct voltage. If desired, the oscillator may be powered independently by a miniature 22.5-volt battery such as the Burgess U15.

Construction data

All component parts of the oscillatory circuit are assembled on a 1⅝ x 2½-inch piece of perforated phenolic board attached to the framework of the vtvm. The leads of resistors and capacitors are pulled through the holes of the board and connected at the back. A small aluminum bracket, also fastened to the board, was provided for the transistor.



C1, C2, C3, C4—.004 μf, ceramic disc
C5—.04 μf, miniature
C6—16 μf, 40 volts, miniature electrolytic
R1, R2, R3—27,000 ohms, 5%
R4—620,000 ohms, 5%
R5—25,000 ohms, miniature pot with spst switch, Lafayette VC-25 or equivalent
R6—39,000 ohms, 10%
R7—15,000 ohms, 10%
V—Sylvania 2N35 (n-p-n)
All resistors ½ watt
Plug and jack set, subminiature, Lafayette MS-370
Knob, miniature, for ⅛-inch shaft, Lafayette MS-185
Transistor socket, Lafayette MS-275

The signal injector is a one-transistor, 1-kc, phase-shift oscillator.

Miniature output control R5 is mounted on the rear of the vtvm framework. This control has an attached switch, S1, which opens and closes the B-plus supply to the transistor. This switch is not absolutely necessary. The oscillator could be left running continuously while the vtvm is turned on.

Oscillator output terminates in a miniature jack mounted on the front panel of the vtvm. A short length of small-diameter, single-conductor, shielded cable connects the output to this jack. A 2-foot length of this same type cable, equipped with miniature plug and Mini-Gator clips, conducts the signal to the equipment under test.

Power supply resistors R6, R7 and filter capacitor C6 are connected directly in the power supply circuit of the vtvm. Unused pin 5 of tube 6C4 of this particular vtvm is used as a tie point for the voltage divider.

Once you build this simple, single-stage, phase-shift oscillator into your audio vtvm, you will always have available a 1,000-cycle audio test signal whenever and wherever you use your vtvm. END

COVER STORY

New Scientific Toys Teach Kids to Think

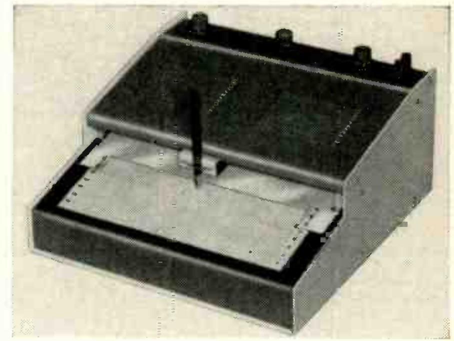
THOSE VIEWERS-WITH-ALARM WHO ARE sure that America is being left behind in the science and technology race, and point as evidence to college enrollments in engineering and physics, are pointing the wrong way. A much more valid gage is what the kids grow up with: there is where the guiding interests begin. The last generation put the United States ahead in technology *despite* a condescending attitude in the colleges to the mechanical arts. Why? Because the youth put in their busiest hours around the Model T in the back yard—and grew up to be mechanics, machinists and engineers.

The youth of our vastly more technical world has greater difficulties. You can't build a computer in the cellar, or a laser in the backyard. But they have one advantage their parents did not—access to scientific and technical equipment in cheap and easily handled forms. Many of our kids are engaged in activities—for fun—that their parents thought of as tedious college subjects (if indeed they learned of them at all). The material for these activities comes from the counters of our hobby shops and electronic supply houses, as educational projects and laboratory kits. The very changes that have taken place in these kits in the last few years show how significantly the youthful taste has developed.

The kit on our cover, made by International Rectifier Corp., of California, is not vastly different from one that appeared on our June 1961 cover. But the instruction book supplied with it starts out: "The fascinating world of electrical and electronic science," goes on to ask "what is electricity and electronics . . . how does a solar cell work . . . what is a circuit?" before even suggesting that the purchaser unpack his lab.

The experiments are headed with such titles as "Learn the principles of electromagnetic devices" (instead of "Build a 10-pound electromagnet"). The fun-seeking child is invited to "learn how a transistor works." Let's face it—the explanations are often extremely simple—but the approach is basic. When the purchaser graduates from these units, he is going to come to more advanced projects with the urge to "learn how" rather than "build a . . .".

And he will have the equipment to help him. An educational kit, put out by the Heath Co. for advanced students, is accompanied by a text book and manual, aimed not at beginners,

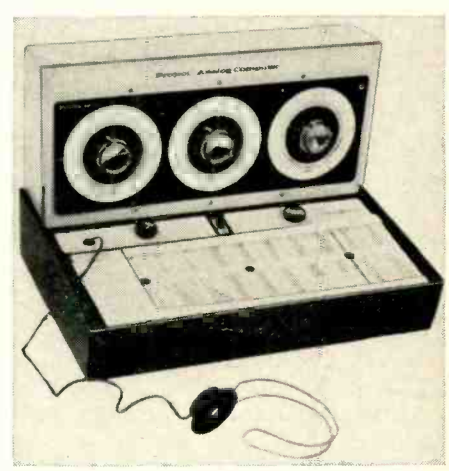


Heathkit Servo Recorder Kit.

but at scientists in other fields (*Electronics for Scientists*, by Malmstadt, Enke and Toren). No doubt the adolescents will swallow the text of that equally as well as the more learned, but less adaptable, scientist.

These post-graduate kits are represented by outfits intended for advanced students and design engineers. A few years ago, an analog computer kit selling at a little less than $1,000 was introduced. Now we have several, including such items as "a complete microwave kit, Model TI . . . for military, college, industrial and vocational school training . . . consists of a complete microwave training system capable of transmitting and receiving signals in the X-band." The kit is priced at $1,873. Similar kits are being offered researchers in thermoelectrics and other fields.

But the child is being offered as wide a variety of activity at a slightly lower technical (and economic) level. He can study phosphorescence, ultraviolet light, build himself a functional weather station, learn how to orbit satellites or study binary mathematics and computers with toy kits. END



The General Electric Educational Projects analog computer kit.

FM stereo in HI-FI packages

How the package systems are modified for stereo broadcasts

By **ROBERT F. SCOTT**
TECHNICAL EDITOR

For a few months, FM stereo was limited to listeners within range of one of a few stations who had added adapters to their component type hi-fi setups. The number of stereo stations has increased rapidly and most major manufacturers include FM stereo circuitry in their packaged equipment. This article analyzes the FM multiplex circuits used by three manufacturers of packaged hi-fi assemblies.

Fig. 1 is the circuit Motorola uses to adapt Motorola FM–AM tuners and receivers for FM stereo reception. Emitter follower Q is a wide-band impedance-matching device that couples the tuner output to the multiplex circuitry.

The composite FM stereo signal, consisting of L + R, L − R and the 19-kc pilot subcarrier, is taken off Q's emitter. Any possible 67-kc storecast subcarrier is removed by series filters L1–C1 and L2–C3. The 19-kc shunt filter L3–C6 filters out the 19-kc pilot subcarrier, leaving only the 38-kc L − R sidebands and the L + R monaural audio signal at the junction of C4 and C5.

When the tuner is tuned to a stereo broadcast, the 19-kc pilot subcarrier is taken off the shunt trap (L3–C6) and amplified by the 6AU6 (V1). A 19-kc signal with a peak value of approximately 200 volts is developed across T1's secondary. This voltage appears across the NE-2H, causing it to light and show that a stereo broadcast is being received. Around 60 volts of bias is applied to the indicator lamp to make it sensitive to weaker stereo signals. The bias voltage is regulated by a second NE-2H.

The 38-kc locked oscillator is a Colpitts type. The oscillator inductance is the primary of T2 tuned by C18 and C19. Normally, the oscillator is biased to cutoff by 12 volts of cathode bias obtained by returning its cathode to a tap on a B-plus voltage divider consisting of R11 and R12.

On an FM stereo signal, diode D rectifies the pilot subcarrier and develops a positive voltage across R7 and C13. This voltage is filtered by R8 and C14 and applied to the grid to turn on the oscillator. The time constant of R8–C14 is long enough to prevent the oscillator from being turned on by 19-kc noise bursts on a monaural signal or by interstation noise. The 19-kc pilot tone locks the oscillator in phase by feeding some of its voltage to the oscillator grid through C12 and R9. R11 sets the oscillator cutoff bias voltage and determines the strength of the 19-kc signal required to turn it on.

Normally, the plates of the synchronous detector are biased 2 volts positive (forward bias) so the diodes conduct continuously. When a monaural signal is tuned in, the FM detector output (audio) appears at Q's emitter. The 67-kc traps have negligible impedance at audio frequencies so the audio signal appears at the center tap of T2's secondary. This circuit offers little or no impedance to the audio voltage so it passes through both forward-biased diodes to the left and right outputs. Thus, a monaural signal is fed to both audio channels.

On a stereo program, the signal at A consists of the L + R (audio) voltage and the L − R 38-kc sidebands. When the oscillator is keyed on by the 19-kc pilot subcarrier, a 38-kc signal of approximately 9 volts peak to peak is developed across T2's secondary. The diodes now conduct only when the impressed signals make the plates positive

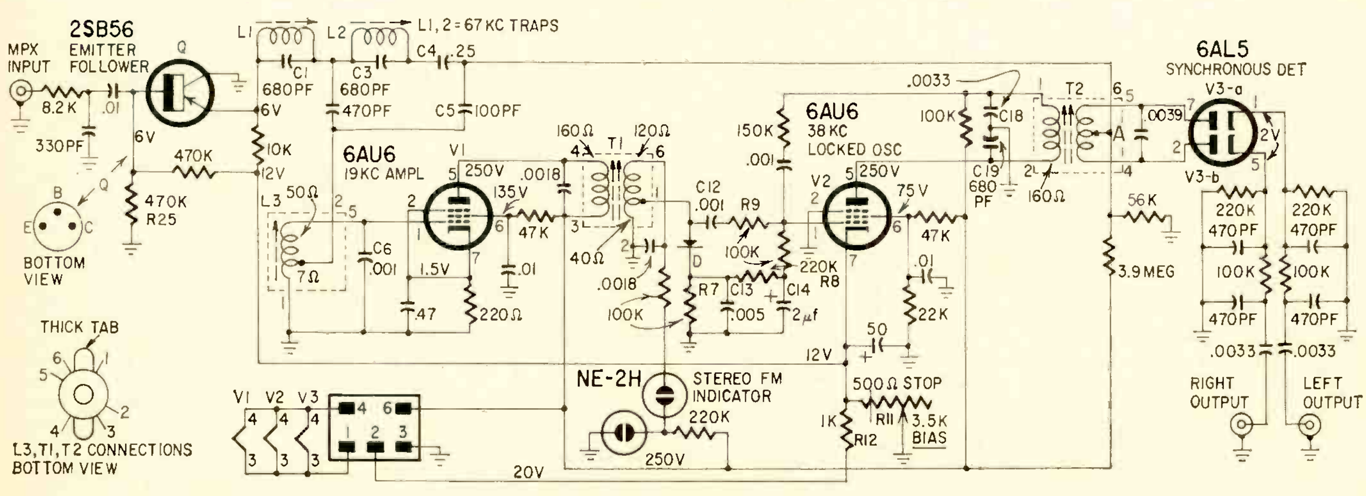
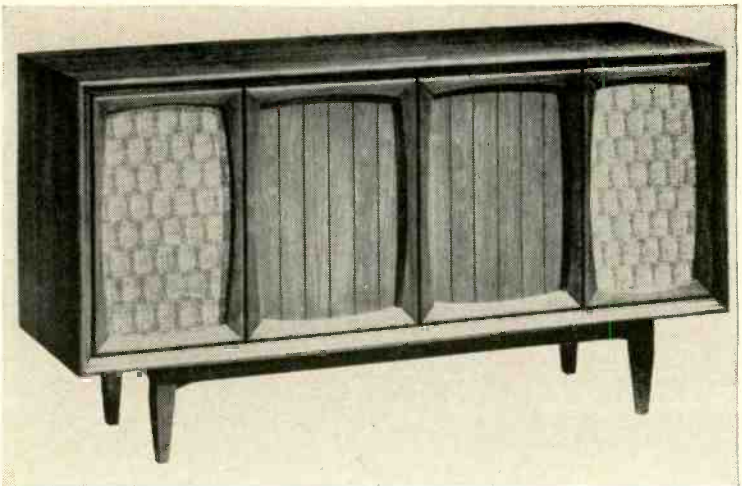
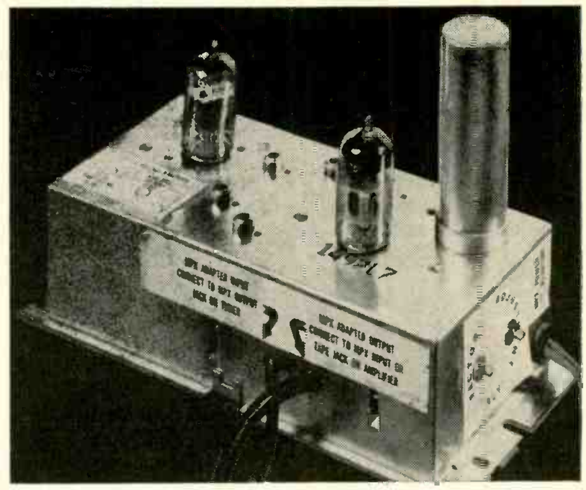


Fig. 1—Motorola uses this HS-996 adapter in many of its package units.





A big "package" by RCA (left) which uses this RK-295 adapter (right). Circuit is in Fig. 3.

with respect to the cathodes. Instead of conducting continuously as during a monaural broadcast, the diodes are keyed on and off at a 38-kc rate when a stereo signal is tuned in.

The 38-kc signal developed across T2's secondary is amplitude-modulated by the L – R sidebands to develop a symmetrical AM rf envelope at the diode plates. The upper half of the envelope carries the L – R signal and the lower half carries the –(L–R) signal.

When V3-a is turned on by a positive half-cycle of the 38-kc signal, it rectifies the upper half of the envelope to produce a L – R audio voltage. This combines with the L + R audio fed to point A to develop a 2L signal at the left output jack. When V3-b's plate is driven positive by the 38-kc signal, the diode conducts and detects the bottom half of the envelope. We now have a –(L – R) that combines with the L + R signal to produce a 2R voltage at the right output jack.

The Zenith adapter

The stereo adapter circuit originally proposed by Zenith engineers used a beam-switching tube to detect the L and R signals. However, in practice, they have developed simpler and more efficient adapter circuitry. The circuit in Fig. 2 is used in the model 9H21 chassis.

The output of the ratio detector takes two paths. The 19-kc pilot subcarrier is amplified in a tuned-grid tuned-plate pentode amplifier (V1-a) and then doubled to 38 kc by the full-wave detector circuit consisting of D1 and D2. Satisfactory operation of a stereo adapter requires that the 19-kc pilot subcarrier exceed a specific minimum level. Therefore, the pilot amplifier is designed to cut off when the 19-kc signal is below the minimum level. In this circuit, V1-a is normally held at cutoff by a positive cathode voltage obtained from the MUTE control.

When the 19-kc signal exceeds this bias on positive peaks, the tube conducts and a series of 38-kc pulses are developed at the output of the doubler. These pulses are filtered by the 1-megohm resistor and .01-μf capacitor to develop an override dc grid bias that is within 2 volts of the mute bias applied to the cathode. The tube now amplifies normally and develops 19- and 38-kc signals at the levels required for proper operation. Thus, V1-a is cut off on monaural signals and very weak stereo broadcasts and only turns on when the incoming stereo signal is strong enough for satisfactory operation.

When a stereo signal is fading, reception is noisy and distorted and will be much better received monophonically. A MPX-MONO switch (on the rear panel) selects the mode of reception. In the MONO position it cuts off V1-a by removing its screen voltage.

The neon stereo indicator light is connected between the bottom end of the doubler transformer primary and the screen grid. When a stereo signal is received, the screen draws current and develops a voltage drop across the 68,000-ohm screen dropping resistor. At the same time, the 19-kc pilot subcarrier develops 200 peak-to-peak volts on the transformer end of the lamp. The lamp fires and indicates that the set is tuned to a stereo program.

The 38-kc pulses from the doubler are clipped in V1-b's grid circuit and then amplified. Flywheel action in the detector transformer's primary produces the 38-kc sine waves that will replace the subcarrier suppressed at the transmitter.

The two L – R 38-kc sidebands and the L + R audio signal follow the second path from the tuner's FM detector. The trap consisting of L24, C51 and C52 filters out frequencies between 59 and 75 kc to prevent any possible SCA storecast signals from causing crosstalk in the multiplex detector. The L + R and L – R signals are amplified by

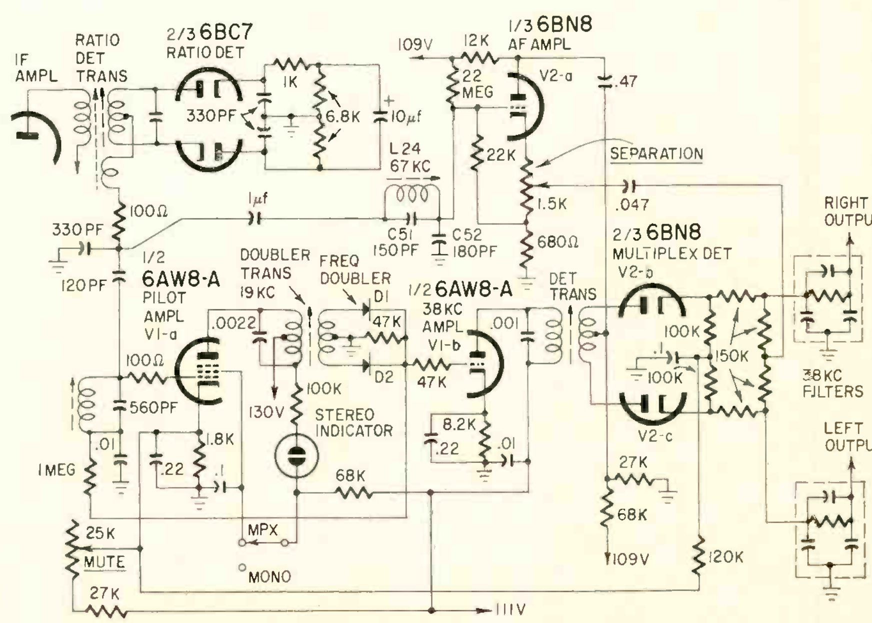


Fig. 2—Circuit of the Zenith 9H21 stereo adapter.

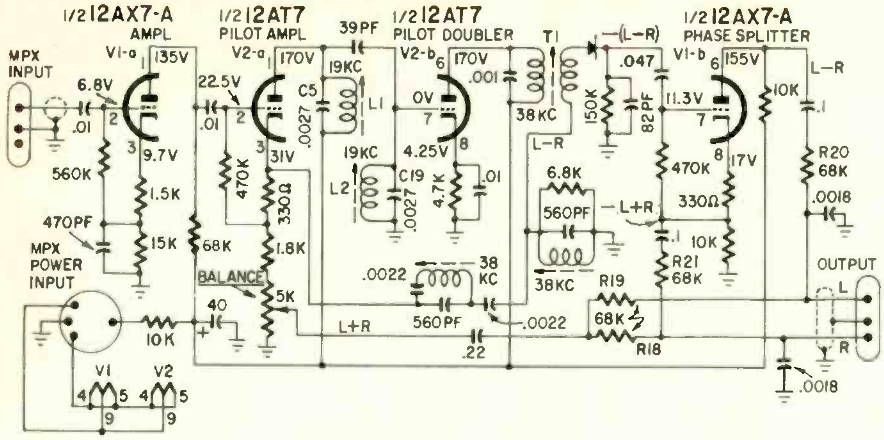


Fig. 3—The RK-295 is RCA's FM stereo adapter.

V2-a and then fed from the plate circuit to the center tap on the multiplex detector transformer.

The L − R sidebands combine with the 38-kc regenerated carrier in the transformer's secondary. The left and right signals are then detected as in the Motorola circuit just discussed.

When the station transmits a monaural signal, the 19-kc pilot amplifier cuts off and there is a slight rise in the dc voltages supplied to various parts of the multiplex circuit. The plates of the multiplex detector (V2-b and V2-c) rise to around 2 volts positive with respect to the cathodes, so the diodes conduct continuously. The L + R voltages at the plates are fed directly to the output terminals and we have the monaural signal on both channels.

In theory, we assume that the L + R, L − R and −(L − R) signals have equal amplitudes so they combine to produce 2R and 2L signals for maximum separation. In practice, separation may not be optimum, because there will be a small amount of residual R signal in the left channel and some L signal in the right channel.

Zenith includes a factory-set separation control that is adjusted as follows: A multiplex generator is set to send an R (right) signal only. An audio voltmeter is connected across the left-channel output and the separation control is adjusted for a minimum reading. Or, the generator may send a left-channel-only signal and the control be adjusted for minimum output from the right channel.

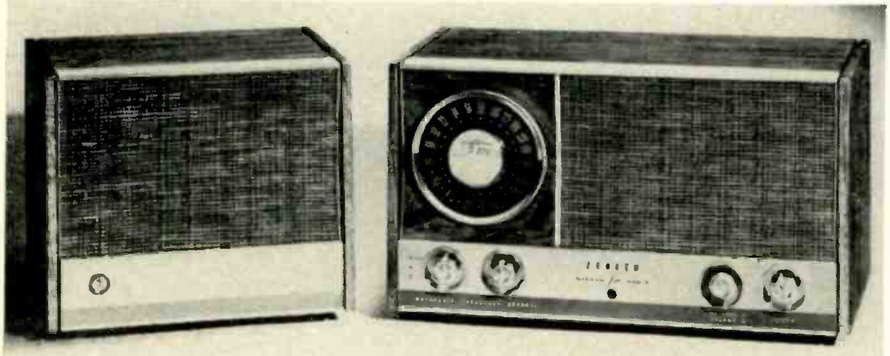
The RCA multiplex adapter

The RK-295 adapter (Fig. 3), is the simplest we've seen designed for packaged equipment. Composite multiplex stereo from the tuner is amplified by V1-a and V2-a. The 19-kc pilot subcarrier is developed across tuned circuits L1–C5 and L2–C19 and then doubled to 38 kc in the primary of T1 in V2-b's plate circuit.

The L + R audio signal is tapped off the BALANCE control and applied to the resistive matrix network (R18, R19, R20 and R21) across the output terminals. The L − R 38-kc sidebands at V2's cathode are filtered out and fed to T1's secondary. The 38-kc reinserted carrier and the L − R sidebands combine to form a 38-kc AM signal between the top of T1's secondary and ground.

This signal is rectified by the detector and fed to phase splitter V1-b. The L − R signal is taken off the plate and the − (L − R)—or R − L—signal off the cathode. There are combined with the L + R signal at the matrix network to develop 2R and 2L signals at the right and left output jacks.

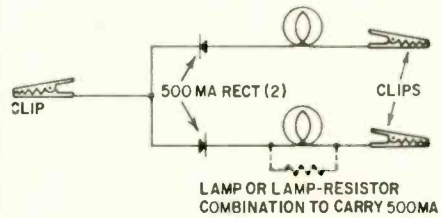
END



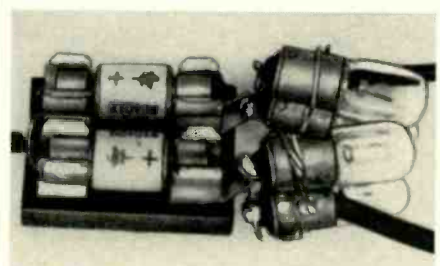
The Zenith "Stereo Symphonaire" uses circuitry shown in Fig. 2.

Power-Rectifier Test Substitute

Connect a pair of 500-ma silicon rectifiers in series with pilot lamps as indicated in the circuit. Any lamp that carries 500 ma or more is usable. A pilot lamp can be paralleled with a resistor or another lamp to handle 500 to 750 ma. If two lamps are used, they must both be the same type. When an indicator lights to near full brilliance, approximately the full current is flowing.



Clipped in parallel with an existing voltage-doubler pair, the brilliance of the lamps shows the condition of the existing rectifiers. If the lamps do not glow equally, the rectifiers under test should be replaced as their current flow is unequal. If the set rectifiers are out of the circuit and the test substitute has unequal brilliance, circuit trouble is indicated.



When using this test substitute it is necessary to apply power gradually with a variable transformer or the initial current surge may burn out both indicators.—*Carl Remel*

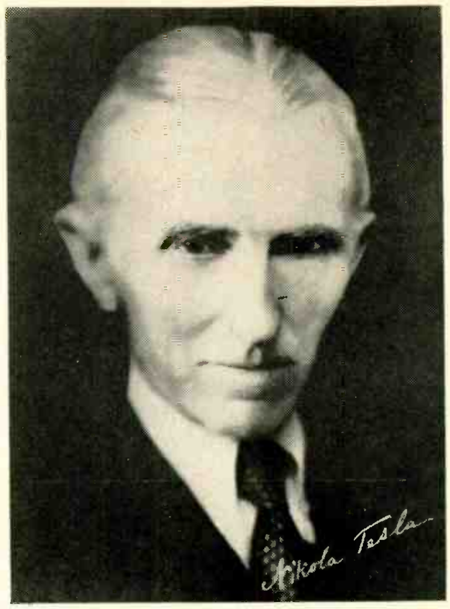
Correction

In the photo of the R/C receiver on page 27 of the January issue, the 50-μh choke (RFC) was mistakenly called L2. L2 is a part of the tuned impedance network labeled Z. C10 is not visible in the photo. It is behind the relay and between V4 and V5.

We thank W. G. Morgan and E. E. Palmer, of Seattle, Wash., for bringing this to our attention.

INVENTORS OF RADIO

NIKOLA TESLA



By DEXTER S. BARTLETT

NIKOLA TESLA WAS AN EXTREMELY visionary person—even bordering on the neurotic—who had the uncanny habit of making most of his visions come true. This is attested to by the more than 900 patents to his credit, many of which were fundamental. His other visions were mostly ahead of his time. Like others who have accomplished things, he preferred his workshop to society.

Nikola Tesla was born in Smiljan, Lika, in what is now Yugoslavia, in 1856. He was the son of a clergyman and Georgiana Maudic, herself not unknown as an inventor. After completing his primary education, his parents wanted him to enter the church but he prevailed upon them to send him to the Polytechnic at Gratz. There he studied mathematics for four years, followed by two years of philosophical studies at the University of Prague. He died in New York on Jan. 7, 1943.

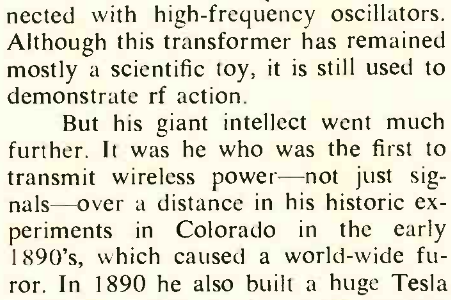
He developed his first invention, a telephone repeater, in 1881, and conceived his idea of the rotating magnetic field which was to be the basis of his famous ac transmission of power. He then traveled in France and Germany, and finally settled down in the United States. He was attracted to America by the remarkable progress of the electrical industry, and with 4 cents in his pocket, stepped off the boat at New York City's Battery in 1884. America as a land of opportunity was soon apparent, for as he walked up Broadway he met a group of men trying to repair an electric motor. They paid him for fixing it. He proceeded with high hopes of finding work with Edison. His luck continued; Edison gave him a job in his laboratory at Orange, N.J., designing motors and generators.

After some time with Edison, designing motors and generators, Tesla began to have visions of high-voltage ac transmission lines covering the nation, while Edison still claimed that dc power was the only logical way. So in 1887 Tesla started his Tesla Electric Co. This was not much of a success and he soon sold his patents to Westinghouse for a good sum. His polyphase ac transmission system was the first used between Niagara Falls and Buffalo—the great granddaddy of all power networks of this day.

Among his many wireless telegraph patents are a rotary spark gap; a coherer in which filings were placed in a chamber exhausted of air, decohered by revolving it constantly; a tikker or loose contact detector; filamentless lamps or neonlike tubes, and suggestions for the instigation of the first time ticks from the Eiffel Tower, made by General Ferrie in 1909.

In 1891, he showed that it was possible to transmit energy through a single wire, without return. In the same year he invented his justly famous Tesla transformer (Tesla coil) which demonstrated the effects and phenomena connected with high-frequency oscillators. Although this transformer has remained mostly a scientific toy, it is still used to demonstrate rf action.

But his giant intellect went much further. It was he who was the first to transmit wireless power—not just signals—over a distance in his historic experiments in Colorado in the early 1890's, which caused a world-wide furor. In 1890 he also built a huge Tesla oscillator which produced 12,000,000 volts at 100 kc. The primary used over 300 kw. Lightning in huge sparks was thrown as far as 22 feet and created such powerful electrical disturbances in the surrounding earth that 1-inch sparks could be drawn from grounded metal plates 300 feet distant. A little later Tesla was able to obtain lightninglike discharges over 100 feet long. Then, in 1898, at Colorado Springs, he succeeded in lighting lamps at a distance of over ½ mile without wires.



The Tesla coil, source of extremely high voltage

In an 1893 lecture before the Franklin Institute and Electric Light Association, Tesla suggested the possibility of wireless telegraphy and the distribution of electrical energy by stationary waves on the surface of the earth, using the entire globe as a conductor. Here we see the first modern radio diagram, identical with fundamental radio and TV circuits today.

In this age of guided missiles, we should never forget that Tesla again was first when he invented and demonstrated his radio-controlled submarine in 1898. He even constructed large-scale operating models. The vessel, which could take the form of a guided torpedo or of other mobile bodies, was steered and controlled by wireless. It was probably the earliest telemechanical radio-controlled model in existence.

Tesla had, before Poulsen, clearly described the use of a direct-current arc burning in the flame of an alcohol-fed lamp for wireless telegraph CW transmission. In conjunction with John Stone Stone, Tesla invented a 4-circuit tuner and received a patent on Feb. 2, 1902, a year before Marconi's.

Dr. Lee de Forest stated that Tesla was his greatest inspiration in the early days. He once applied for a job, but Tesla had visions of de Forest going on to greater things and turned him down. His vision was soon vindicated. END

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GOOD LITTLE INDIAN the Mohican

10-transistor multi-band portable all-wave receiver that's better than just good

By JOHN T. FRYE, W9EGV

EXPERIENCED TECHNICIANS ARE NOTORIOUSLY blasé about equipment in their respective fields. The auto mechanic takes a jaundiced view of most cars; radio and TV technicians seldom get excited about a new receiver. Now and then, however, a piece of electronic equipment comes along that wins the grudging admiration of even the most seasoned technician. The Heathkit Mohican all-band transistorized receiver (kit or wired) merits such approval on at least three counts: its clever, unusual circuit features; its excellent performance; its fulfilling of a definite need.

Using 10 transistors and 7 diodes, this receiver tunes 550 kc to 32 mc in 5 bands. Only 10 μv of signal on the broadcast band or 2 μv on other bands produce a 10-db or better signal-to-noise ratio. Selectivity is 3 kc wide at 6 db down. The receiver puts out 400 mw of audio at 10% distortion. It is powered by either eight type-C flashlight cells, which give up to 400 hours of normal service, or by an optional ac power supply that can be plugged in in place of the batteries. It has such communications receiver features as continuous bandspread, bfo, rf gain control, signal-strength meter, avc switch, automatic noise limiter, antenna tuning, phone jack and receiver muting terminals. It measures 6⅞ x 10 x 12 inches, weighs 17 pounds, and sports a telescoping antenna that extends to 50 inches high.

Interesting circuit features

Probably the first thing you'll notice in the circuit diagram is that three-terminal devices labeled "404-40" are used between i.f. transistors V4, V5, and V6 instead of conventional transformers. These are Transfilters. Details of how they operate are found in the October 1962 issue of RADIO-ELECTRONICS. They are ceramic devices that perform much like crystal lattice filters. They pass only a narrow band of frequencies to which they are permanently resonated, with a long-term stability of 0.1% for every 10 years of service. Their medium input impedance and low output impedance make them ideal for use with transistors.

404-41's are similar two-terminal ceramic devices that act as resonant bypasses with about 15 ohms of reactance at 455 kc. A single Transfilter stage using these bypasses is claimed to be equivalent to three conventional i.f. transformers.

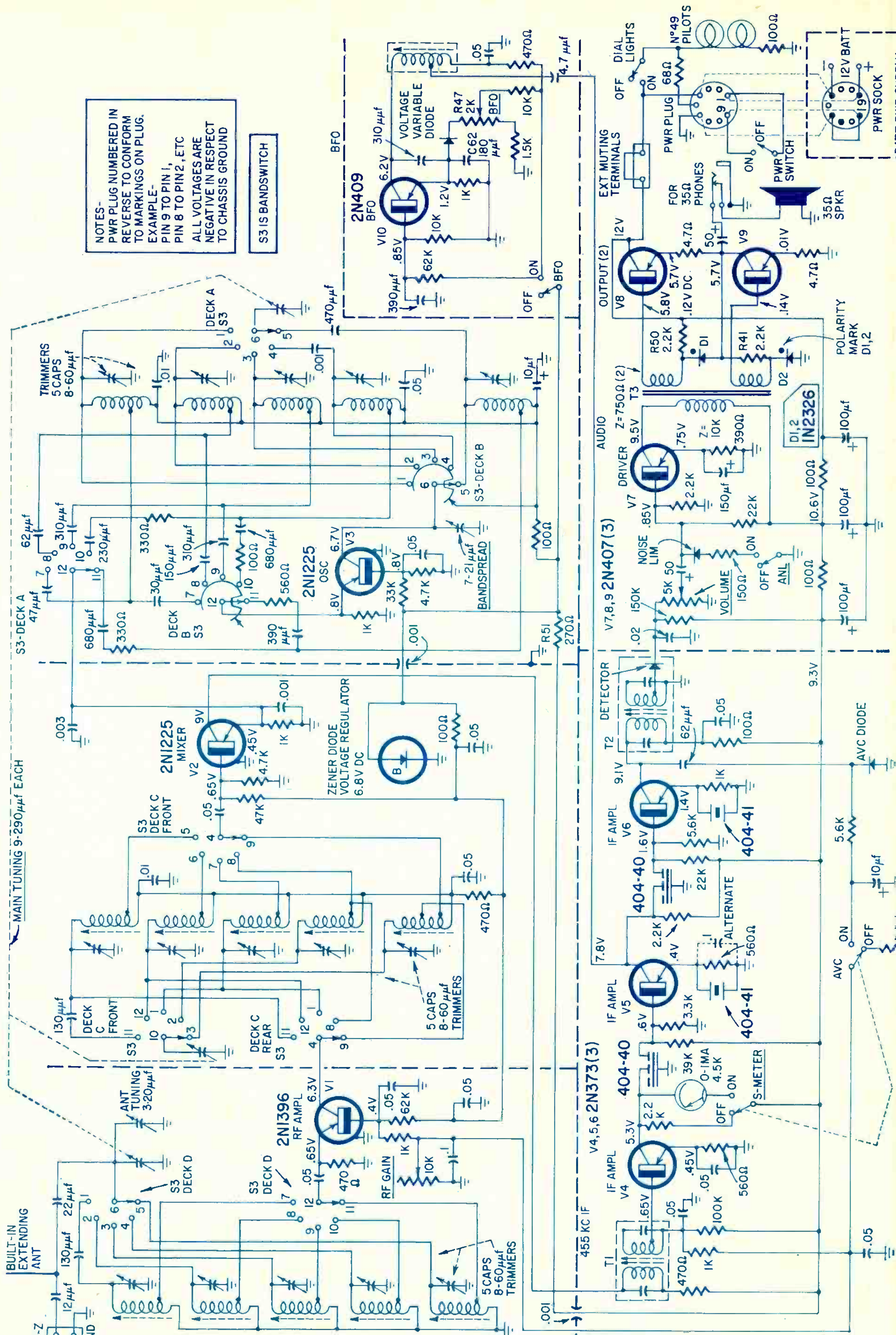
Since the Mohican uses two Transfilter stages with i.f. transformers at the input and output of the i.f. strip, it is easy to see where it gets its excellent selectivity and the good shape factor of its i.f. system—qualities it will retain for years without need for realignment.

The bfo pitch control is actually R47, a potentiometer! Notice it varies the amount of reverse bias applied to the variable voltage diode, which is effectively in parallel with C62, a part of the frequency-determining capacitance of the bfo. When reverse bias is applied to a diode, the electrons go to the positive terminal and the holes to the negative terminal, leaving a depletion area near the junction. The more voltage applied, the wider this depletion area becomes. Here we have the equivalent of a variable capacitor—two conducting "plates" separated by a variable amount of nonconducting dielectric. This capacitance effect of a reverse-biased diode is put to work to vary the frequency of the bfo through the i.f. passband.

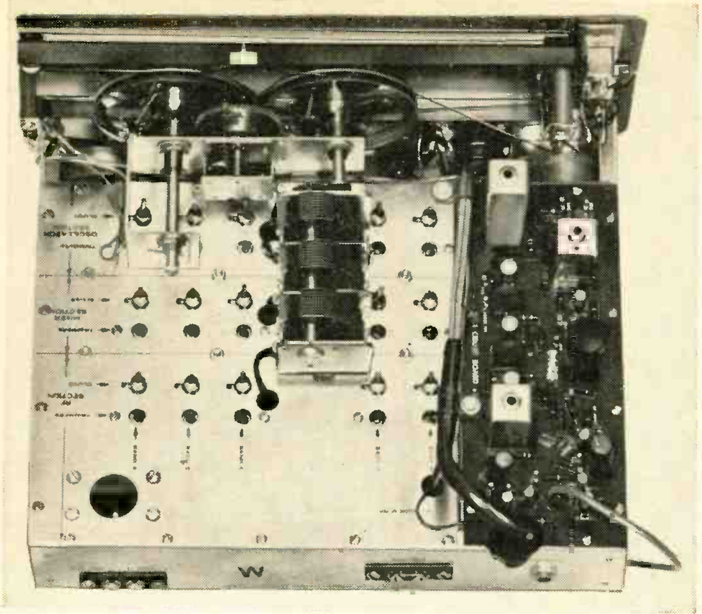
But consider this: the collector-to-base junction of a transistor is actually a back-biased diode and undergoes the same change in capacitance with a change in applied voltage. This effect, put to good use in varying the bfo frequency, is a great nuisance in high-frequency transistor circuits, for the change in capacitance with voltage variation produced by aging batteries or avc action causes serious detuning of such circuits.

The cure is a Zener. This particular Zener has a breakdown potential of 6.8 volts, and current is fed to it through current-limiting resistor R51. The combination makes a very effective voltage regulator circuit. The voltage appearing across the diode is fed to the rf amplifier, mixer, local oscillator and bfo and is maintained at very nearly 6.8 volts in spite of wide variations in supply voltage and considerable changes in current demands of these transistors.

The output circuit also has some unique features. Transistors V8 and V9 are operated in a modified push-pull class-B circuit that employs no output transformer. The 35-ohm speaker voice coil is driven alternately from V8's emitter and V9's collector. There is



Circuit of the receiver with its battery power supply.



A look under the hood.

−12 volts on V8's collector, but the voltage-divider network consisting of R41, R50, and the two 1N2326 compensating diodes places −6 volts on the base, leaving a 6-volt difference between the emitter and collector. V9 has −6 volts on the collector, and the emitter is practically grounded; so the two transistors run at the same voltage level.

The compensating diodes do two things: First, they act as nonlinear voltage regulators to maintain proper cutoff condition in the class-B stage in spite of changes in battery voltage. Second, they have a negative temperature coefficient that effectively compensates for the positive temperature coefficient of the output transistors and prevents excessive battery drain and poor quality at high temperatures.

There are other interesting features. Notice when batteries are in use the dial lamps do not light until the spring-loaded dial-lamp switch is pushed to the right. This lamp switch doubles as a battery condition indicator, for the extra load of the lamps will cause an appreciable drop in the voltage output of nearly spent batteries—a drop too great for the Zener diode to control. If switching on the lamps causes a marked change in the tuning of the receiver on one of the higher frequency bands, you need new batteries! When the ac power supply is used, the lamps are automatically connected across the supply as a stabilizing bleeder resistor and are on all the time.

The receiver even has a built-in transistor tester. Any transistor in the set can be tested in the V4 socket which has an S-meter in its collector circuit and an rf gain control to vary its base bias. If varying this control from one extreme to the other causes the meter to change by at least half-scale, the transistor in the socket may be assumed to be good.

Assembly

This is not a kit you want to, or can, put together in a couple of evenings. I have assembled many kits, including the Mohawk receiver, Apache transmitter and SB-10 SSB adapter, yet it took me a full 40 hours to assemble the GC-1A, align it and put together the ac power supply. The receiver's i.f., af and bfo circuits are on a printed-circuit board, while the rf, mixer and local oscillator circuits are hand-wired.

For those who look askance at printed circuits—often with reason—let me assure them this is a *good* printed circuit. The board is heavy, with clean circuitry well bonded to one side only. No weighty, board-flexing parts are mounted on it, and the board is rigidly supported on the main chassis by bolts around the entire perimeter. Mounting parts on the board presents no problems if the detailed instructions are followed carefully.

The critical front-end wiring is where it would be easy to goof. First, you mount all 15 slug-tuned coils and 15 trimmers on the bottom of the main chassis plate and do all possible wiring to these components. Wire lengths are specified down to ⅛ inch.

Next you mount the rf and mixer transistor sockets on one subchassis and the oscillator socket on another. Now you take apart the four-deck band-change switch and reassemble it with the two subchassis properly spaced between the decks. Finally you bolt this whole subassembly to the main plate and solder all loose wire leads coming from the coils, sockets, etc. to the switch connections. When the finished receiver is slid into its metal cabinet, each high-frequency stage is fully shielded in its own compartment.

Points to watch

Check that reassembled band-change switch very carefully to make sure you have each wafer properly positioned and oriented before you start connecting wires to them. It would be very easy to have one wrong, and those switch connections will not stand much unsoldering and resoldering! Follow instructions regarding lead length and lead dress exactly. Both are very important to the high frequencies handled by these circuits.

Take enough time and care to insure that both the main tuning and bandspread pointers slide freely and smoothly. This takes a little doing, but it pays off big dividends in satisfaction later.

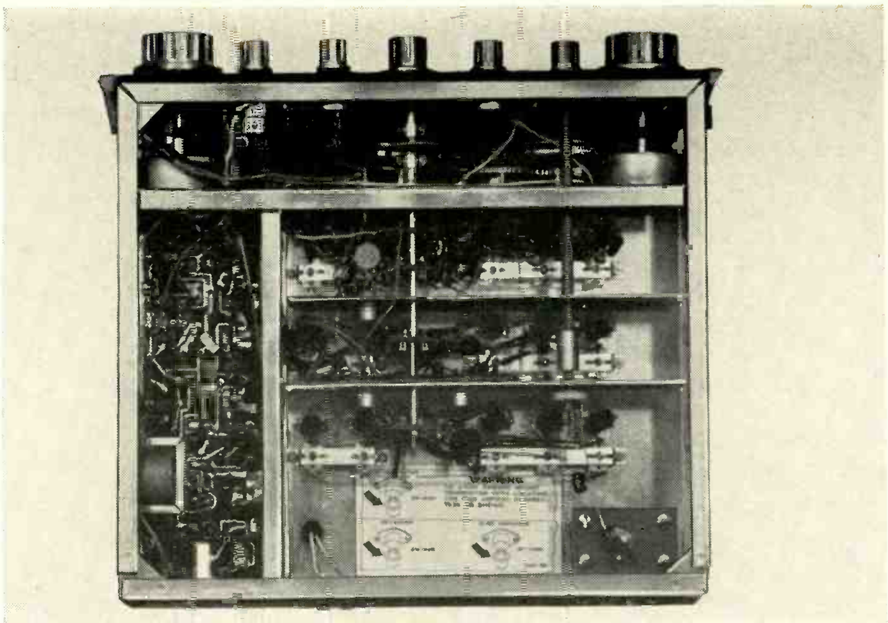
I suggest you place the receiver on a metal cookie sheet when aligning. The sheet will "stand in" for the metal bottom of the receiver cabinet. This will make things a bit easier as this metal does have some effect on alignment, especially on the higher frequencies. In aligning and checking the image frequencies, remember that the oscillator works on the high side of the signal on bands A, B, C and D, *but it is on the low side on band E.* This is easily overlooked in a rush to complete the job.

Finally, keep in mind that the slugs and trimmers of each coil interact, and you have to keep going back and forth from one end of the band to the other, adjusting the three slugs at one end and the three trimmers at the other until you can no longer get any improvement *at either end of the band.* Admittedly, this takes time and patience, but doing the aligning job right will spell the difference between a mediocre receiver and a really "hot" GC-1A.

Performance

Candidly, I did not expect too much from the Mohican. My station receiver, the Mohawk (see RADIO-ELECTRONICS, December 1958) is a specialized communications receiver tuning only the ham bands. I wanted something with which I could hear WWV transmissions, listen for out-of-the-band harmonics, and copy a few of the stronger broadcast and commercial short wave stations. In short, I wanted a second receiver that would let me see the "big-picture" of the short-wave spectrum, even though dimly, in addition to the powerful, fixed-position, narrow-field "shortwave telescopes" I already had. Experience in my service shop with many so-called multi-band transistor radios had conditioned me not to expect much on the higher frequencies.

But when I placed the Mohican atop the Mohawk and started comparing reception, I was astonished at how sensitive the GC-1A was on the 10-, 15- and 20-meter bands. I found stations on each of them that would nearly "pin" the S-meter. Undoubtedly the use of 100-mc cutoff drift transistors in the



Underchassis view shows receiver sections are shielded from each other

front end accounts for that 2-μv sensitivity, and in most receiving locations it takes a good ear to detect a difference between 2-μv and 1-μv sensitivity.

Selectivity was all it was claimed to be. I live about halfway between WLW on 700 kc and WGN on 720 kc, both running 50.000 watts. With the ordinary broadcast receiver you would never suspect there was another station between these giants. With the Mohican, however, I can pull in WOR on 710 kc at night without interference.

Encouraged by these experiences, I put a relay on the muting terminals, connected the external antenna leads to my change-over relay, and started calling CQ. I had satisfactory AM, CW and SSB contacts on all bands, 10 through 80 meters. Next, I used the Mohican as my receiver while acting as net control station for our 75-meter state traffic net into which both AM and SSB stations check—truly an acid test! I missed my product detector on SSB reception, for the rf gain control had to be backed off until the bfo could insert sufficient carrier, but I managed without too much difficulty. Incidentally, that rf gain control is needed, for many signals come in so powerfully they overload the front end if it is running wide open.

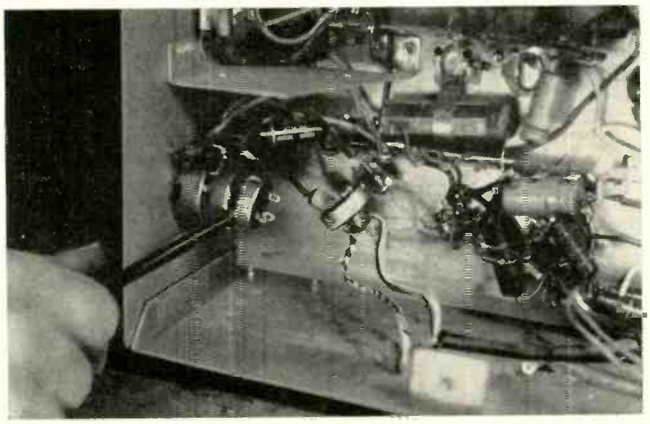
Drift presented no problem. There is some shift in frequency with a change in ambient temperature, but this is a long-term affair having nothing to do with how long the receiver has been on.

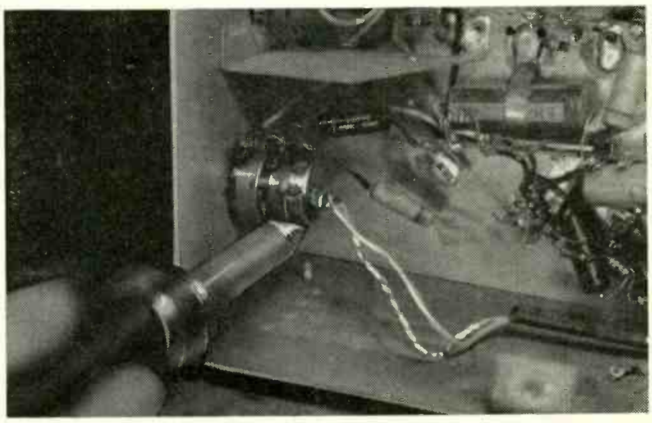
I tried the built-in telescoping antenna, a long wire, my all-band trap antenna fed with 72-ohm transmitting type ribbon and my TH-4 tri-bander beam fed with RG-8/U. Naturally reception with the 50-inch whip is not as good as with the more efficient types, especially on the lower frequencies, but it is surprisingly good. I was happily astonished to find the receiver worked very well when its high-impedance antenna terminals were connected to my low-impedance transmitting feedlines. When I used balun coils to provide better theoretical match, the improvement could not be detected on the S-meter.

I hesitate to recommend the Mohican as an *only* fixed station receiver. Under present-day crowded band conditions and the growing accent on SSB, the station receiver needs a product detector, variable selectivity, a notch filter and lots of bandspread. The bandspread tuning on the Mohican varies only the oscillator. When the bandspread pointer is moved from the set position, the oscillator can be followed with the rf stage by manipulating the antenna tuning, but the mixer stays put. For wide excursions of the bandspread pointer, this results in impaired selectivity and sensitivity. I like to leave the bandspread pointer near the set mark and do my tuning with the slow-ratio main tuning knob. The bandspread knob is used as a fine-tuning control. This retains the excellent sensitivity and selectivity of the GC-1A.

Where the Mohican really shines is as a deluxe receiver for the serious SWL and as a second, backup receiver for the ham station. The SWL fan has, in the Mohican, a receiver with portability, sensitivity, selectivity and versatility far beyond most receivers used for this purpose. With it, he is divorced from noisy power lines, he can try a wide variety of antennas, and he can receive all modes of transmission. Using only the whip antenna, I have picked up SW broadcast stations from every corner of the globe. END

Replacing the Irreplaceable Switch





Switches mounted on potentiometers and auto radio pushbutton assemblies pose a definite replacement problem. When exact replacements are not available, switch failure often necessitates replacing the whole assembly. But the cost of a replacement and the delays in getting it can lose a customer. There is a way around this:

Insert the blade of a screwdriver between the switch and the body of the control. Twist the blade until the retaining lugs straighten. Remove the switch. Take a new switch section and clip the retaining lugs on its body to 1/32 inch. This keeps them from extending into the body of the pot and interfering with the moving parts. Position the new switch in the old mounting holes and make sure the trip arm on the control rotor actuates it properly. Solder the switch in place at two or three points and reconnect it. The photos show this being done.

HOLES

Hole—an open place. But making one in steel or concrete or wood isn't exactly simple

By **JACK DARR**
SERVICE EDITOR

The title of this article might be misleading. Let's straighten this out right now: the holes I'm referring to aren't the kind that wander around in transistors, or that go "Now you see 'em—now you don't" in tunnel diodes, or even the ones in the writer's head. The holes in this article are the plain old-fashioned kind you have to make in TV chassis to hold things.

Cutting such holes is a job the service technician often runs into. I thought it might be a good idea to run over some of the ways of making them.

Where to make the hole is determined by the part you're mounting. Mark the spot with a soft pencil. Then use a center-punch to make a wee pit to keep the drill from scooting off into nearby parts (Fig. 1). Set the chassis solidly on something that will take the impact of the punch. A good trick here, if you can do it, is to use a backing block of metal. It can be any kind of piece of solid metal. Fig. 2 shows one useful type. It's a short piece of metal shaft with two parallel flats ground on one end. Shove this end in a vise and place the other end below the place you want to hit.

Drills and bits

There's some confusion about the terms drill and bit. They are often used interchangeably. In this article, the bit is the part that does the cutting. The drill is the part that holds the bit.

The standard twist-drill bit has two spiral flutes on its stem to clear the chips. The tip of the bit is ground so the two cutting edges take off thin chips of metal as they revolve (Fig. 3). These edges must be sharp. Standard bits turn clockwise, looking down on the work.

Dull bits are standard equipment around the shop. However, they aren't hard to resharpen if you use just the right twist of the wrist. You'll need a smooth, fine-grit grinder. One very important point is the angle of the cutting edges. For sheet-metal work, and this makes up most of our jobs and most of yours, it ought to be about 85° to 90° (Fig. 4).

To sharpen a bit right, you've got to hold it very steady. There's a special holder for this purpose, but you can do it by hand, using the tool rest on the grinder (Fig. 5). Hold the tip against the wheel, taking only a very small bite each time. Keep a glass of water handy and dunk the tip in it each time you stop. Never let the tip get too hot. This takes the temper out of the steel and the bit will become dull again very quickly.

Touch one face then the other against the wheel. The angle at which the bit is held determines the final tip angle. Be sure to keep the two faces equal (Fig. 6) and flat. Never turn the bit while grinding. The faces, in Fig. 6, *must be equal in area and perfectly flat.*

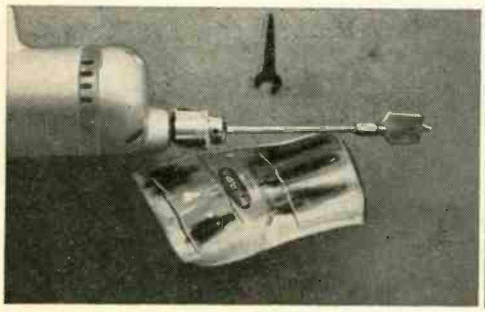
Drilling plastics

For drilling plastics, you can get better results with a flatter angle on the bit. Most plastics tend to melt under the heat generated by the spinning bit, clogging the hole. Drill very slowly. One trick used in drilling thin sheet plastic is to sandwich it between scraps of Masonite, clamping tightly and drilling through all three at once. Even then, take it slow and easy for the neatest results.

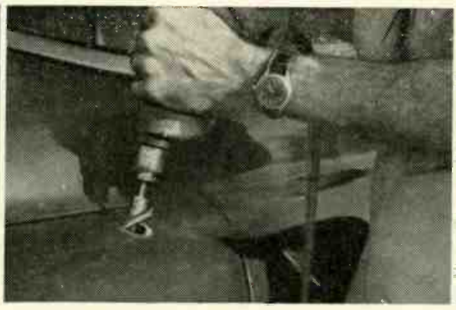
Electric hand drills

The most popular size electric hand drill for TV shop work is one with a ¼-inch chuck. There is only one right way to make holes with a hand drill. Hold the drill firmly in both hands as in Fig. 7. Note the knuckle extended below the left hand resting on the top of of the if transformer can. It keeps the bit from plunging on through the sheet-metal chassis and wrecking numerous delicate components underneath.

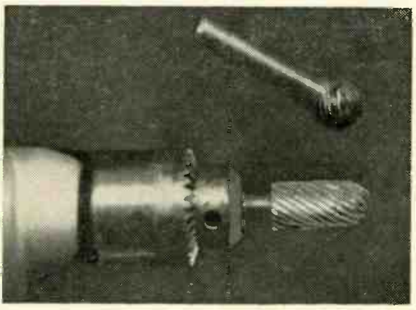
When drilling sheet metal, you'll soon learn to recognize the change in pitch of the sound when the drill is just about



Wood bit in chuck of electric drill. This is not the type bit used with a hand brace.

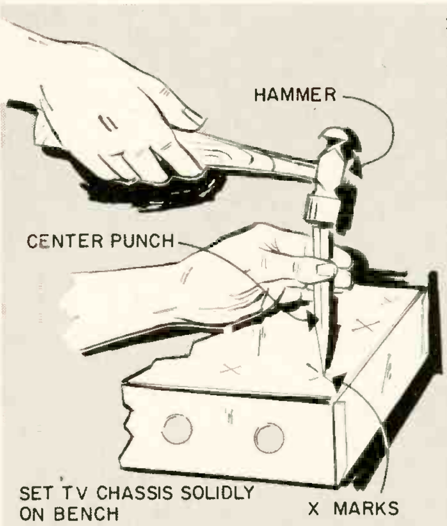


Fly-cutter being used to cut 1-inch hole in car fender for mounting auto-radio antenna.



Small burr and electric drill make job easier in tight places.

Fig. 1—Use a center punch to make a small pit in sheet metal. This holds the point of the bit until it gets started and you put the hole right where you want it.



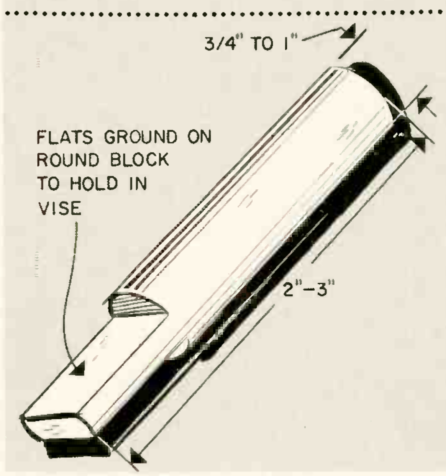
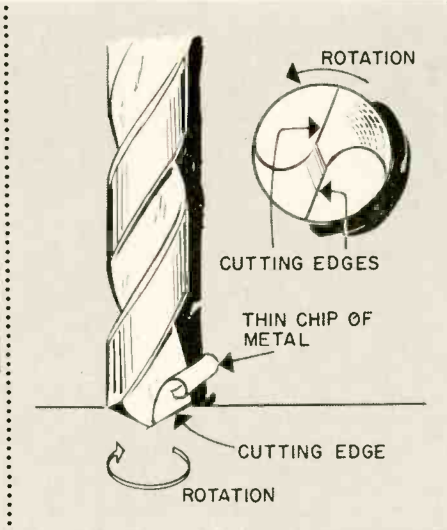


Fig. 2—This handy backing block can be made from a short piece of round metal shaft. Grind two flats on one end so it can be held in a vice.

Fig. 3—Typical twist drill bit.



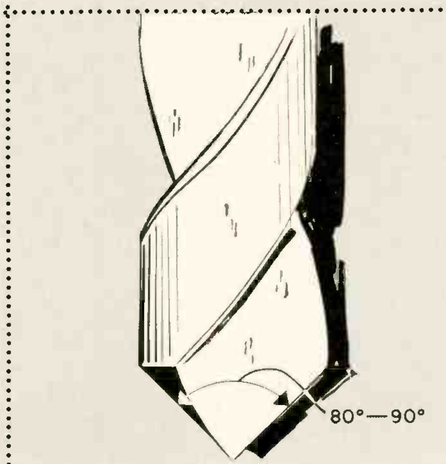
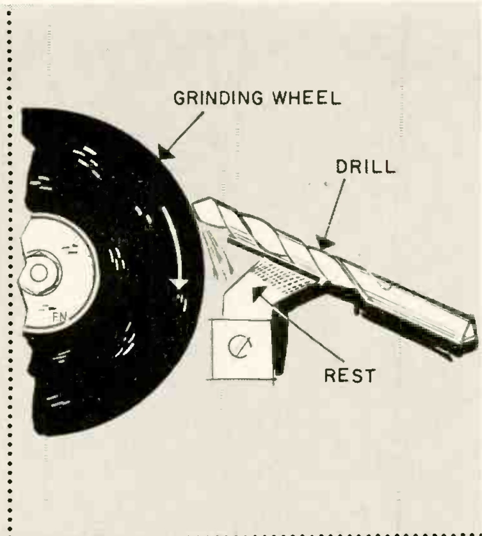


Fig. 4—Correct angle of cutting edges gives best results.

Fig. 5—Always use the tool rest when holding the bit against the grinder. No one can hand-hold a bit steady enough to get the proper angle. Never turn the bit while grinding. Both tip faces must be flat.



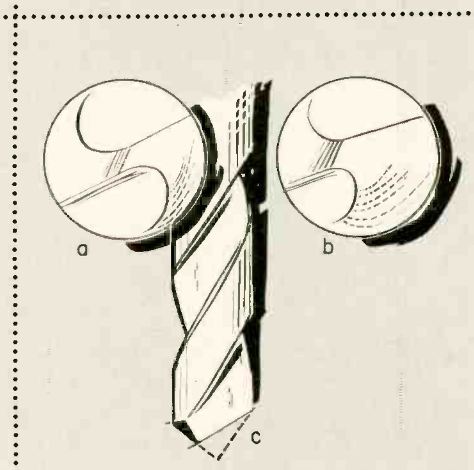
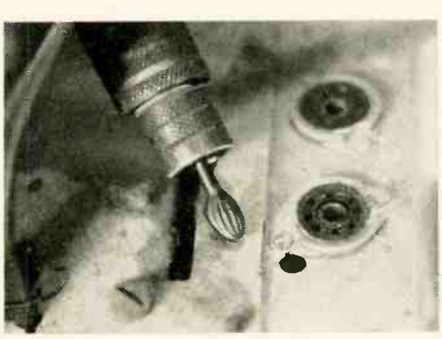


Fig. 6—A twist bit that is properly ground (a) and improperly ground (b). Side view of the improperly ground bit (c) shows how the tip is off-center and the angles are unequal.

ready to go all the way through. When you hear that, get ready to catch the weight of the drill to keep it from going too far. By the way, this should have been mentioned first, but *always check the chassis under any hole you're thinking of drilling! See what's under there that could be damaged.* If you must drill a hole where parts below might be damaged, make a temporary depth gauge by wrapping tape tightly around the bit stem at the proper place (Fig. 8). While it won't stop the drill entirely, it will slow it up enough to let you gain control.

When drilling holes in thick metal, use lubricating oil on the tip of the bit to reduce friction and speed cutting. As a further aid, use a small bit first, then change to the final size of bit needed. This is particularly important when



Rotary files are ideal for enlarging holes cut in sheet metal.

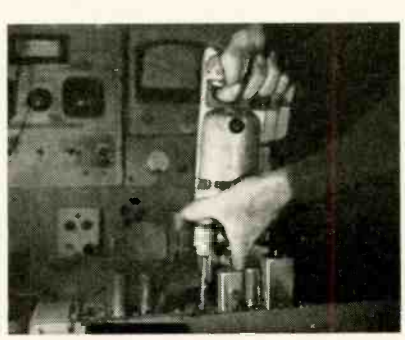


Fig. 7—The correct way of holding an electric drill.

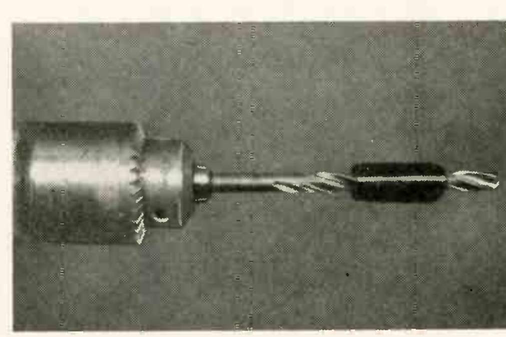


Fig. 8—Temporary depth gage is made by wrapping tape around bit.

the final bit is ¼ inch or larger.

Drilling out rivets

Lots of components are riveted in modern chassis. Removing the rivets can be a tough job sometimes. One way is to center-punch the head of the rivet and drill it out (Fig. 9-a). This is all right, but it has its drawbacks. A rivet will often come loose and simply spin instead of sitting tight and being drilled out. The easiest way in the long run is to use a small burr or rotary file (Fig. 9-b). For very tiny rivets a miniature burr is better. They can be used in a ¼-inch drill. For even better results in tight places, use one of the small electric drills known as a hand grinder.

For larger rivets, and also for finishing holes which must be made slightly larger, the ¼-inch shank rotary files are very handy. They have many other uses, which you'll discover as you go along. (Cleaning rust, paint, etc.)

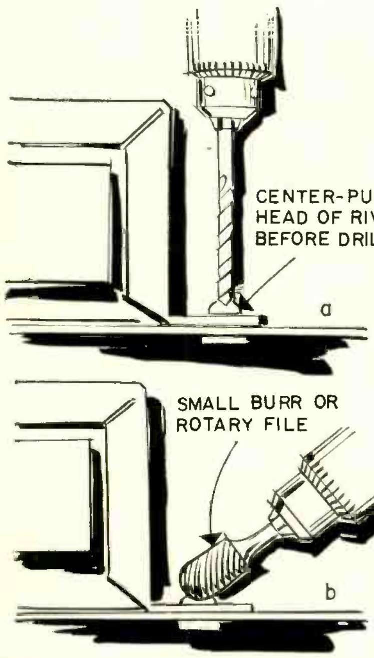


Fig. 9—A small burr is often better than a bit for removing rivets.

Small holes

Once in a while you'll have to drill a very small hole. This can be done with a hand drill if you're very careful. Be sure to keep the pressure off the bit as much as possible. Let the weight of the drill take it into the metal. Hold the drill very straight, so that there is no side pressure on the bit. That breaks small bits immediately.

Special tools

You can make holes up to 2 inches in diameter with a ¼-inch drill and the right accessories. You can use either flycutters or holesaws. The flycutter gets its name from the fact that the cutter bar, the small diagonal bar seen at an angle across the shank, cuts as it "flies" around the circle. (The same action is found in a lathe.) The holesaw is a circular hacksaw (Fig. 10).

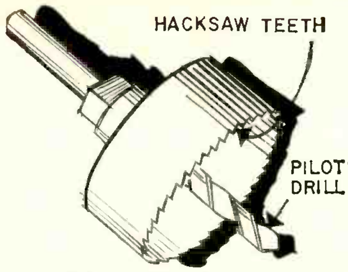


Fig. 10—Holesaw made for use with an electric drill. They are made in a variety of sizes.

Each of these tools uses a ¼-inch pilot bit. It makes the starting hole and holds the cutting tool steady after it has penetrated the surface. When using either of these tools, be sure to keep a very tight grip on the drill and feed the cutter into the work *very* slowly. Watch out for the moment when the cutter goes through the work. Both tools have a tendency to "whip" at this point. Be prepared to cut the power instantly and keep the tool from running wild.

Wood boring bits

Boring holes in wooden walls, making neat holes in phonograph mounting boards and jobs like those have always been a headache for the TV technician. But a set of *electric-drill wood bits* can make things much easier. The bits are actually just flat metal shapings in a special holder, which in turn is chucked in the drill. A nut is tightened to hold them in place. These will cut very smooth holes in any kind of wood, in a fraction of the time needed to make a similar hole with a brace and bit. They're real handy for boring through wooden walls when installing TV lead-ins, intercoms, etc.

Chassis punches

About the final classification would be what I have always called shear punches or chassis punches. These are made in two sections, the anvil and the shear (Fig. 11). In use, a pilot hole is drilled at the center of the larger hole, the punch separated, the bolt passed through the hole, and the shear screwed on it. As the bolt is tightened the two parts are drawn together.

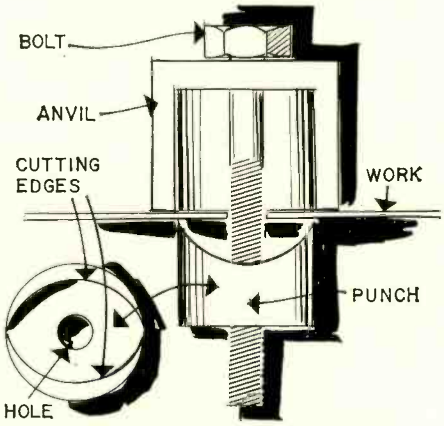


Fig. 11—Chassis punch uses a threaded bolt to pull the punch through the metal to be cut.

The shear has two lips which penetrate the surface of the sheet metal. The anvil is made so that the shear will just slip inside it. When the bolt draws the two halves together, a very neat round hole is punched. They are also made in square, D and keyed types, for making almost any kind of hole needed.

Such punches are much used to make holes for tube sockets and other components in radio and TV work. In two-way radio work, the 1¼-inch hole needed for installing a mobile whip antenna can be made very easily with one of these.

Another type of shear punch is shown in Fig. 12. It is actually a set of punches. Matching shears and anvils are selected, placed into the pilot hole and hit with a hammer.

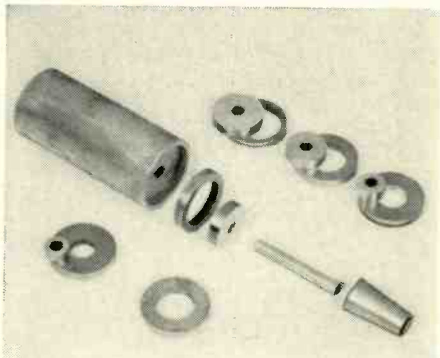
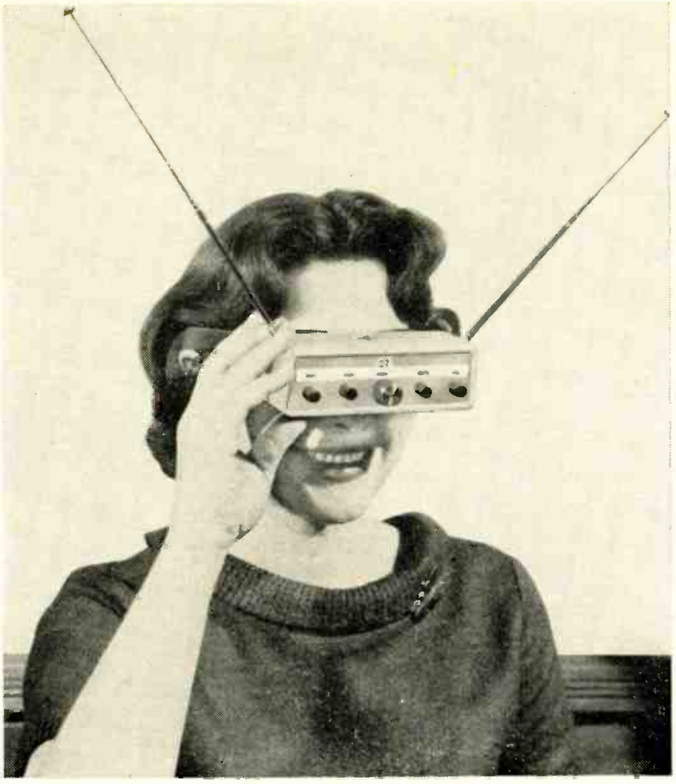


Fig. 12—This chassis punch is hit with a hammer to make chassis holes. It comes with a variety of punches in different sizes.

Masonry bits

Another place the electric drill is handy is with masonry bits. Any antenna technician who has ever spent a miserable afternoon hanging on a ladder while he tried to make holes in a brick or masonry wall with a star drill and hammer will certainly appreciate these. They look just like ordinary drills, but usually have special silicon carbide tips to withstand the terrible punishment of grinding through stone, mortar and bricks. They come in several sizes from ¼ inch on up to ½, ⅜ and so on. While the tips are extremely tough, they can be resharpened by a machine shop with a diamond wheel, used to resharpen lathe tools.

Masonry bits should not be used in a standard ¼-inch drill. These drills rotate too fast for them and will reduce their life. They should be used with a slow-speed ⅜- or ½-inch drill. If you must use a high-speed drill, apply minimum pressure to prolong the life of the bit. When using these bits, be sure to hold the drill perpendicular to the surface you are cutting the hole in. If this is not followed, the silicon carbide tip will wear rapidly and form a bevel on the cutting edge, making it necessary to resharpen the bit before it can be used again. This can happen in a very few minutes, so be extremely careful. END



TELEYEGLASSES

Worn like spectacles, this set is ready for stereophonic, stereoscopic TV.

By MOHAMMED ULYSSES FIPS, I.R.E.*

THE IDEA OF TELEVISION EYEGLASSES IS by no means new. In the October 1936 issue of *Short Wave Craft* Magazine. its editor said:

> ". . . You will use a tiny television receiver placed right on your very nose—a device which I term 'television eyeglasses.' These will be regulation eyeglasses, but instead of having the normal lenses, they will have a small projection of one or two inches which will house the entire television receiver. There will be two such receivers (sound and picture) working in unison . . ."

That was 27 years ago, BT (Before Television) and Before Transistors, when microminiaturization was not even a dream. But the idea was sound, although up to now no one has built a self-contained, battery-operated TV-eyeglass receiver. Then, too, who would be silly enough to wear on his nose a set that requires a picture tube with a 12,000-volt supply that could electrocute him?

But I knew I could build such a receiver which, I was well aware, millions of people would buy.

Look at all its advantages: No more family fights about *what* channel to select. Everybody wears his own set on the nose, tunes in to his own program. The set weighs only 6 ounces, has its own antenna, so you can walk anywhere with it, with the sound turned up, yet no sound is heard on the outside because I use bone-conduction audio back of the ears. Moreover, I have calculated that such sets can be marketed for less than $100 each, and *much less when made in Japan.*

I therefore worked feverishly for nearly 2 years, constructed many models in my spare time, and finally succeeded beyond my fondest dreams. This, then, is a complete report of my labors:

1. I use a standard plastic eyeglass frame that has two bone-conduction receivers, now common on many hearing aids. Hence you hear with both eardrums.

2. The set is all transistor, with microminiature transistors so small that you cannot see them except under a microscope. The transistors need no wiring because they are mostly interconnected films electrodeposited under vacuum.

3. While I experimented with microcathode-ray tubes less than 1 inch long, they still were too big! I wanted something better. I finally had constructed for me a flat CRT of the Aiken-Geer type now used in some military applications, 1 inch square and ½ inch thick. (For further information see the article, *Flat TV Tube,* by Eric Leslie, page 43, March 1957 issue of RADIO-ELECTRONICS.) This tube scans as well as or better than a standard 1-inch CRT.

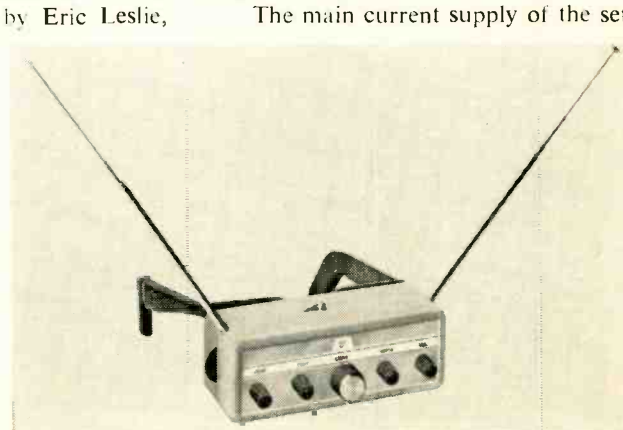
4. Keep in mind that the screen of the tube is less than ¾ inch from the average eyeball. The actual picture (screen) measures ½ inch wide by ⅜ inch high. This is sufficient, because its proximity to the eye gives an exceedingly sharp picture. (If you doubt this, get a pair of binoculars and view a landscape 1 mile away.)

5. Because of the small flat picture tube so close to the eye, we don't need high voltage for the CRT—only about 250 volts, at very low current. It is so weak that if you touch its terminals with your bare fingers you cannot even feel it! Hence the Teleyeglasses are super-safe—no problem here!

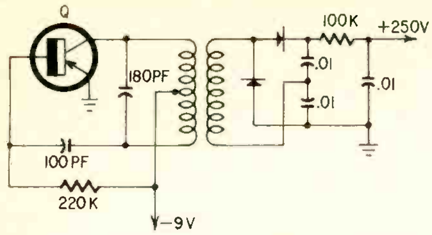
6. I use eight standard batteries to activate the set. Two standard dime-size "button" mercury batteries go into the audio bone-conductor "forks" that fit behind the ears.

The main current supply of the set

Closer view of Teleyeglasses. Antenna sections telescope for convenience and optimum tuning. Knobs (left to right) are vertical hold, contrast, channel, brightness, volume. Black wheel protruding from side adjusts focus.



* Institut Recherché Electroniciens (Paris).



Circuit of hv power supply. Though actual "circuit" uses molecular electronic techniques, standard symbols help show how it works.

is composed of six standard 1.5-volt alkaline batteries (Mallory Mn1500). I constructed a special transistor power supply to boost the 9 volts current to 250 volts for the flat TV tube. (See circuit diagram.) The circuit itself is almost standard TV.

7. The channel selector, on-off switch, brightness control, vertical and horizontal controls, etc., are all standard except for their miniature size.

8. This set differs from other TV receivers in that it has *two* flat TV tubes, both working in parallel, one for each eye, exactly as the two sound channels.

9. The receiver, as you will note, blocks any outside view for the wearer—normally you can see only the two TV screens. If you want to walk around without stumbling, just push the TV eyeglasses up on your forehead. (A later model, not illustrated, has two prisms which allow you to walk about freely by shifting your eyes—something like bifocal spectacles.) You will also note the two binocularlike wheels which bring the two viewing screens closer or further from your eyes, for proper focusing.

* * *

I had kept this whole project secret from everyone, including my co-workers at the office, on account of the great commercial value of the receiver. There are also patents pending on certain features not disclosed here.

On the big boss' birthday, I walked into his office, intending to unveil my Teleyeglasses to him as a special surprise and birthday present.

Suffering from an old gout, with his leg propped up on the desk, he was not pleasant to contemplate, with his face contorted in pain. It must have been bad, because he was not even smoking his customary 8-inch cigar. Since the Cuban shindig he had been trying to get a good cigar, but the "Netherlands *Dutch Havanas* are putrid stinkadores, unfit for even a smokestack," he bellowed at his cigar dealer, who then made a hasty exit.

He then observed me wearing my TV glasses, pushed up upon my forehead, antennas extended and all.

He looked mighty surprised when I offered him a second set, but I begged him not to switch it on as yet, but first listen to my sales spiel. This he did with his usual scowling "good" grace.

When I came to the Japan-made lower-price feature, he winced audibly, muttering something unintelligible. This I took to be a sudden gout pain of his.

He then put on the set and turned it on. For a while he looked on and listened in silence.

Suddenly he leaped up like a wounded bull, and because of the set on his nose that blocked any outside view, he couldn't see where he was going. That made him stumble. In the process he collided with his sore gouty foot against a chair. The ensuing bellowing was as awesome as it was horrific.

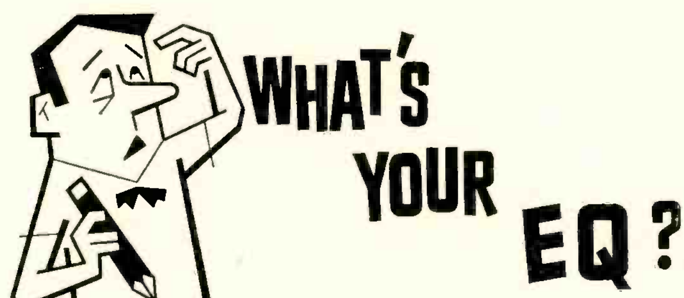
"Fips, you . . . you infernal tinker-stinker, you have outdone yourself in stupidiocity. First you want to foist more Japanese junk on us, so we will lose our own bread-and-butter American advertisers. Then you get up this hellish contraption, that blinds a man so he can't even see your moronitwit map to smash it to a pulp!

"Out! Get out—you televisionary buncombum—you should be televised while frying in Hell!"

With that he hurled his own teleyeglasses at me. He missed, but the glasses smashed a big hole in the glass door.

Departing in haste, I just had a glimpse through my own TV eyeglasses of the newscaster sitting before a large leaf calendar, announcing loudly: Today is the first of the month

APRIL 1



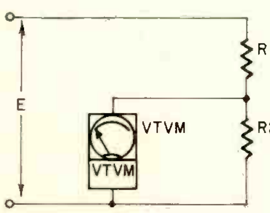
Answers on page 67.

Time constant

Suppose you have two 1-megohm resistors and a 1-μf 50-vdc capacitor. Using a 100-vdc supply voltage, how can you connect these resistors to provide a time constant of 0.5 second, without exceeding the 50-volt rating of the capacitor?—*Earl H. Rogers*

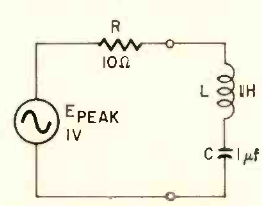
Series resistor circuit

In the circuit shown, the vtvm reads 24 volts. A 100-ohm resistor paralleled with R1 raises the voltmeter reading to 40 volts. The same resistor paralleled with R2 reduces the voltmeter reading to 20 volts. What are the ohmages of resistors R1 and R2 and what is voltage E?—*L. B. Hedge*

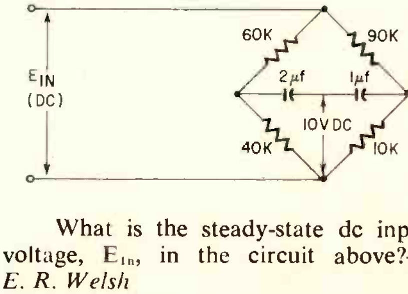


A Problem of Resonance

Inductance L and capacitor C form a series-resonant circuit used in a radio command system. The L-C combination is driven by a variable frequency voltage source having a source resistance R and a peak output of 1 volt. What is the minimum permissible capacitor working voltage in such a circuit?—*Phil Cutler*



How much voltage?



What is the steady-state dc input voltage, E_{in}, in the circuit above?—*E. R. Welsh*

By J. A. MADDOX

automated multiplex

When a stereo FM station goes on, your adapter switches in automatically

IF YOU ARE THINKING ABOUT ADDING A multiplex adapter to your hi-fi system, have you figured out where you will put it? It often demands "up front" placement, but have you room for it? Here is a simple, inexpensive, yet effective, solution to the problem—especially if the adapter has a stereo indicator lamp.

To reproduce stereo FM broadcasts, we reinsert the 38-kc subcarrier by a local oscillator synchronized with the received 19-kc pilot frequency. For monaural reception, this signal is not needed or desirable. It can, in fact, be a decided nuisance when listening to monaural broadcasts—especially if the station is also broadcasting SCA store-cast on a low subcarrier frequency. This makes the front panel oscillator on–off switch important and prevents placing the unit in an inaccessible position. The separation control is no problem. Once the optimum setting is determined, it seldom requires changing. The power switch is taken care of by simply leaving it "on" and plugging the line cord into a switched outlet on the rear of the tuner or amplifier. So the problem of stashing the adapter behind the scenes and forgetting it boils down to eliminating the oscillator switch.

The 19-kc pilot is a unique feature of the composite FM stereo signal. In some adapters it is used to light a signal lamp. If it does that you can also make it switch on the 38-kc frequency generator!

Fig. 1 is a portion of the EICO MX-99 Autodapter circuit. The isolated and amplified 19-kc pilot frequency is doubled at T1 by the fullwave rectifier consisting of diodes D1 and D2. This 38-kc signal synchronizes the 38-kc push-pull oscillator consisting of both halves of a 12AU7. In addition, the diodes create a negative potential when the 19-kc pilot frequency is received. This negative potential is more than enough to bias the 12AT7 stage to cutoff, raising its plate potential to the full supply voltage. This in turn fires the neon lamp, indicating that stereo is being received.

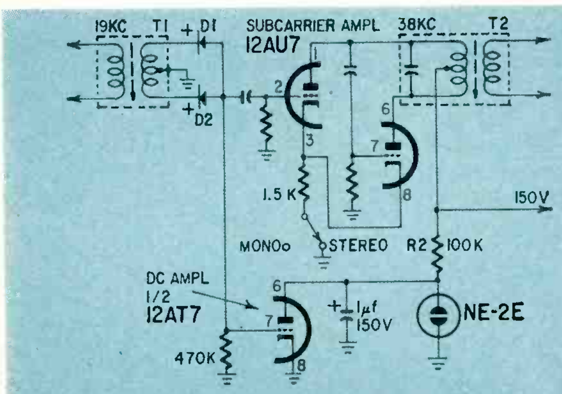


Fig. 1—Partial circuit of the EICO MX-99 stereo adapter.

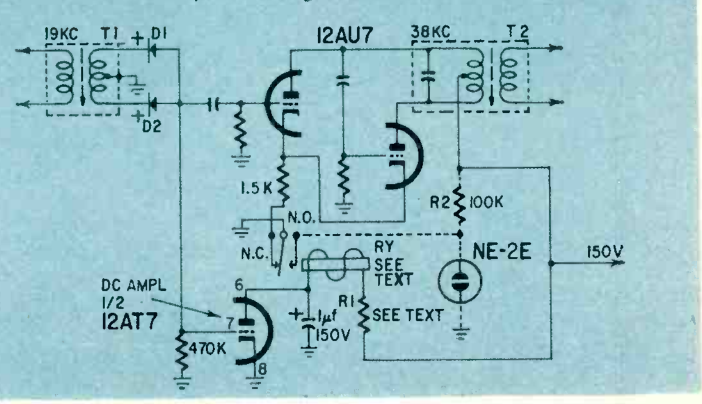


Fig. 2—The same circuit after being automated.

Changes are simple

Fig. 2 shows the automated circuit. First, the neon lamp is disconnected from the plate of the 12AT7. Then the coil of a sensitive plate relay is made part of the plate load. The total plate-load resistance is reduced to a value that passes enough current (when the switch tube conducts) to activate the relay. The exact value of R1 depends on the relay selected and the actual supply voltage impressed on the circuit. Suitable relays are the Sigma 11F-9000-G or 41F-10000-S or Potter & Brumfield RS-5D (2.5 ma at 10,000 ohms). I used the Sigma 11F. This relay has 9000 ohms dc resistance and a 2.4-ma pull-in current. With a supply of 135 volts dc, we found 18,000 ohms quite satisfactory for R1. In calculating this resistor, remember that, when there is no 19-kc signal, the negative potential developed by the diodes, due to noise or spurious signals, may still be as much as 0.5 volt or slightly more—so don't count on zero bias for the conducting condition.

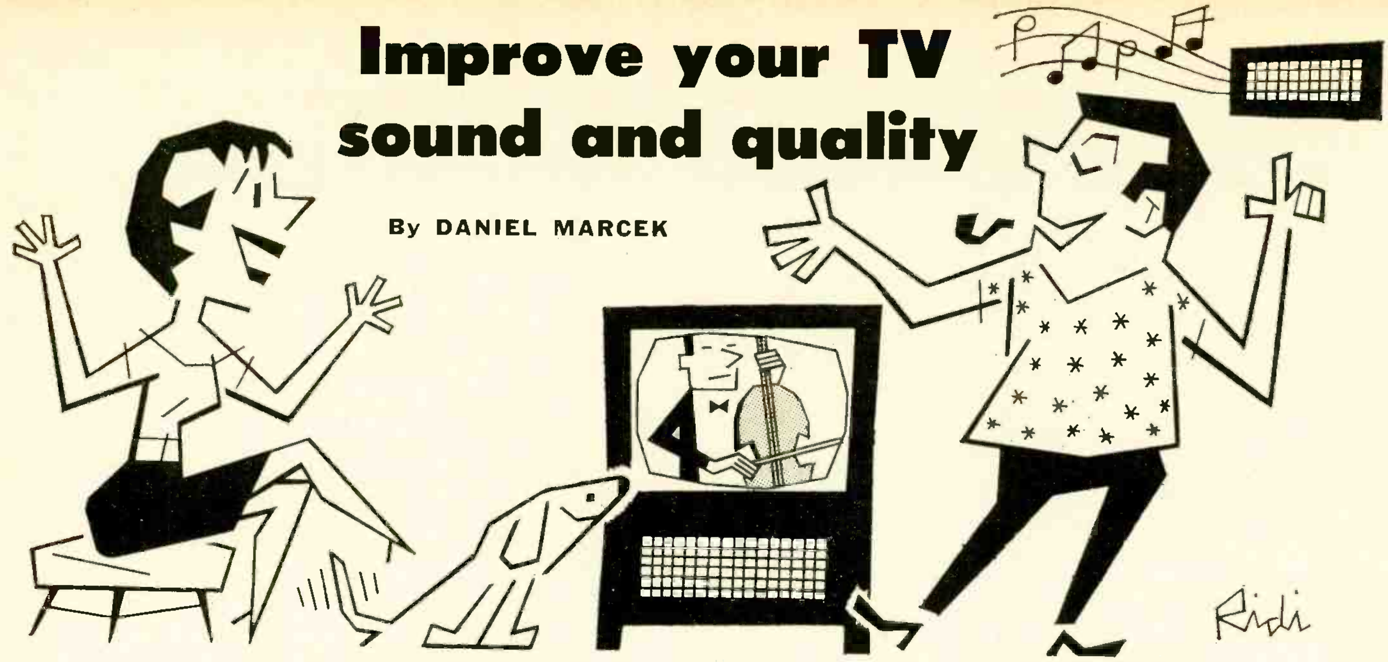
The spdt relay contacts replace the manually operated spst switch. The armature of the 11F relay is grounded to the frame and is automatically grounded to the adapter chassis when it is mounted. Use the normally closed (mono) contact for the oscillator cathode connection. On mono stations (no 19-kc pilot) the unbiased switch tube conducts and the relay is energized, breaking the oscillator circuit. At the same time, if the indicator lamp circuit is included, it is shorted by the normally open contact and extinguished. When a stereo broadcast is received, the 19-kc pilot causes the switch tube to be biased to cutoff, deactivating the relay. This allows the relay armature to drop to its "normal" position, which closes the oscillator cathode circuit (turns it on). At the same time the short is removed from the indicator lamp and it lights.

Continued use of the stereo indicator light is optional since automatic adapter operation lets you place it out of sight. If you decide you don't need it, leave out the lamp and R2. If you do want it, hook it to the normally open relay contact as shown by the dashed-line circuit. If the adapter power supply uses series resistors instead of a choke in the filter circuit, it may be better to increase R2's resistance and connect the neon lamp circuit to an intermediate point or directly to the rectifier cathode, avoiding an additional voltage drop across the filter resistors. Since the voltage drop across the NE-2E lamp is about 55 volts, R2 should limit current to about 1 ma.

Variations of this circuit may suggest themselves or be required. The essential feature, however, is the use of the 19-kc pilot, which means that it must be amplified to useful levels. Remember that the tube manual states that with a 12AT7 (for instance) the negative grid bias required to reduce the plate current to 10 μa is -5 volts with 100 volts on the plate, or -12 volts for a plate voltage of 250. END

Improve your TV sound and quality

By DANIEL MARCEK



THE PICTURE ON MOST NORMALLY OPERating TV receivers is good—but is it really *excellent* when you look at it closely? Some detail is missing, sharpness may be lacking, and audio quality is often poor. Why?

The answer is rather simple: Television is a very competitive market and manufacturers must design and build their sets so that they will meet the competition. This means that many ideas cannot be used because they would increase the price of the product and cut the profit margin.

What can the consumer do? One thing is to purchase a custom-designed set. This is too costly for most of us. Therefore, the only answer is to insert a few simple circuits to improve the set we have. I find that adding a few simple ideas (basic and of long standing) to a TV receiver will improve reception and increase more viewing enjoyment.

The first item to be considered is picture focus. Sets that use electrostatic focus have a picture tube with a third (focus) grid. This is usually connected to ground or some fixed B-plus supply point. As a result, optimum focus is not possible and, as various parameters change with age and operating conditions, the picture cannot be refocused easily.

But there is a solution. Disconnect the focus grid lead (Fig. 1). Mount a 2-megohm 2-watt linear potentiometer on the chassis, preferably along the back apron with the other service controls. Now reconnect the focus grid lead to the wiper (center lug) of the potentiometer. Connect one of the other lugs to ground, and the third lug to the end of the dropping resistor away from the accelerating grid (second grid). This resistor may be connected to B-plus or B-boost. Also, insert a .0047-μf capacitor from the focus grid to ground to stabilize power supply regulation. The voltage rating of this capacitor should be great enough to withstand the highest potential at the end of the accelerating-grid dropping resistor. Now simply rotate the pot to set best focus.

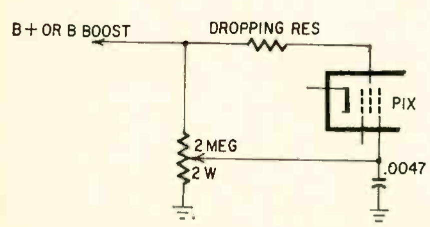


Fig. 1—Electrostatic focus control calls for adding one pot and one capacitor.

Dc restoration

The next item, one which can greatly improve the video, is adding dc restoration. This circuit was done away with several years ago when one manufacturer placed a stripped set on the market. It was accepted by the average consumer since it met his price. To keep in the competitive market, most manufacturers were forced into deleting the circuit.

Without dc restoration the blacks are usually dirty gray, the grays are lightened and the whites appear washed out. Video information is often coupled from the final video amplifier to the picture tube through a conventional coupling capacitor. This capacitor blocks the video amplifier dc potentials from the picture tube. At the same time, it blocks the necessary dc level of the video information. This results in a continuously variable video signal level. There is nothing to clamp the video signal at any given reference point. Contrast ratios are constantly changing and the only way to correct this problem would be to vary the contrast control 15,750 times per second.

Some of the more recent sets (and particularly de luxe types) maintain the dc level—usually by dc coupling through from the detector to the picture tube. Older sets which lack dc coupling or dc-restoration circuit can be improved by adding dc restoration.

For a set with a cathode-modulated picture tube, use the circuit in Fig. 2. Mount a 12AX7 near the video amplifier or as close as practical. (A 12AX7 is used here since the second section is used later in a cathode-follower circuit. If you decide not to use the cathode-follower circuit, a 6AL5 or similar tube will do instead.) Connect pins 4 and 5 together. Connect these to one heater pin of an adjacent tube. Connect pin 9 to the other heater pin. The resistor from the picture tube cathode to the brightness control should be approximately 100,000 ohms. Change it to 470,000 ohms and connect the rest of the circuitry as in Fig. 2. If you're adding the 6AL5 or 12AX7 dc restorer to a set with series-string heaters, **don't** tie the heater to the nearest tube. You'll have to add a small filament transformer instead. Therefore, with series-string sets, it is often best to use semiconductor diodes for dc restoration.

If the picture tube is grid-modulated, use the circuit of Fig. 3. This time no components have to be changed. A 12AX7 is also used here. Insert a 100,000-ohm and a 1-megohm re-

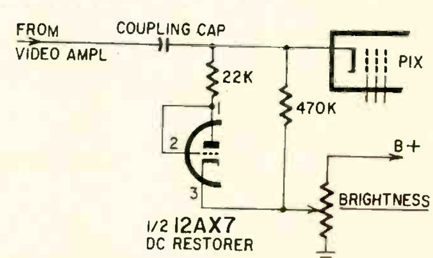
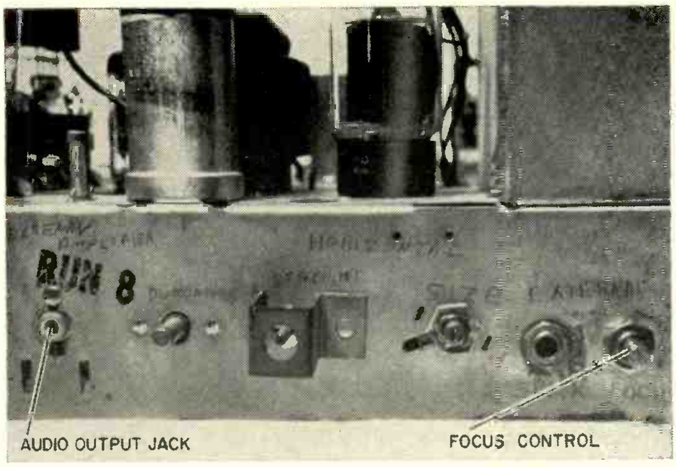
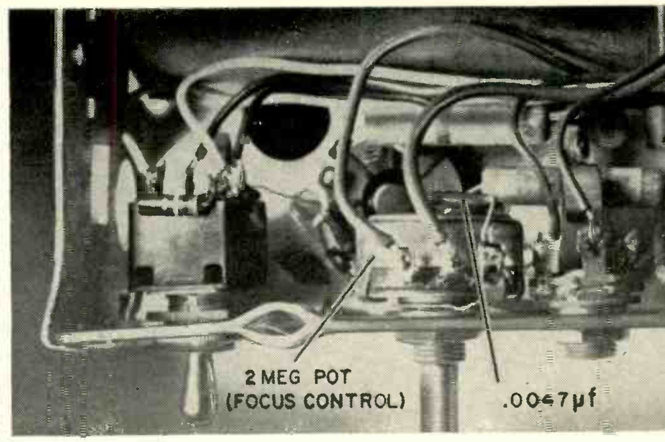


Fig. 2—Dc-restoration circuit for a cathode-modulated CRT.



Focus control and audio output jack for hi-fi amplifier are on rear of chassis.



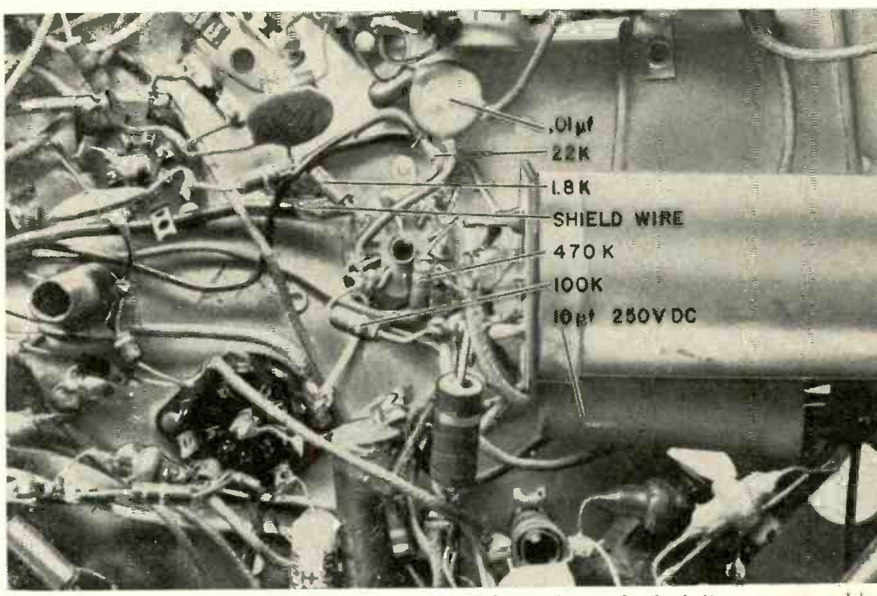
How the focus control was added.

sistor in series to ground and connect the tube across the 100,000-ohm resistor as shown in the figure.

Audio improvement

With the many good musical programs being televised (symphonies, popular music shows, etc.) TV audio systems leave much to be desired. The TV's FM sound channel can be enjoyed and appreciated as well as conventional FM broadcasts if reproduced through a well designed high-fidelity audio amplifier. The majority of TV audio amplifiers are single-ended single-stage jobs that do not reproduce the full audio spectrum with much fidelity. A good answer to this problem is to feed TV sound to a hi-fi system.

But first the audio signal must be removed from the TV receiver at a point where all audio information is available. To take this signal off at the volume control and feed it through a capacitor directly to an external amplifier, as some may recommend, is not acceptable. Losses are too high (especially high frequencies), hum may be introduced and impedance mismatch is great. Taking the signal off at the TV speaker is also a poor practice since audio reproduction is then limited to the capabilities of the TV audio amplifier. The only proper answer is to insert a cathode follower. With it, the signal is fed to the cathode follower direct from the audio detector. All high-frequency components are preserved and can be fed directly to an external amplifier or tape recorder.



Where the cathode-follower was added.

The second section of the 12AX7 dc restorer is used here (Fig. 4). Connect the input capacitor (0.01-µf) to the high side of the volume control or any other point which connects directly to the output of the TV audio detector. Connect the resistor of the plate supply low-pass filter to approximately 250 volts dc. The lead to the output jack (mounted in a convenient location such as the back apron) should be shielded wire and grounded only at one end. Keep the shielded wire from the TV receiver to the external amplifier or tape recorder as short as possible. **If your set doesn't have a power transformer, don't try this. Sets minus power transformers often have hot chassis and connecting a shielded cable between the TV and amplifier chassis makes the amplifier chassis hot, creating a shock hazard.**

Inserting the circuitry described here may take a little time and cause you to miss few favorite TV programs, but by adding one tube and a few resistors and capacitors, you'll be repaid with improved performance and greater enjoyment. END

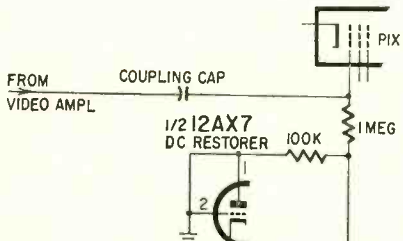


Fig. 3—Dc restoration for a grid-modulated CRT.

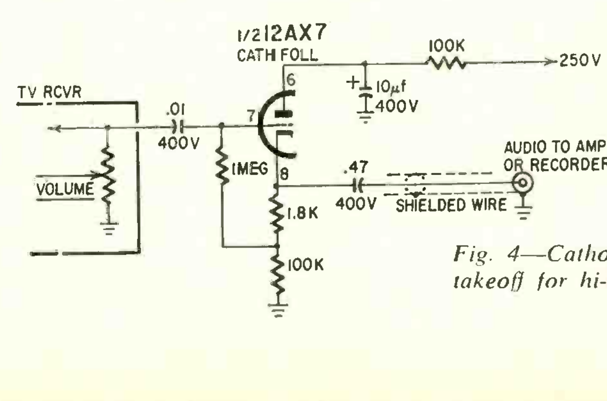


Fig. 4—Cathode follower permits audio takeoff for hi-fi amplifier input.

By H. B. CONANT*

sensitive Light Meter easy to build

One-day project is simple, useful and accurate

The light-level indicator by Harold Reed (Radio-Electronics, June 1961) suggested to me this circuit (Fig. 1) for measuring light levels accurately. A rectifier-type ac milliammeter reads the current flowing through the photoconductive cell. It varies according to the cell's resistance, which varies in relation to the light level. To make it easier to spot small changes in light level, the instrument has three ranges, calibrated in terms of an available photographic exposure meter.

Accuracy is insured by compensating for line-voltage variations with R1. This is done while S3 is depressed, connecting R8 in place of the photocell on the LO range. Then R3 and R4 are adjusted for full-scale meter readings on the MED and HI ranges.

* Conant Laboratories, Lincoln. Neb.

Construction

I have not attempted to miniaturize, but this is a matter of preference. I used a NSL-5 photocell suggested by Mr. Reed although others can be used. It has two raised glass seals for the leads. They nest neatly in two 3/16-inch holes drilled through one end of the metal box. Clamp the flange of the cell against the box with an Amphenol tube-socket mounting plate with its inner projection filed away (Fig. 2).

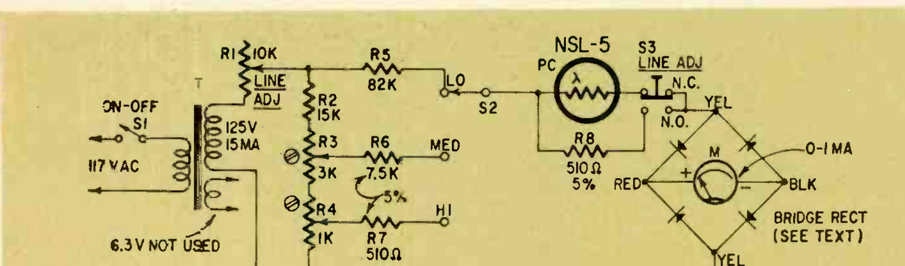
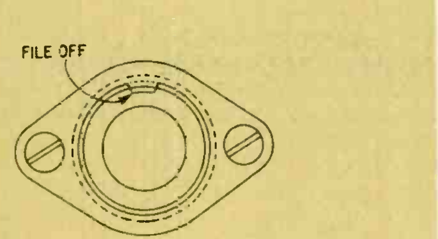


Fig. 1—Circuit of the accurate light meter.

R1—pot, 10,000 ohms, linear taper
R2—15,000 ohms, ½ watt
R3—pot, 3,000 ohms, linear taper, screwdriver adjust
R4—pot, 1,000 ohms, linear taper, screwdriver adjust
R5—82,000 ohms, ½ watt
R6—7,500 ohms, ½ watt, 5%
R7, R8—510 ohms, ½ watt, 5%
M—0-1 ma, dc
PC—NSL-5, National Semiconductors, Ltd. of Canada photoresistive cell. Available from Harvey Radio Co., 103 W. 43rd St., New York 36, N. Y., and other sources.
RECT—see text
S1—spst slide or toggle switch
S2—single-pole 3-position rotary switch
S3—spdt pushbutton switch, momentary contact
T—Power transformer: primary, 117 volts; secondary, 125 volts, 15 ma; 6.3-volt heater winding not used
Case, to suit
Miscellaneous hardware



Detail (Fig. 2, left) of the photocell mount and insulated mounting (Fig. 3, right) for the bridge rectifier.

The meter rectifier is a Conant SeB-ERM, but types B, B-C or B-ERM, which are more readily available, will serve a little better. Type B can be mounted directly on the metal chassis, but the others must be insulated. This is conveniently done with a short length of large spaghetti (Fig. 3).

The cadmium sulfide photocell has a considerable time lag, so once the cell is tightly covered to exclude all light, it takes several seconds for the meter reading to drop to a steady reading of about 1 scale division. This is the *dark current*. Balance it out with the meter zero adjustment.

Set up a "point light source" at one end of a table or bench at least 5 feet long. The source can be a concentrated-filament lamp of approximately 60 candlepower. You must be able to regulate its brightness. I used an old-fashioned dual-filament auto headlamp bulb with both filaments in parallel. Power was from a husky 6-volt transformer, fed from a Variac (Fig. 4). Clean the glass bulb and place some dark, nonreflecting material behind the lamp.

Now mark off a distance scale on the bench top, beginning with the sensitive part of the photocell 3 inches from the lamp *filament*. The end of the box is a good straightedge for marking the graduations, and makes for more accurate placement of the light meter during calibration. Succeeding scale marks increase the distance ×1.41 (the square root of 2), so the distance doubles for each two scale marks. Therefore, the scale marks are at 3, 4.25, 6, 8.485, 12, 16.97, 24, 33.94 and 48 inches. The light reaching the cell decreases 50% as the meter is moved back from one mark to the next.

The cell must be shielded so it receives light through only a small angle for best accuracy. I used a 2¼-inch length of phenolic tubing, ⅞-inch ID, with the OD built up with gummed paper tape to match the OD of the cell body. It was painted dull black inside to kill reflection.

It is convenient to calibrate in photographic units, using the same numbers as camera f stops, but in reverse order.

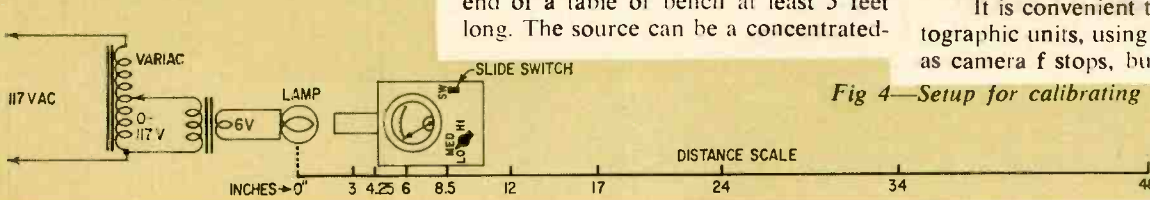
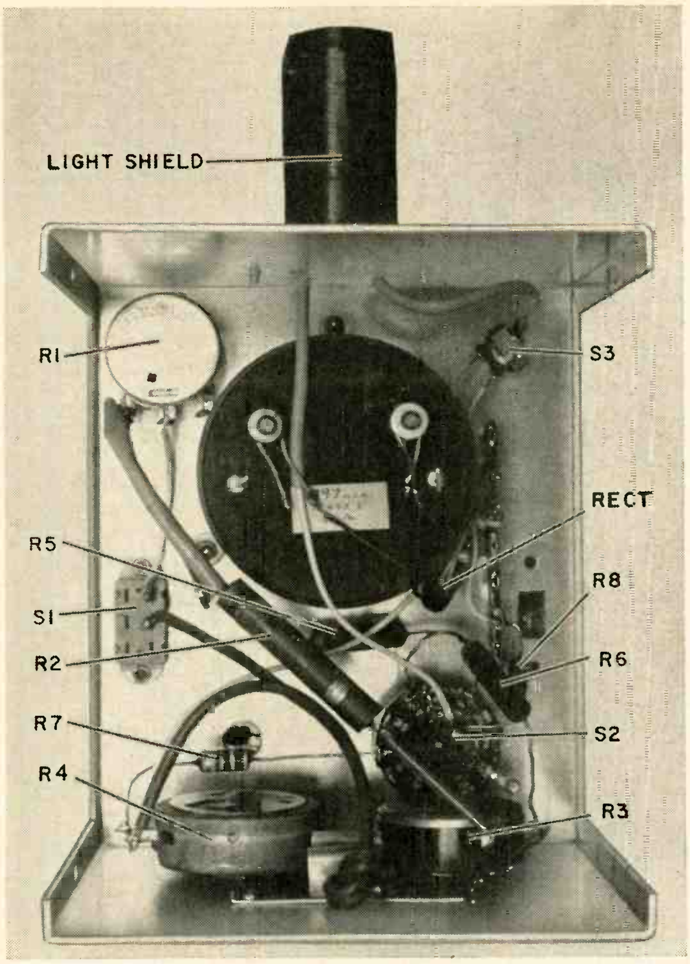
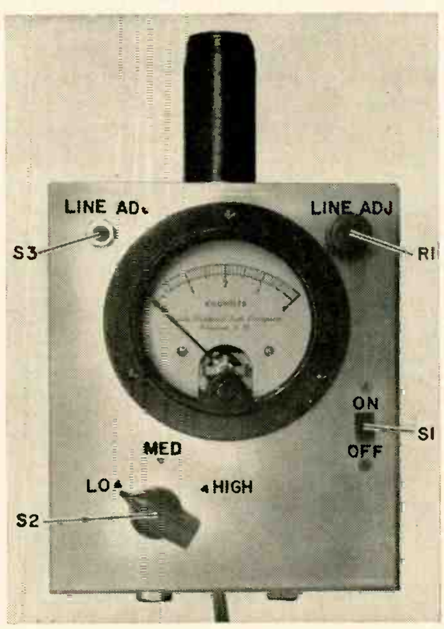


Fig 4—Setup for calibrating the unit.



Closeup shows parts layout inside case. Model shown was powered by external isolation transformer. You may wish to use a larger case and include transformer shown in Fig. 1.



Front-panel view of the completed instrument.

By this system, a typical exposure meter covers a range of 1 to 45, each succeeding graduation increasing roughly as the square root of 2, and representing double the light of the preceding graduation.

For a starting point, take light readings on all three ranges of the light meter, and compare them with the reading of an accurate exposure meter. Do this outdoors in bright sunlight and read the light off a light-colored wall. I got a reading of 22 on the exposure meter.

To cover the next two graduations, 32 and 45, place the light meter at the 6-inch mark of the distance scale, and adjust the lamp filament to give the same reading obtained for a light level of 22. Advancing to the 4.25-inch and then the 3-inch mark gave readings for light levels of 32 and 45, respectively. Then reduce light output to the original reading for 22 with the meter still on the 3-inch mark. Now moving the meter away from the lamp, mark by mark, gives readings for light values of 16, 11, 8, 5.6, 4, 2.8, 2 and 1.4 when the 48-inch mark is reached.

Return the meter to the 3-inch mark, turn down the lamp filament to produce the 1.4 reading and repeat the process to get readings for light levels of 1, 0.7, 0.5, 0.35, 0.25, 0.177 and 0.125. Do this in a dark room, using a small flashlight to find the marks and read the meter. Take readings on all three ranges at each point and make up a table with this data.

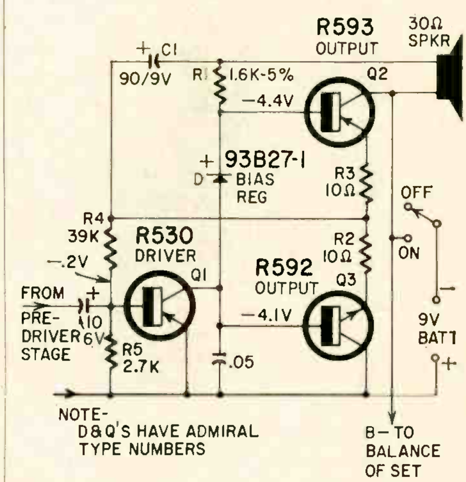
When using the instrument, for greatest change in meter reading for a given change in light level, use the HI range for light levels of 4 through 45. The MED range is best from 1 through 4, and the LO range for all light levels below 1. At 0.125, which is 1/64 of the minimum detectable on the exposure meter, I got a one scale-division reading on the LO range. END

Complementary Symmetry Audio Output Circuit

THIS TRANSFORMERLESS OUTPUT CLASS-B circuit is used in the Admiral model 6V3 transistor radio.

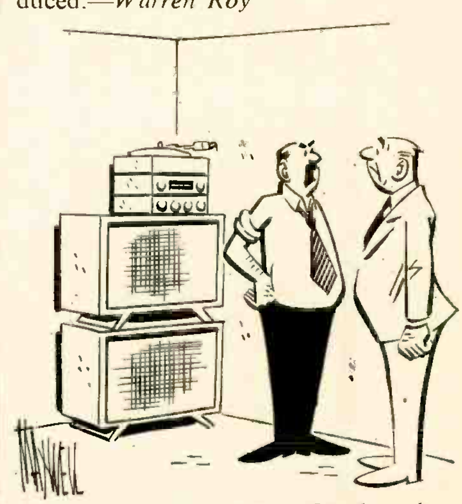
When the signal at Q1's base is in its negative half-cycle, Q1 conducts, increasing base bias on Q2 and Q3. Increasing positive base bias increases collector current of an n-p-n transistor and decreases collector current of a p-n-p transistor. So Q2 is cut off and Q3 conducts heavily.

There are two current paths at this time. One, the dc path from B-minus, through the speaker voice coil, R1, D, Q1, and back to B-plus. The other, the signal path, is created by the charging of capacitor C1 through R2 and Q3.



When the signal at Q1's base is in the positive half-cycle, the opposite happens and Q3 is cut off while Q2 conducts. Now the current paths are from B-minus through Q2, R3, R4, R5 and on to B-plus. The signal path is now from C1, discharging through the speaker voice coil, Q2 and R3.

As during both half-cycles, the audio signal appears across the speaker voice coil, the received signal is reproduced.—*Warren Roy*

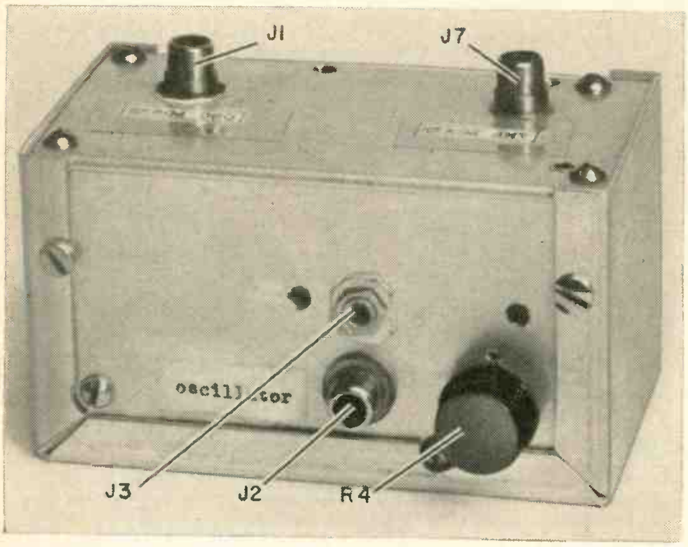


"Oh, yes, I enjoy stereo. On the other hand, my wife loves neatness."

OSCAMP— an ac bridge

By I. QUEEN
EDITORIAL ASSOCIATE

Fig. 1—Block diagram shows how the Oscamp is set up.



Power supply inputs are on top and oscillator outputs on one side.

AC BRIDGES ARE USED TO MEASURE CAPACITANCE, inductance and other parameters. Often a strong audio signal (from a tube type oscillator) is fed into the bridge, and balance (null) is detected with a pair of headphones. An alternate method is to apply a relatively weak signal across the bridge, and add an amplifier between bridge and headphones to boost sensitivity (Fig. 1).

The Oscamp is a convenient device for making bridge measurements. It combines a sine-wave oscillator with a multistage amplifier. Measuring only 4 x 2 x 2 inches, it weighs less than 9 ounces and is battery-powered. To use it, simply connect input and output cables to the bridge, and plug in an earpiece. The oscillator and amplifier are independent, so either may be used separately around the shack or shop.

The completed Oscamp can be used to power the minicapacitance bridge (RADIO-ELECTRONICS, March 1960), the percent bridge (December 1959) and others that are energized by an audio signal, including transistor testers, etc. It eliminates the bother of having to connect a bulky line-operated audio generator and provides the convenience of aural detection which can tolerate loud signals yet is highly sensitive to the tiniest output.

The amplifier is a modified PK-544, a five-transistor unit recently announced by Lafayette Radio Electronics. The few changes are easy to make. Snip off the battery plug which is part of the PK-544 and connect the battery leads to a phono jack mounted on the metal box. The outside shell is used as the negative connection. Connect the gain control leads to a 10,000-ohm pot (Fig. 2-a).

The black *output* lead is grounded to the box, but the black *input* lead is removed. It must not be grounded since it connects internally to battery positive! The two orange leads are for an on-off switch if you want one. Since the battery may be plugged in, there is no need for a switch and the orange leads are shorted.

A single 1.5-volt cell will power the amplifier, although 9 volts is specified for it. The output impedance of the PK-544 is about 10 ohms, so any low-impedance earpiece may be used.

Fig. 2-b shows the oscillator circuit, a simple Hartley with C1 determining frequency. The larger the capacitor, the lower the frequency, the better the waveform, and the smaller the output. A 0.25-μf capacitor corresponds to about 800 cycles. Too large a capacitor will prevent oscillation altogether. All oscillator parts except the output control are mounted on an insulated strip about ¾ by 2¾ inches.

Both units fit easily into the 4 x 2 x 2-inch aluminum box. The amplifier is held in place with four threaded spac-

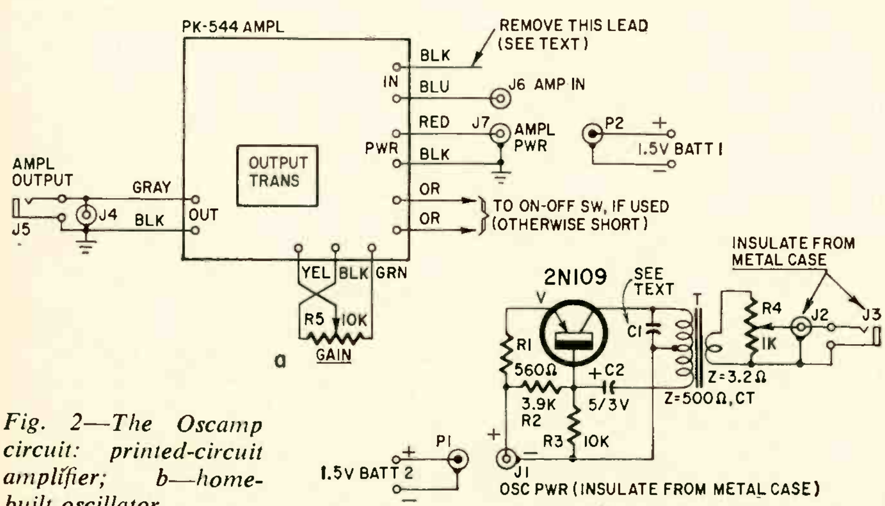
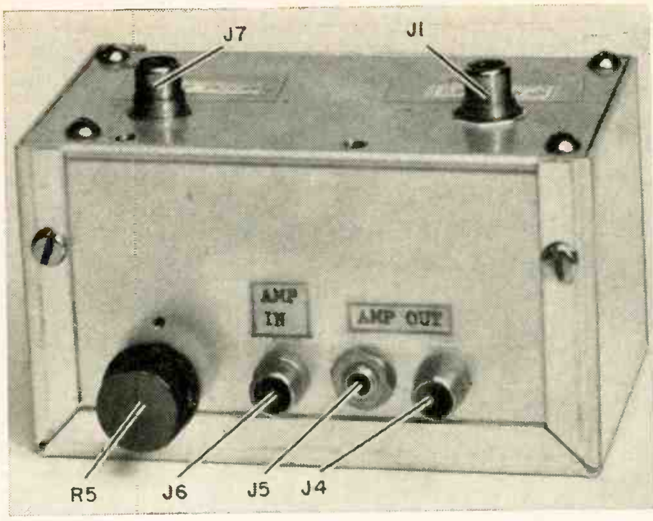
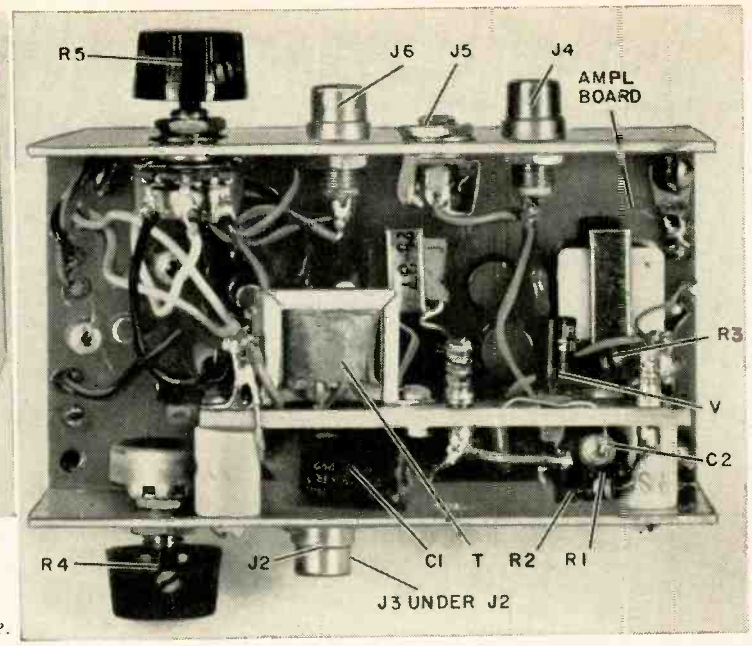


Fig. 2—The Oscamp circuit: printed-circuit amplifier; b—home-built oscillator.

R1—560 ohms
R2—3,900 ohms
R3—10,000 ohms
R4—pot, 1,000 ohms
R5—pot, 10,000 ohms
All resistors ½-watt 10%
C1—see text
C2—5 μf, 3 volts, subminiature electrolytic
BATT 1, BATT 2—1.5 volts
J1, J2, J4, J6, J7—phono jacks
J3, J5—phone jacks
T—output transformer: primary, 500 ohms, ct; secondary, 3.2 ohms (Argonne AR-119 or equivalent)
V—2N109
Printed circuit amplifier (Lafayette PK-544 or equivalent)
Case—4 x 2 x 2 inches
Transistor socket
Low-impedance earpiece
Miscellaneous hardware



Other side reveals amplifier input and output jacks.



Parts arrangement inside the compact case.

ers, and the oscillator with two threaded spacers.

One important point that must be made is: *The input and output of a bridge do not have a common terminal. Since the amplifier output has been grounded (to the box), the oscillator output must not be grounded.* Therefore, I insulated the output phono jack of the oscillator from the box. For convenience, I added an *earpiece* jack for the oscillator too, and it must also be insulated.

Tests showed that a small residual tone remained at bridge balance (due to leakage) when a common battery was used for both oscillator and amplifier. To reduce this I use separate power supplies. A single cell is enough for each circuit, but the battery phono jack for the oscillator should be insulated from the box. This isolates one supply from the other.

The separate oscillator and amplifier circuits are available for general use in tests and measurements. The PK-544, while definitely not a hi-fi amplifier, has high gain and can operate a speaker. For maximum output you can apply up to 9 volts to it. END

Panel Meters Need a Home

By E. C. CARLSON

PROPER CARE OF EVEN SURPLUS PANEL meters is just as important to their accuracy as the gentle handling given to the best multimeter.

For maximum repeatable accuracy, meters should always be held in the same vertical, horizontal or angled position when measurements are taken. When they are mounted in a protective case, the proper angle is assured for repeat measurements (Fig. 1).

Fig. 1—Meter case assures repeatable readings (and keeps meter on the bench!)

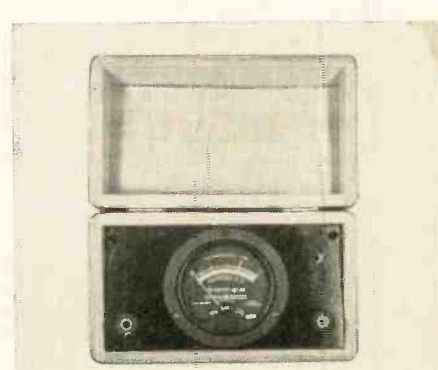
Meters marked "calibrated for steel panel" must be mounted in a steel plate to maintain their calibration. The steel plate can be mounted inside the nonmagnetic case front of plastic or aluminum meter boxes.

Special meters that are used infrequently or that must be often carried can be protected from dirt and breakage by mounting them in a file-card box (Fig. 2).

Using five-way binding posts helps eliminate most bad connections. Fig. 1 shows three posts for a 0-15- and 0-150-volt meter. Spaced ¾ inch apart, they will accommodate a dual banana plug. Meters with low-range movements and built-in shunts or multipliers can often be modified by bringing out an extra lead from the meter housing to a third terminal on the case. This way you can either bypass the shunt or multiplier and use the sensitive movement directly, or use the meter on its original range.

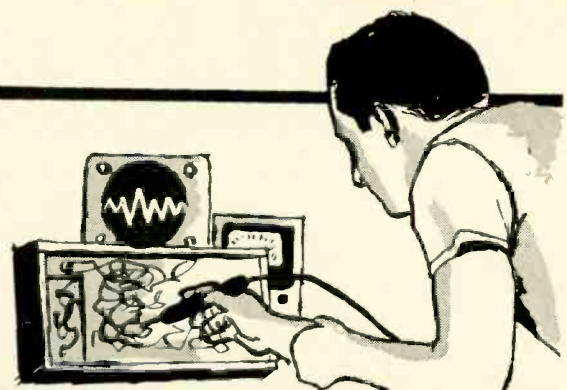
A word of caution: plastic cases and meter faces often collect an electrostatic charge that completely disrupts meter readings unless an anti-static solution is used on both sides of the plastic surfaces. Commercially mounted meters have this solution applied at the factory, but it *must* be renewed when the plastic surfaces are cleaned. This anti-static solution can be obtained through parts distributors and from some meter manufacturers. Complete instructions are given in the meter instruction manuals and with the anti-static solution. END

Fig. 2—Seldom used meters can be mounted in covered boxes for protection.



SERVICE CLINIC

Conducted by JACK DARR
SERVICE EDITOR



This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge, and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envelope. Write: Service Editor, Radio-Electronics, 154 West 14th Street, New York 11, N.Y.

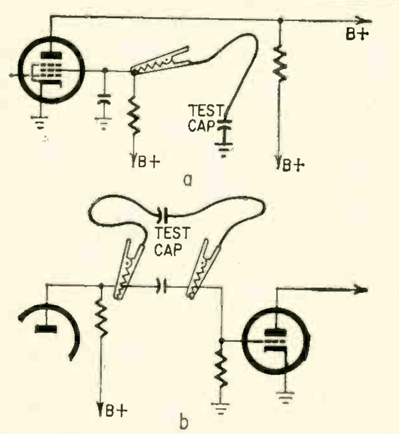


Fig. 1—Jump a known good capacitor across the suspected unit to check for an open.

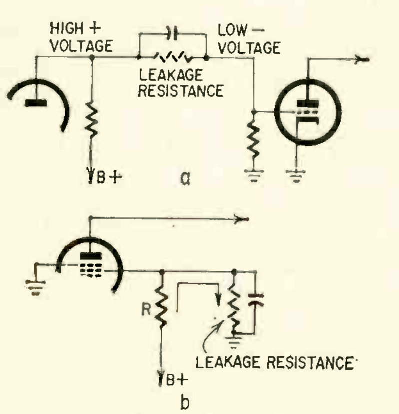


Fig. 2-a—Leakage through capacitor puts high voltage on next grid. b—Leaky bypass causes added voltage drop across R, lowering screen voltage.

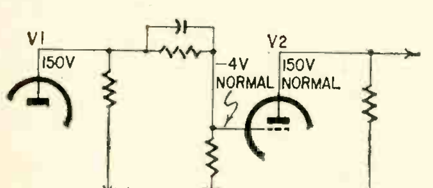


Fig. 3—Coupling capacitor leakage could drop plate volts on V2 to 75, raise grid voltage to +1.

WHAT DO WE HAVE TO KNOW ABOUT A CApacitor in an electronic circuit? Three things: Is it the right size? Is it open? And is it leaky? We need simple tests that will answer these three questions fast and accurately. You can make many such tests with a vtvm, and you'll find them useful in everyday service work.

Open capacitors

These are the easiest to spot. Just pick up a capacitor somewhere near the right size and connect it across the suspected one (Fig. 1).

If you're checking a capacitor in the middle-size range, say a .05-μf unit, you can use any size from .01 to 0.1. How? Simple. If the suspected capacitor *is* open, it's having some effect on the circuit—oscillation, distortion, loss of signal. So if you bridge a good capacitor across an open one, something's going to happen. If it's oscillating, the oscillation will stop, or at least change pitch (lower its frequency) very noticeably. If it's an open coupling capacitor a good capacitor of any size across it will pass signal and you'll get a burst of sound or signal.

Size? So, after this test has shown the old capacitor to be bad, disconnect it and replace it with one of the proper capacitance.

Incidentally, if you're looking around in vhf tuned circuits for open capacitors, try touching suspected points with the blade of a dial screwdriver, about 3 to 4 inches long. This will make a fairly good substitute for capacitors in the 3-to-5 pf ($\mu\mu$f) range!

Leakage testing

This is almost as fast. You want to know if there is enough *dc leakage* through this capacitor to upset the circuit. For example, plate voltage leaking through a coupling capacitor to a grid, causing distortion; leakage in bypass capacitors, reducing the voltage across the circuit, and so on. Fig. 2 shows some examples.

To check, simply disconnect the ground- or low-voltage end of the capacitor. Connect your vtvm to the voltage point and turn the set back on. Now touch the open end of the capacitor to ground. If the dc voltage drops, it's leaking.

If the plate voltage on a tube is mysteriously low, although the supply voltage is OK and the tube is good, look out for a very small dc leakage in coupling capacitors (Fig. 3). A voltage difference of even 1 or 2 volts is enough to upset grid bias and cause a tube to draw far higher plate current than it is supposed to!

Almost all coupling capacitors are connected between a plate (with high positive voltage) and a grid (with negative voltage). Quick test? Disconnect the grid end of the capacitor and connect your vtvm to it (Fig. 4). If you get a permanent reading, the capacitor is leaking. Double-check. Ground the end of the capacitor, with the meter probe still connected. This discharges the capacitor. If the voltage reading comes right back, you know it's leaking.

Check *all* suspected coupling capacitors this way. For example, the one used in the diode circuits of horizontal afc circuits. But, you say, there is no high dc voltage *in* that circuit to make this check. So, take the capacitor completely out of the circuit, and touch one end to a source of high dc voltage, while the meter is still connected to the other end. A small alligator clip is very useful for this test. There are several types that will clip to the end of your vtvm probe (Fig. 5). By the way, you can also use this test to see if small capacitors are *open*. Discharge the capacitor by touching the open end to ground. Then

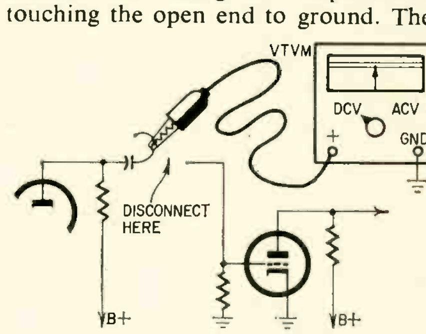


Fig. 4—Lift one end of suspected capacitor and measure the dc voltage on it to check for leakage.

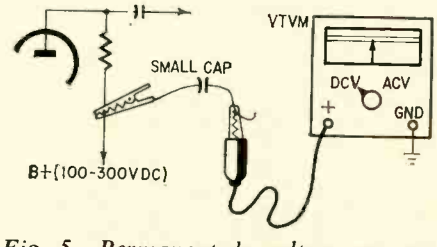


Fig. 5—Permanent dc voltage on open end of capacitor indicates leakage.

no question about it—

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"6 db BETTER THAN THE BEST!"

If you are installing JFD Log Periodic LPV's, no doubt you will agree with this report from R. L. Monroe, a leading TV antenna service-dealer of Charleston, West Virginia—a problem reception area.

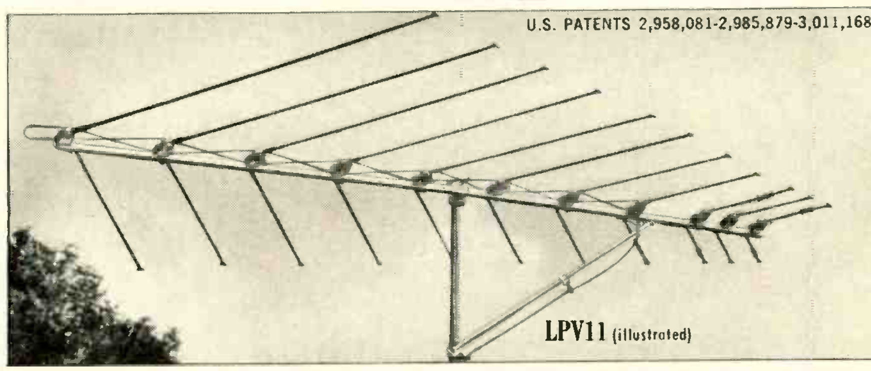
"It beats all, it beats everything that I have ever seen. Not only that, but this antenna is better than 6 db better than the best that I have installed. It pulled in a consistently clear picture from Columbus, over 130 miles away. *** *** **** *"It's just great on color —turns browns into real reds, faded bluish greens into brilliant greens, and completely eliminates the chronic ghost problems we have been suffering from in this area."*

****I have been in this business since 1948, which is a considerable time, particularly in the valley, and have yet to see any antenna, even near to this log periodic antenna in performance of the things I have wanted."*

Why the JFD Log Periodic LPV Outperforms Every TV Antenna Ever Made!

The log-periodic LPV blows the whistle on cumbersome antennas with their "Chinese puzzle" combinations of collectors, directors and reflectors. Now a single precisely-engineered antenna—the first based on a geometrically-derived *logarithmic* scale—actually *tunes* itself to the desired channel for unprecedented performance in crisp black and white or stunning color—plus FM STEREO. Is it any wonder that never before have so many installers and technicians so quickly acclaimed a TV antenna?

We would like to tell you more about the LPV, and how its *frequency independent* characteristics, have broken through distance, ghost and interference barriers to bring clear, steady pictures into previously "impossible" areas. Write today for your log periodic LPV Sales Kit. Better yet, call your JFD distributor and try one with our money-back guarantee of a better picture. You will prove it to yourself.



U.S. PATENTS 2,958,081-2,985,879-3,011,168

LPV11 (illustrated)

Developed by the University of Illinois Antenna Laboratory—Now Serving in Satellite Telemetry—Adopted to TV by JFD! THE LOG PERIODIC LPV ENDS THE ERA OF ANTENNA COMPROMISE! FOR THE FIRST TIME ONE SCIENTIFICALLY FORMULATED ANTENNA CONFIGURATION SATISFIES ANY LOCATION DEMAND:

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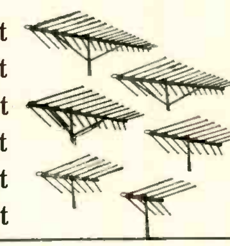

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touch the B-plus. If the capacitor is not open, you'll get a small kick reading from the charging current.

Vertical roll

I've a Motorola 21T57 TV on the bench. When it is first turned on, it rolls vertically. As it warms up, it gets better. The vertical hold control runs at almost its maximum position. It still rolls at times when operating. Also, the other adjustments, such as vertical size and linearity, affect the vertical hold. How can this be stopped?—K. J. D., Kingsville, Tex.

First, resetting vertical adjustment controls *always* affects the hold. By altering the waveshape of the vertical oscillator, they can make it difficult for the sync to trigger the oscillator at the proper time. So, when checking for this, always set the size and linearity controls for a correctly proportioned raster *first*. This should be about ½-inch overscan at top and bottom of the screen.

Second, weak tubes are the most common cause. After this comes defective resistors or capacitors. From your statement that the hold control is at the end of its range, a defective component is the most likely thing. Check all the R-C combinations in the oscillator circuit; one of them has changed (Fig. 6).

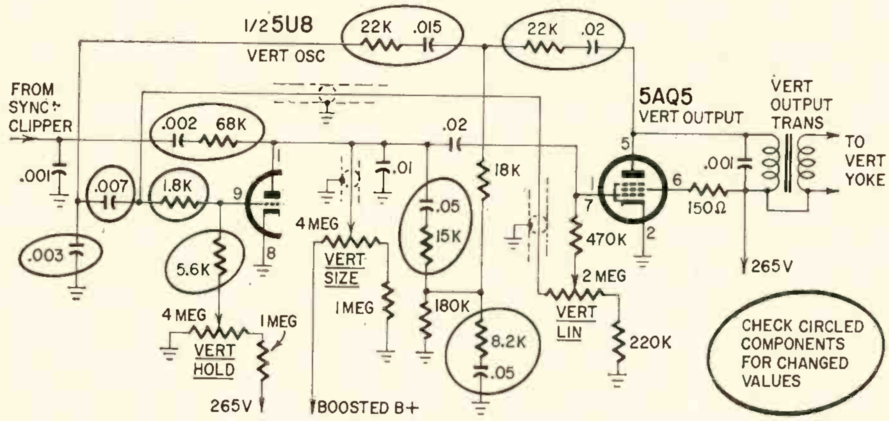

Fig. 6—Changed resistance and capacitance values in vertical oscillator output stages is likely to cause vertical roll.

No high voltage and boost

I have an Admiral 21D1 which has turned into a tough dog. Sound, no picture, no raster. The cathode resistor (47 ohms) is burning up, there's no drive on the grid of the 6BQ6, and I have no boost voltage. I accidentally connected the boost filter capacitor to the horizontal phase comparer 6AL5. Do you think I damaged the yoke by doing this?—V. I. A., Ozone Park, N. Y.

I wouldn't think that any damage was done by this temporary misconnection as you would have to go through the 12,000-ohm shaper resistor to get to the tube. From the symptoms and the voltage readings you gave, I'd say that your main trouble is in the horizontal oscillator circuit.

This could be a bad yoke, which would upset the boost voltage, and I note that you show the damper tube plate and cathode as exactly the same voltage. This is a sure indication of boost troubles. Try disconnecting the yoke and temporarily substituting the horizontal section of a similar yoke to see if this brings the boost votlage back up. The horizontal oscillator is fed from the boost in this set.

Flyback failures

I'm beginning to get pretty sore at ———. I've been using them for quite a while, and I've had several of them burn up. They arc to the shield, flash over to anything in the vicinity, including me, and don't last more than 2 or 3 weeks. They run hot, too. What do you think about this situation?—H.S., Comstock, Mich.

Like yourself, I have used ——— (a very well known brand of flyback transformers) for many years now, and I have never had the trouble you describe. From the symptoms you gave, including the fact that all of the troublesome sets were within a mile or so of the river, I'd be tempted to say that this was mainly a humidity problem.

Notice that most of the troubles seem to originate in flashovers, and that you say all are running hot. One thing which *must* be checked when replacing a flyback is the operating temperature. Check horizontal output tube plate current, screen dissipation and so on. If a flyback is run above *normal* operating temperatures, it will be prone to softening of the wax and flashover trouble. This can happen to any flyback under these circumstances.

So my recommendation would be to check the replacements for temperature very closely, before returning them to their homes by the river. Also, it would be a very good idea to give them a little help in the form of additional insulation. Try spraying about three coats of Krylon or a similar acryl-

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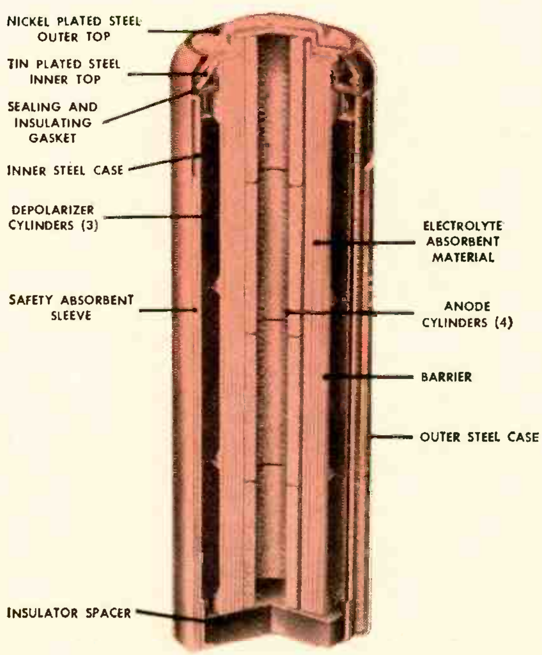
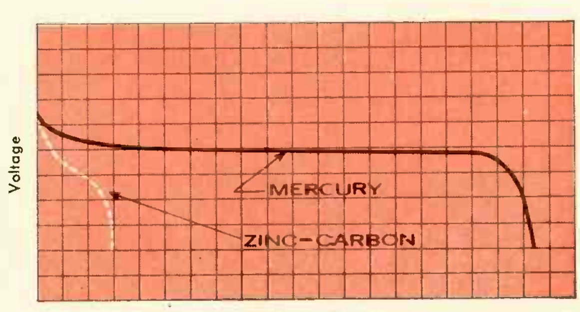
The new generation of batteries ...how to use them





You may not realize it, but dry batteries used in modern electronic circuits are as different from old style dry cells as 1962 autos are from the Model T.

Of primary interest to you as a technician is the mercury battery. Instead of the ordinary combination of zinc, carbon, and electrolytic compounds, Mercury batteries use mercuric oxide and a zinc amalgam in combination with an alkaline electrolyte. This chemical system produces a dry battery uniquely matched to solid-state electronic circuits. For example, Mercury batteries have about four times the milliampere-hour capacity of ordinary batteries of the same physical size.

Not only do mercury batteries contain more actual power, they hold this power for long periods of time. Ordinary batteries start to lose power from the instant they are assembled *whether used or not*. On the other hand the storage life of a mercury battery is amazing. We've had some on storage test for more than nine years . . . AND THEY'RE STILL ALIVE.

Perhaps the best thing about mercury batteries is their steady output voltage. It stays nearly constant throughout the entire life of the battery (see chart). Ordinary battery voltage drops steadily. Constant voltage is important in solid state circuits . . . it means constant gain and linearity.

Terminal voltage on a mercury cell is 1.35 volts $\pm\frac{1}{2}\%$! This is so accurate there's a special multi-voltage reference battery (Pt. No. 303113) that's widely used as a secondary voltage standard. It's excellent for setting scopes, meters, etc., and all sorts of lab work. We'll be happy to send complete information. Just ask.

Mercury batteries are a Mallory development. We like to think we're experts on them. But we know there are jobs a mercury battery shouldn't do. Jobs where very high surge drains or continuous heavy drains are required . . . flash cameras, flashlights, movie cameras, etc. So we developed the Mallory Manganese Battery. It's the king of heavy drain batteries . . . with excellent storage life and moderate price.

There are literally dozens of other battery systems available from Mallory. We simply don't have space to go into them here. But if you're interested in rechargeable batteries, or ultra low temperature types, or extreme low or high voltage types, or other exotic types, write to Dept. 762. We'll send the information.

Meanwhile, when you need a battery for a grid bias circuit, or a portable instrument, or a transistor radio, use a Mallory Mercury Battery. For flashlights and similiar applications use Mallory Manganese Batteries. You can get them from your Mallory Distributor. He's the man to see for Mallory capacitors, controls, switches, semiconductors, and vibrators . . . and for all your electronic requirements.

ic plastic into the flyback cage, letting each coat dry for at least 2 hours. Apply extra insulation, such as Colman's High-Voltage Putty, to points where arcing is apt to show up—the high-voltage rectifier socket wiring, the tire, core and so on.

You could write to the manufacturer and give him the same story. If there is anything defective in these transformers, as there *could* be, he will be happy to take care of it. I enclose his address.

Agc making trouble

In a G-E 14T009 TV, the grid of the first video if reads 0.1 volt instead of −0.5 volt, and the rf amplifier is the same. Other voltages are tolerable. Oh, for the good old days when there was room to work in a TV set.—C. W., Rio Vista, Calif.

I suppose we all sigh for the good old days when there was more room to work in TV sets. I know I do. This circuit takes the agc voltage directly from the video detector, through R159, 220,000 ohms and R156, 2.2 megohms (Fig. 7). A 0.2-μf and an 800-pf capacitor are used for filtering.

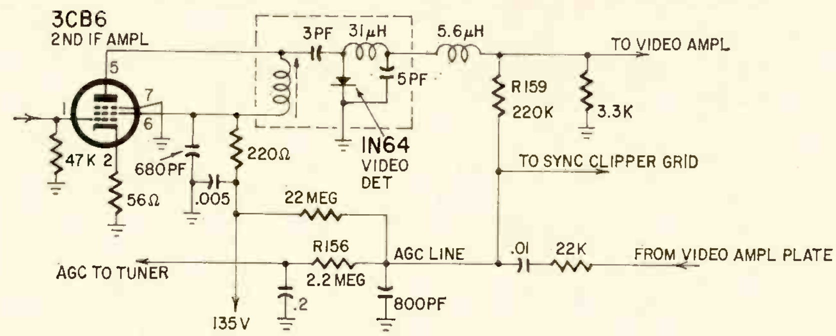


Fig. 7—Agc circuit in the G-E 14T009.

I'd suggest checking the video detector crystal, by replacement, measuring the value of the agc filter resistors and checking the filter capacitors for leakage. You might also check the .01-μf coupling capacitor between the sync clipper grid and the video output plate for leakage. This could be bucking out some of your agc voltage if any positive voltage was leaking through here. The correct voltage on the 6AU8 sync clipper plate is −2.8 volts. If this is incorrect, that capacitor is probably leaky.

Vertical trouble

Though all resistance and voltage readings check ok, I've still got vertical troubles in a Muntz 721TS TV. It rolls when first turned on, then holds for a while, then rolls again. I've heated the resistors with a soldering iron and checked all the capacitors and tubes.—A. G., Cleveland, Ohio.

You've certainly done all the right things so far! Ordinarily, you would have caught it. So the trouble must be somewhere else. First, try free-wheeling the vertical oscillator by disconnecting the sync. See if it will run close enough to the right frequency to allow a picture to be held on the screen with the vertical hold control only. If not, change some of the resistance values, or the capacitors, until it *will* free-wheel at the proper frequency. This will make it easier for the sync to hold.

If this doesn't work, check the amplitude of the vertical sync. I have a feeling that this is your trouble. Check the sync separator, integrator network and sync circuits.

CRT life too short

Are there any factory modifications that could be used to prolong the life of picture tubes in a 21-inch RCA chassis KCS-96B? It's gone through two picture tubes in less than 3 years. The third (rebuilt) tube is already using a booster.

The chassis is working normally, since I can get a perfect picture every time I put a new picture tube in it.—J. M. K., Aiea, Hawaii.

You're making an unwarranted assumption that the chassis is OK because it gives a good picture with a new CRT. Many things could be responsible for this trouble: high ac line voltage at the user's home, excessively high voltage on the tube, misset ion trap, etc. If I were you, I'd measure the heater voltage, also check the rest of the operating voltages.

If the filament voltage on the CRT is too high, try installing a small resistor to hold it down to about 6 volts.

To the best of my knowledge there are no factory modifications on this chassis dealing with CRT life. If all the operating voltages are OK, we have had very good life on this chassis.

I'd suggest using either a new CRT or a guaranteed factory-rebuilt tube the next time. Don't use off-brand rebuilts.

Video washout

We have an Admiral 20A7 in the shop that has all the symptoms of a bad CRT. But when we put a check tube on the set, we get the same symptoms! People's faces have patches of silvery light on foreheads, shirt fronts

and highlights; no detail at all in these places. The more the brightness and contrast are increased, the more this spreads.—W. R., Oak Harbor, Ohio.

This is video trouble! I wasted a good deal of time on a Philco with exactly the same symptoms not too long ago—loss of focus, washout of highlights. I replaced the video amplifier tube, which checked perfectly good, and the symptoms disappeared.

This effect, I'm sure, is due to gas in the tube. You're getting upper-knee saturation of the tube, at a much lower level than you should. This *could* be due to trouble in the plate circuit, but seems to be caused mostly by gassy tubes. Check the peak-to-peak amplitude of the video signal at the input of the picture tube. Compare the waveform you get here with that on the grid and you'll see what is happening. I expect you'll find a definite flattening of the video, not clipping but flattening from the white side. END

Technical Publication on Phonograph Record

"MUSIC FROM MATHEMATICS" IS THE name of a new record (Decca DL9103) which, its authors state, "constitutes a publication of several years of work carried out at the Bell Telephone Laboratories." The authors are J. R. Pierce, director of research of the laboratory's Communications Principles Div., M. V. Mathews and N. Guttman. The record is the result of work on the constitution of sound waves, undertaken with the help of an IBM 7090 computer and digital-to-analog output equipment, to change the digital sequences to musical sounds. The selections on the computer vary from pure experiment with various shapes of waves to arrangements of well known musical pieces and, in one case, an English song. The piece "Bicycle Built for Two," arranged by M. V. Mathews, illustrates how far synthesis of human speech has progressed since the Voder of the '30's. The words of the chorus could be mistaken for those of a human voice by anyone not aware of the nature of the record. The larger number of pieces are composed or arranged by Pierce or Mathews, with one by Guttman and others by three outside composers.

Reversing the usual "technical paper", in which a report is read and then supplemented by a demonstration, this "publication" is supported by a paper of some 15 pages entitled "Musical Sounds from Digital Computers." This, however, does not reach purchasers of the record, who do get a shorter report printed on the back of the record jacket. END

Puzzled about Hum-m?

By ANTHONY PRASIL

THE ARTICLE "PUZZLED ABOUT HUM" BY Norman H. Crowhurst which appeared in the January 1961 issue is excellent. It especially interests me because for many years I have been designing and building very-low-noise preamplifiers, both vacuum-tube and transistor types. Since these are required to amplify signals as small as the Johnson noise of the input resistance (between 1 and 10 μv, depending on the system bandwidth), the slightest amount of hum pickup is very obvious and must be eradicated. Doing this sort of work, one soon learns the many pitfalls which may be encountered and the way to cure the trouble at hand. You also learn to avoid the same mistakes in future designs.

One point which Mr. Crowhurst did not mention is important to those who may be building transistor preamps for magnetic phonograph pickups, microphone inputs or other low-level inputs. These must be hum-free, but may be mounted near a turntable motor or a power supply transformer or choke in a 60-cycle magnetic field which induces excessive hum in the signal circuits.

A vacuum tube is a high-impedance voltage-operated device. It is susceptible to pickup from *electric* fields which can induce voltages in high-impedance circuits. This type of pickup can be eliminated. Simply place conductive metallic shielding between the source of the disturbing field and the place where the voltage is induced in the signal circuit.

Transistors are current-operated devices used with low-impedance components and circuits. *Electric* fields have little effect in producing hum pickup. *Magnetic* fields, however, can produce hum currents in these circuits. The lower the impedance, the greater the hum. Unfortunately, electrostatic shielding does not attenuate a 60-cycle magnetic field. Magnetic shielding of high-permeability iron is not available to the average experimenter and does not completely eliminate the trouble anyway. It merely reduces it.

The typical symptom of 60-cycle magnetic field pickup is a transistor preamp that picks up hum even when it is completely enclosed in a metal box. The hum magnitude changes as the preamp is moved or turned about so that it changes its orientation in the ever-present stray magnetic field. There will be some orientation that gives minimum or zero hum pickup. Invariably, it will be at an angle that makes it impossible to mount the preamp.

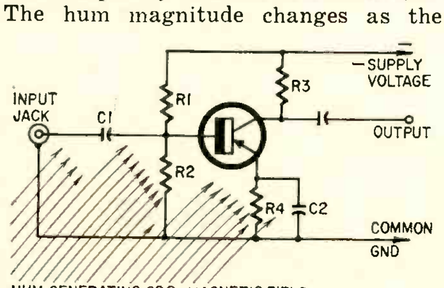


Fig. 1—This wiring arrangement is no good if you are trying to keep magnetic hum to a minimum.

The next question is: How can an amplifier be designed so it is immune to the magnetic hum field, or, if we have an amplifier that is plagued by this trouble, how can we cure it?

The amount of pickup is proportional to the amount of magnetic flux enclosed by the critical loops in the circuit. The most critical part of any circuit is generally the input circuit, where any disturbance is amplified by all of the amplifier stages. The loop formed by the signal input lead to the transistor, from the transistor to ground and the ground back to the input, is the most critical and the wiring should be laid out so that it encloses the least area and consequently the least amount of magnetic flux. Fig. 1 shows the right and Fig. 2 the wrong way to lay out wiring for minimum hum pickup.

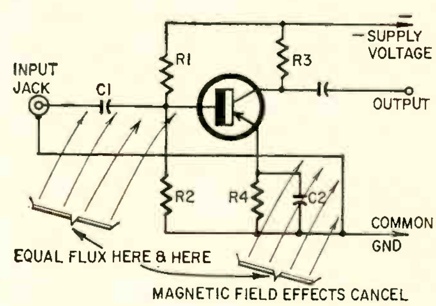


Fig. 2—Slight change in wiring makes circuit relatively hum free.

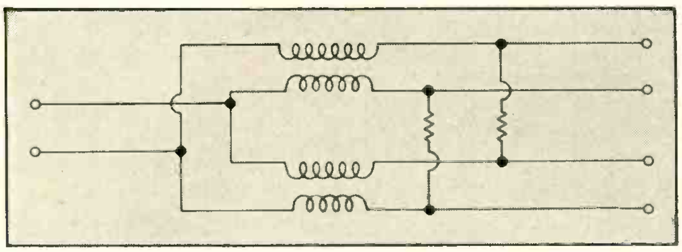
The input loop shown in the illustration consists of input coupling capacitor C1, the base-to-emitter conductance of the transistor, and emitter bypass capacitor C2. Base-bias resistors R1 and R2 and emitter-bias resistor R4 are not a part of the loop. Their resistance is considerably higher than the capacitors' reactances. In the "wrong" circuit configuration, a great many magnetic flux lines are enclosed in the loop, causing hum. In the "right" configuration, there are fewer lines of flux within the loop, and there are also an equal number of flux lines on each side of the point where the ground wire to the input connector crosses the emitter lead. Because of this crossover, the induced hum on one side is in the opposite polarity to that induced on the other side, and, if the areas on either side are equal, the two hum components being equal and opposite will cancel.

Thus for nothing more than careful attention to wiring layout, the finished product can be made immune to the effects of 60-cycle fields ordinarily encountered. END

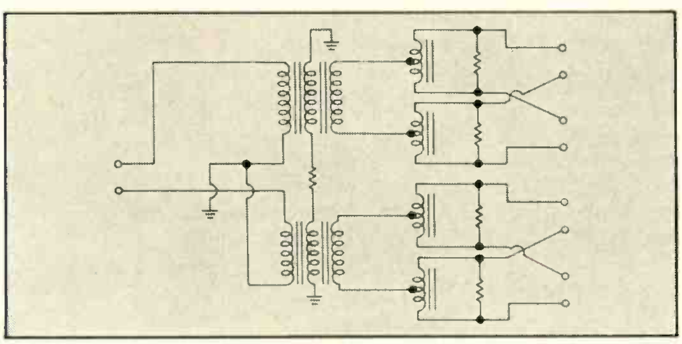
THE SECRET'S IN THE CIRCUIT

BLONDER-TONGUE TV/FM COUPLERS

You can't tell a coupler by its case. However, a view of what's inside can tell you why a coupler will deliver clean, interference-free signals to a multi-set installation. Examine the circuitry of Blonder-Tongue couplers. Compare them with ordinary units. It's easy to see why they are the best selling quality couplers on the market.



THE TIME TESTED BLONDER-TONGUE A-102
This is the champion performer among all 2-set couplers judged on the basis of its popularity with technicians and TV viewers. The A-102 offers 12 db isolation *with only 3 db insertion loss*—half the insertion loss of the average 2-set coupler! Designed for both TV and FM, it is especially effective in weak signal areas. For FM stereo, this low loss hybrid type unit is the answer. A look at its circuitry will tell you why. • patented bifilar transformers • backmatched for precise impedance match • heavy conductors end burnouts. List $3.20



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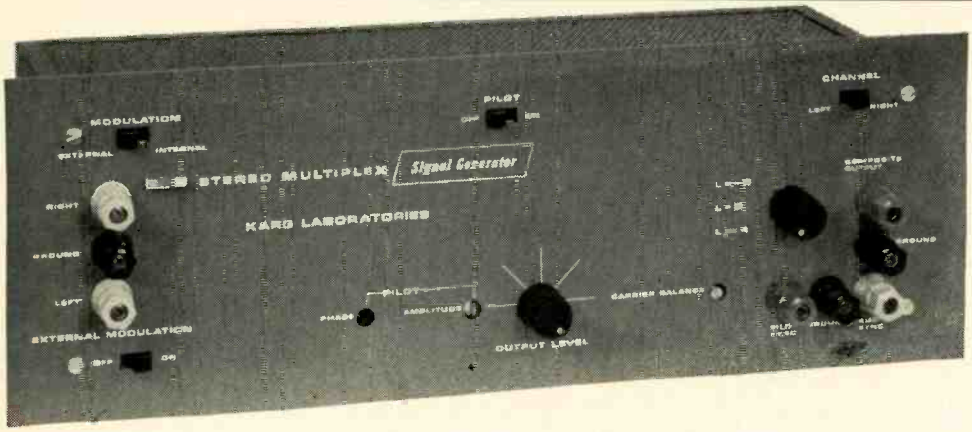


Ideal for the service technician who plans to work on FM stereo receivers

By GEORGE MORDWINKIN*

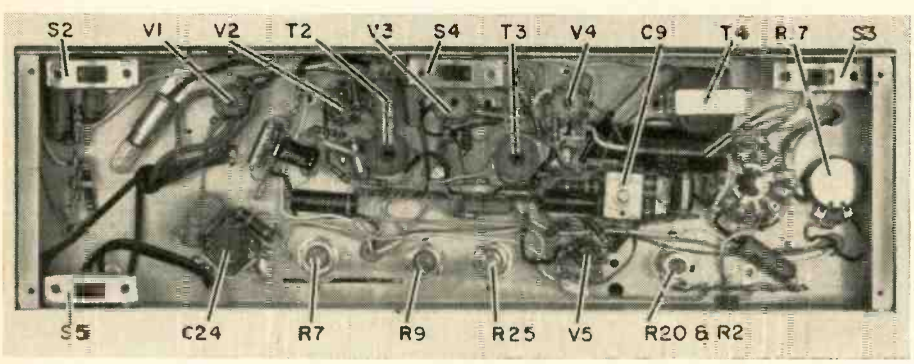
NEW LOW-COST FM STEREO GENERATOR

SERVICING FM STEREO ADAPTERS AND tuners is rapidly becoming a new field for the service technician. With the proper test equipment, such work can be handled easily and accurately. But the cost of such equipment, running from $400 to $1,000, is high.

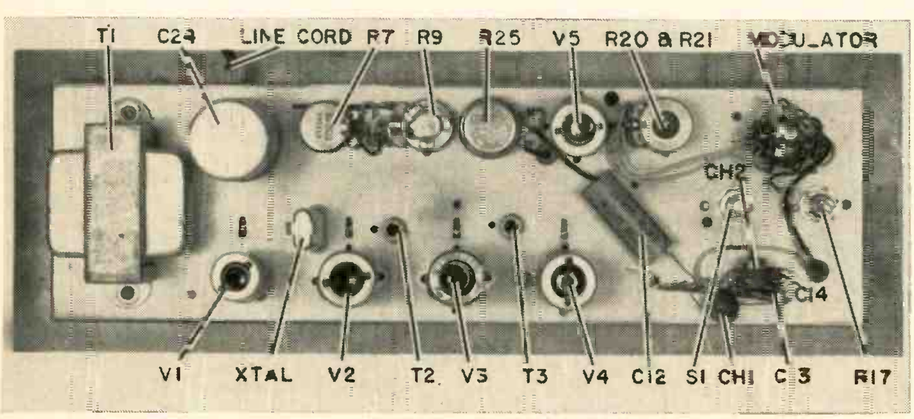
To help to solve this problem, Karg Laboratories Inc. has produced the MX-1G Generator at a lower cost (approximately $250). It does everything the technician needs, but uses simpler circuitry.

* Associate engineer, Hancock Telecontrol Corp.

The MX-1G produces a composite waveform similar to the modulating signal of stereo broadcasting stations (thus such a generator can also be used as a stereo modulator for closed-circuit broadcasting in a showroom demonstration). The composite waveform consists of the audio signal sampled at 38 kc and the 19-kc pilot signal at an amplitude 10% that of the total signal.



Removing front panel reveals bottom of chassis.



Top of chassis with major components identified.

The generated signal can be applied in three ways:

1. *Right or left channels only.* This signal is the one most important to the service technician, because it allows him to adjust for maximum separation between channels.

2. *Right and left channels fed simultaneously with the audio signal at the same phase* ($R = L$). This condition simulates a monaural signal.

3. *Right and left channels fed simultaneously with audio signals at 180°* ($R = -L$). This signal is usually used to check the balance of both channels.

The amplitude of the 19-kc pilot is usually 10% of the composite signal, but can be decreased to determine the minimum pilot-signal level that will sync the local oscillator. The stability of the local 19-kc oscillator can be checked after alignment by switching off the 19-kc pilot from the generator.

A block diagram of the multiplex generator is shown in Fig. 1. The 19-kc oscillator is a conventional crystal-controlled type. As you can see from the schematic (Fig. 2), it uses a twin triode (V2). The primary of transformer T2 is connected to the plate circuit of the second triode and tuned to 19 kc by capacitor C2. Its core is adjusted for maximum amplitude.

T2's secondary feeds a phase-shift network which produces variable (0° to 90°) phase shift. This network is varied by potentiometer R7.

When switch S4 is OFF, it disconnects the 19-kc pilot from the composite output waveform. When it is *on*, the 19-kc pilot feeds the cathode-follower stage, where R9 controls the amount of pilot signal in the output signal (relation of the 19-kc amplitude to the composite signal amplitude).

V3-b, the audio oscillator (approximately 1 kc), produces the audio frequency for modulation purposes. It is a phase-shift oscillator using a plate transformer. The secondary of this transformer delivers split-phase balanced output. The two phases are then applied to the cathode followers (V4) to match the low impedance of the modulator.

If frequencies other than the internal 1-kc tone are desired for testing, connect an external audio oscillator to the EXTERNAL MODULATION terminals on the front panel. S2 disconnects the internal audio source and connects the terminals for the external audio into the circuit. The same terminals are used to modulate the generator with stereo program material.

Outputs from cathode followers V4 are applied to S1, the MODE SELECTOR. In position 1, S1 in combination with S3 feeds right or left channels of the modulator. In position 2, S1 feeds both channels the same signal in the same phase. In position 3, S1 feeds both channels the same signal, but 180° out of phase.

The modulator is basically an eight-diode gate. The audio signals are sliced at 38 kc and then mixed into one composite signal. The dual potentiometer (R20–R21) controls the dc level of the both channels to correct the symmetry of the waveform.

The 38-kc subcarrier is applied to the modulator from T3's secondary. C8 tunes T3's primary to 38 kc and this tank circuit is connected to V3-a's plate.

The grid of this doubler tube is connected through C7 to T2's secondary, which feeds the 19 kc. For synchronizing a scope, there are two test jacks on the front panel—one for audio and the other for the 19-kc pilot frequency.

The output circuit consists of a cathode-follower stage and filter. The output signal level is controlled by R25, which serves as partial cathode resistor of the output stage. C9 takes care of phase compensation for the high-frequency signal component. R17 in the modulator circuit is used to balance the 38-kc signal.

The 19-kc (PILOT SYNC) test jack can also be used to inject the SCA carrier. When SCA carrier is applied, S4 should be OFF, so the 19-kc pilot does not appear in the output waveform. END

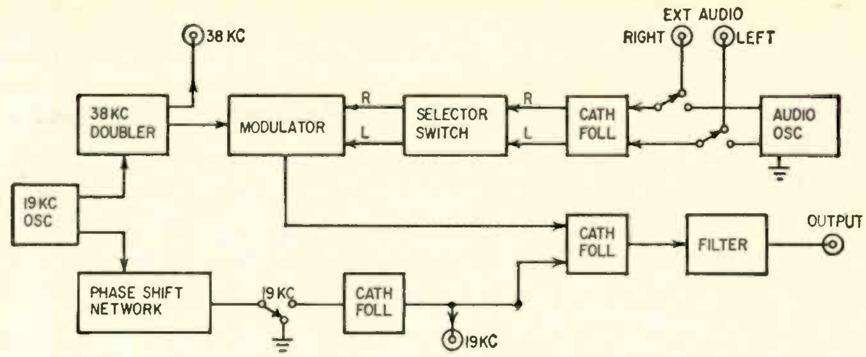


Fig. 1—Block diagram of the stereo generator.

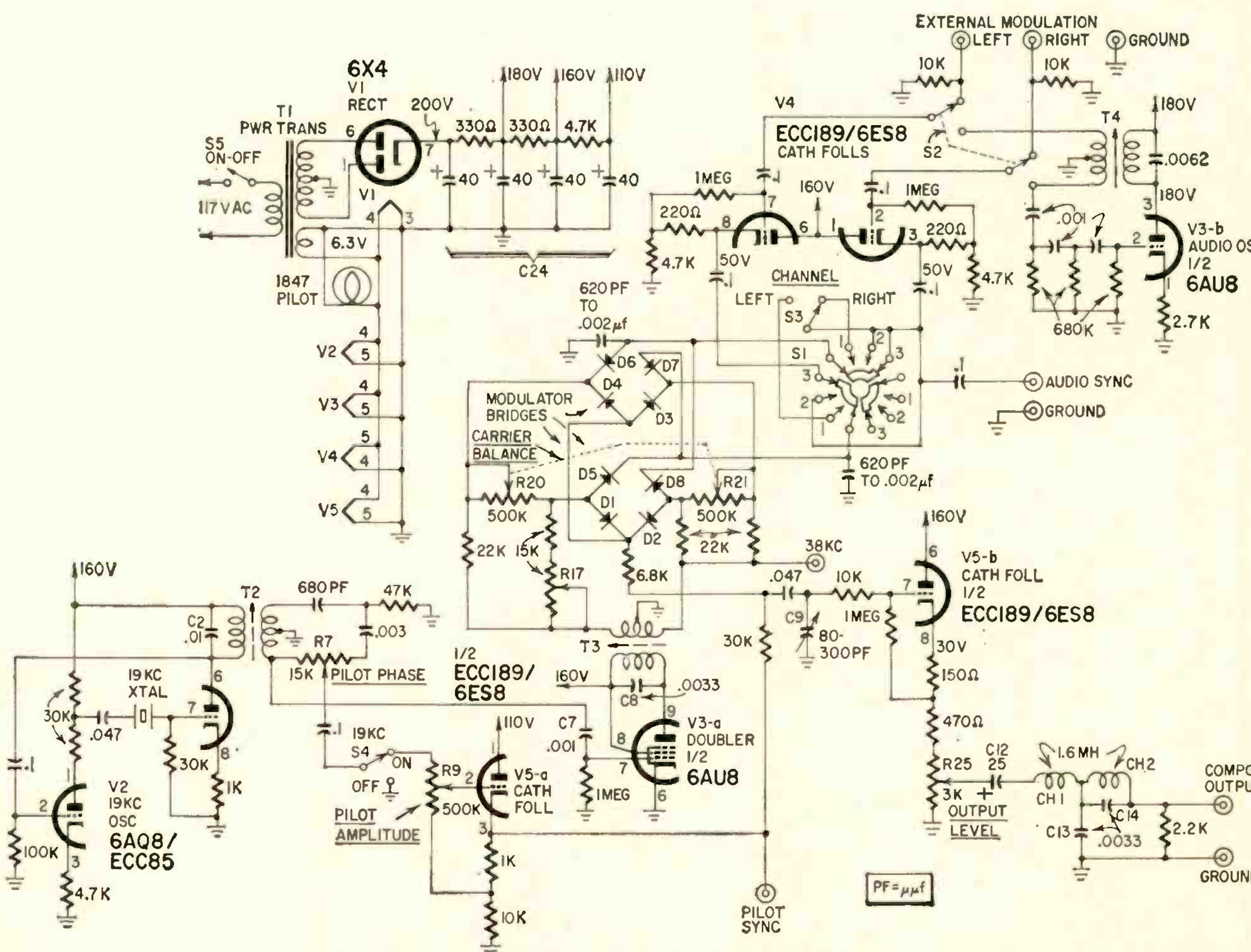
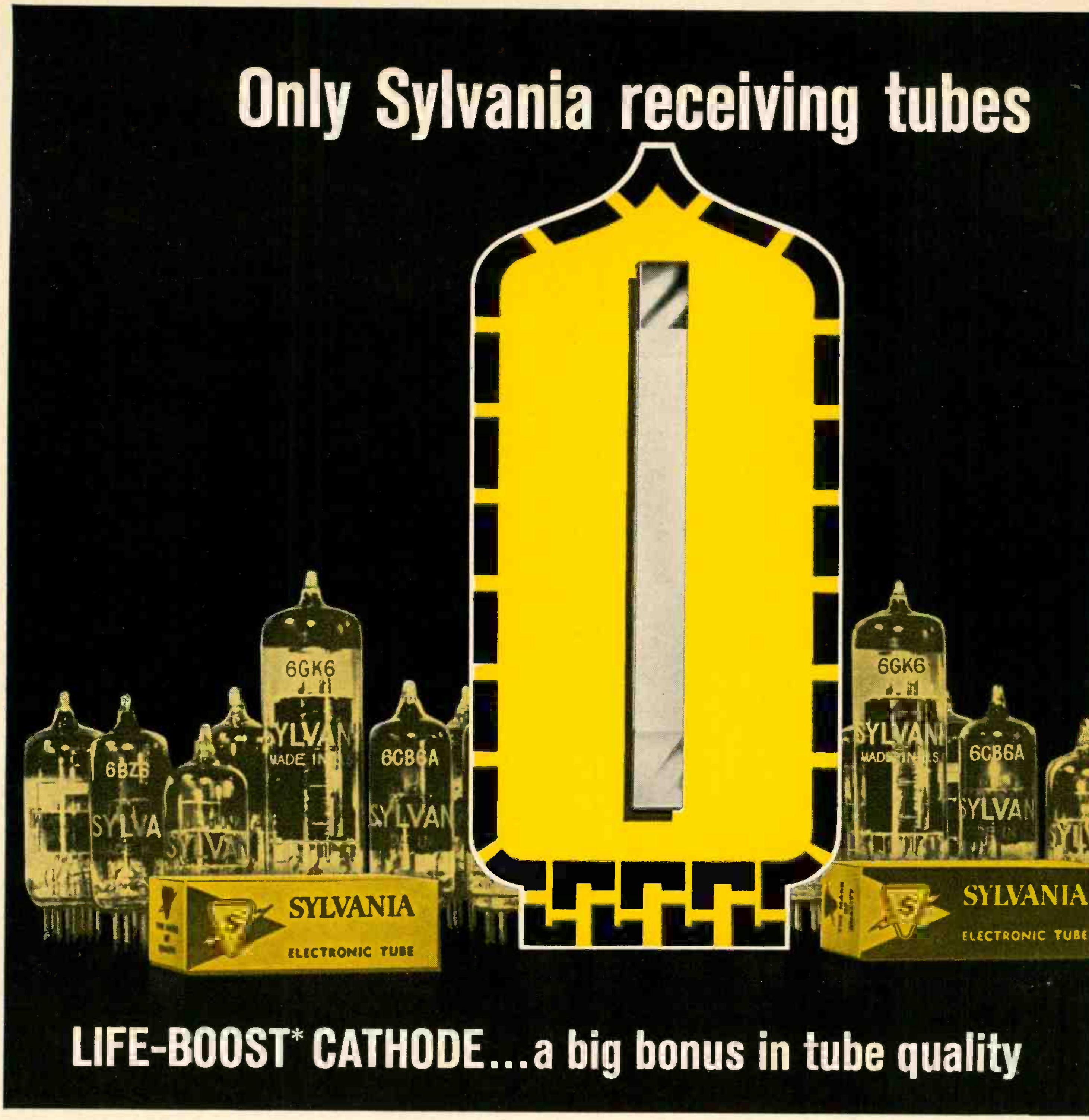


Fig. 2—Circuit of the Karg Labs MX-1G FM stereo generator.



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KEEP Your Scope LINEAR... *if it isn't,*

it can lead to errors in TV servicing

By WM. DARRAGH

I've received several questions lately about horizontal nonlinearity in oscilloscopes. This can be annoying and sometimes causes trouble diagnosing faults.

Fortunately, nonlinearity is pretty easy to check, with only the simplest equipment. Just put a signal known to be linear on the scope and set the horizontal sweep to show about four cycles on the screen. Set the horizontal gain so that the pattern just touches both edges of the screen.

A 400-cycle audio signal from an rf signal generator, or a square wave from an audio generator, or four frames of a TV signal, taken from the video detector or video amplifier circuit are suitable (Fig. 1). If the horizontal amplifier is nonlinear, it'll promptly tell you. You'll spot crowding at one side of the pattern when it should be exactly the same all the way across. If you step back 4 or 5 feet, nonlinearity will become more apparent than if you're very close to the screen.

If the scope isn't linear, what do we do about it? This trouble is always caused by a fault in the scope's horizontal amplifier or oscillator. Since a scope CRT always uses electrostatic deflection, the horizontal sweep must generate a perfect voltage sawtooth and not the familiar trapezoidal waveforms of TV (Fig. 2).

Obviously, if there is anything in the scope amplifiers that will distort the voltage sawtooth, the electron beam will not be deflected at the same rate as it passes across the screen, and we'll have nonlinearity (Fig. 3). With a perfect sawtooth, the beam travels across the screen at a constant speed. With a distorted sawtooth, flattened or peaked, the speed is not the same all the way across and we've got nonlinearity.

Older scopes used single-ended horizontal and vertical deflection amplifiers, while the later and more expensive models use push-pull deflection (Fig. 4). Most of the troubles seem to be in this amplifier stage, although there is always the possibility that they're in the oscillator, so don't overlook it.

You've undoubtedly had many cases of trouble in TV sets with vertical nonlinearity. We've got the same trouble here. If you find that characteristic

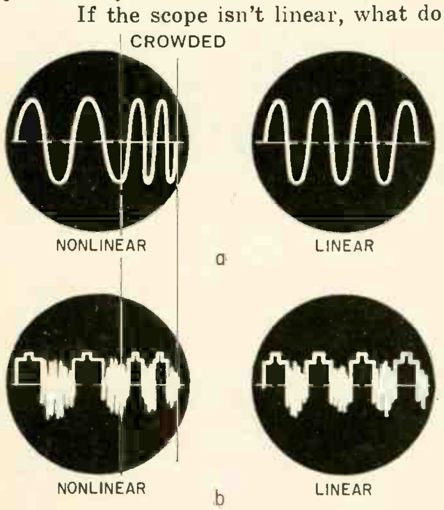


Fig. 1—a—Nonlinear and linear waveforms of sine-wave patterns. b—Nonlinear and linear waveforms of composite video patterns.

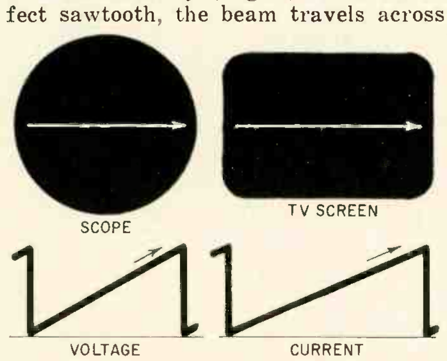


Fig. 2—Perfect sweep waveforms for scope or TV. Sawtooth voltage on scope (electrostatic) or current wave on TV (electromagnetic) deflection makes electron beam travel all the way across the screen at a constant speed.

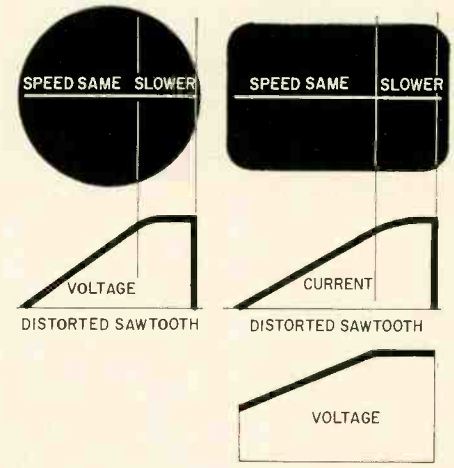


Fig. 3—Any defect that causes the sawtooth to change shape will cause nonlinearity. Flattening of the top, shown here, causes a nonlinear sweep.

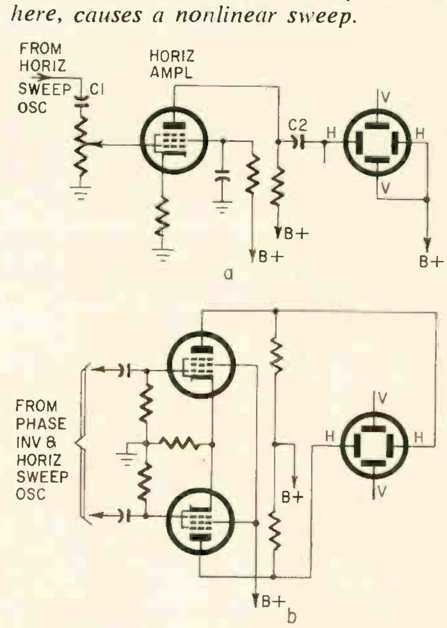
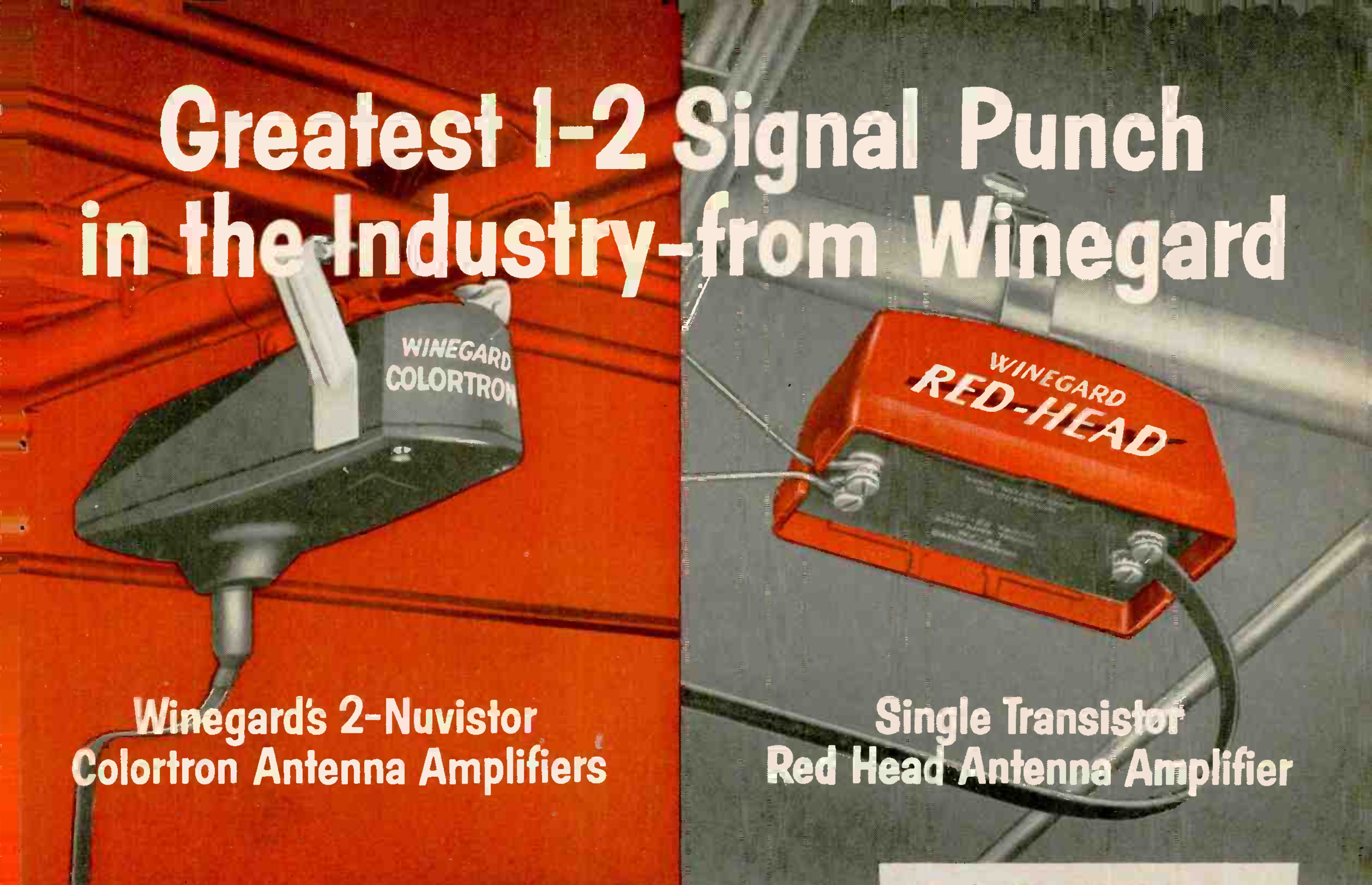


Fig. 4—a—Single-ended horizontal deflection stage in typical scope. b—Push-pull horizontal deflection stage in typical scope.



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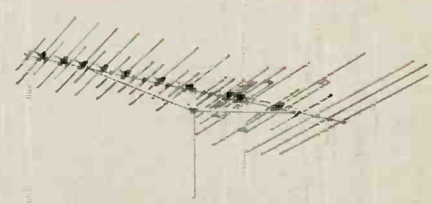

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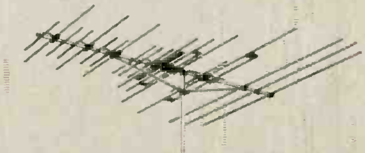

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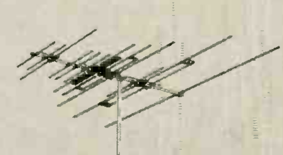

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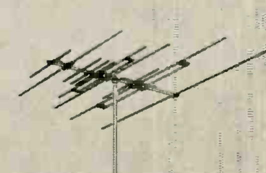

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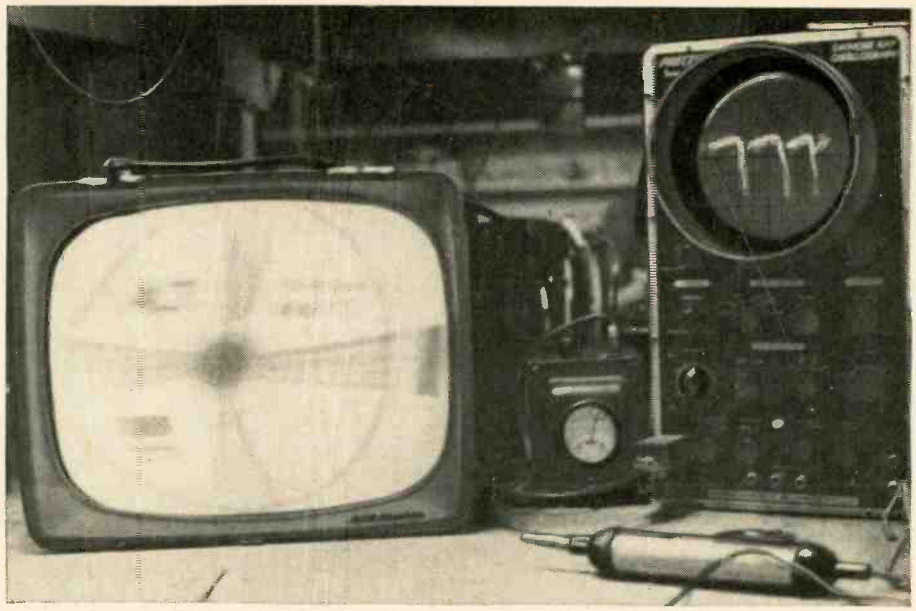


The scope on this bench is displaying a square wave with severe compression on the right edge of the screen.

flattening of the top of the sawtooth, there is the cause of your nonlinearity. So check the same things—plate load resistors for a change in value, especially in push-pull stages. If a load resistor changes too much, our tube won't be operating on the linear portion of its E_P/E_G curve, and our "saw" gets very dull. Even the slightest dc leakage through a coupling capacitor will throw the stage off the proper place on the curve. Bias voltages are very important too. They determine the operating point of the stage. Therefore, check all resistors and capacitors for leakage and value. In most commercial circuits you won't normally find the cathode bypasses used in TV sets; but you might, so check the schematic carefully. A defective cathode bypass would be an excellent place to find linearity troubles.

While the relaxation oscillators used in most commercial scopes, especially the older models, do not seem to cause too much of this kind of trouble, it's a good idea to check them while you've got the instrument out of the case! There isn't too much to the circuit: a plate load resistor; grid resistor, sometimes two, and the cathode resistor with its bypass capacitor. Check the grid resistors and cathode resistor closely for any signs of increase in value. This would cause an increase in grid bias, and increasing the bias above "normal" is one of the easiest ways to make this type of oscillator get very highly nonlinear!

Also, in difficult cases, check the supply voltages. Be sure they are very close to what the schematic calls for. If the supply voltage to a relaxation oscillator is below normal, the first result is nonlinearity. Since we're trying

Trying to service with a scope waveform like this is impossible. It is so badly distorted that the technician won't be able to tell whether there really is a fault in the TV or not.

to deal with scopes in general here, rather than one specific model, we can't give definite voltages. However, they will always be found in the instruction book.

If another scope is available, waveforms can be checked at each point in the circuit, beginning with the horizontal oscillator. However, this is not essential. The pattern on the screen will give you all the information you need.

Oh, you did check the tubes, didn't you? If not, you certainly should have. A weak tube will cause this kind of trouble very quickly. If it isn't able to put out its full normal output, the curve will definitely be flattened on top. It's a good idea to try one or more tubes in this circuit, even though they are all new ones. We just avoided a long and tedious service job on one occasion by substituting a second new tube. It seems that there was something wrong with the first new one.

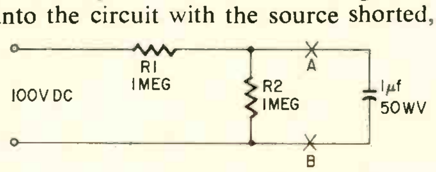
If a square-wave generator is on hand, check the vertical circuits at the same time. Watch for tilt, high- and low-frequency response and things like that, as well as nonlinearity. In fact, while you've got the thing out of the box, it would be a good idea to go over it thoroughly. Check power supplies, tubes, clean controls with a spray cleaner, look for signs of corrosion on the high-voltage rectifier socket, and give it a "going over" in general. There is nothing quite so annoying as a service instrument that doesn't work just right! END

These are the answers. Puzzles are on page 44.

WHAT'S YOUR EQ?

Time constant

The maximum voltage the capacitor sees is the steady-state dc voltage of 50 across R2. Using Thevenin's theorem, the resistance that the capacitor sees is between points A and B, looking back into the circuit with the source shorted,



or the equivalent of R1 and R2 in parallel, or 500,000. Note the circuit is broken at points A and B when determining the Thevenin equivalent resistance.

How much voltage?

1. E across the two capacitors = $0.9E_{in} - 0.6E_{in}$

2. E across the 1-μf capacitor = $2/3(0.9E_{in} - 0.6E_{in})$

3. E across the 10,000-ohm resistor = $0.1E_{in}$

4. $2/3(0.3_{in}) - 0.1E_{in} = 10$
Therefore, $E_{in} = 100$ volts dc.

That Resonant Problem

The capacitor voltage is maximum at resonance and equal to Q times the input voltage, E. The resonant frequency is $0.159/\sqrt{LC} = 159$ cycles. The inductive reactance at resonance is $2\pi fL = 1{,}000$ ohms. The circuit Q at resonance is $Q_r = X_L/R = 100$. Therefore the peak voltage the capacitor must withstand is QE = 100 volts.

Series resistor circuit

The solution is:

$$\text{(A)}\ \frac{E \times R2}{R1 + R2} = 24$$

$$\text{(B)}\ \frac{E \times R2}{R2 + \dfrac{100 \times R1}{R1 + 100}} = 40$$

$$\text{(C)}\ \frac{E\,\dfrac{100 \times R2}{R2 + 100}}{R1 + \dfrac{100 \times R2}{R2 + 100}} = 20$$

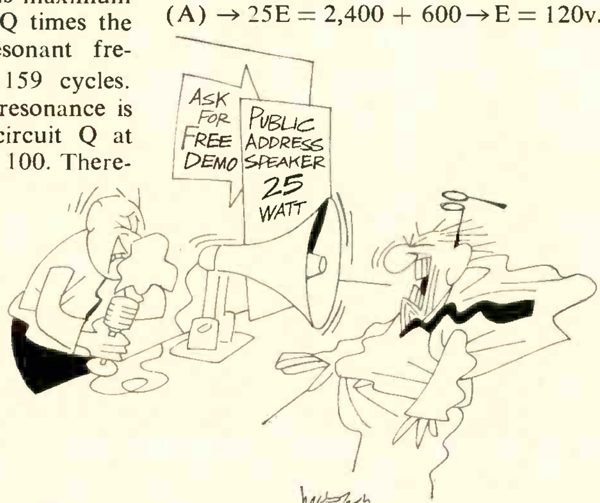
$$(2C = B) \rightarrow 200R2E = 100R2E + R1R2E \rightarrow R1 = 100 \text{ ohms.}$$

$$(A) \rightarrow R2E = 24R2 + 2{,}400$$

$$(B) \rightarrow R2E = 40R2 + 2000$$

$$24 \times R2 + 2{,}400 = 40R2 + 2{,}000 \rightarrow R2 = 25 \text{ ohms.}$$

$$(A) \rightarrow 25E = 2{,}400 + 600 \rightarrow E = 120\text{v.}$$



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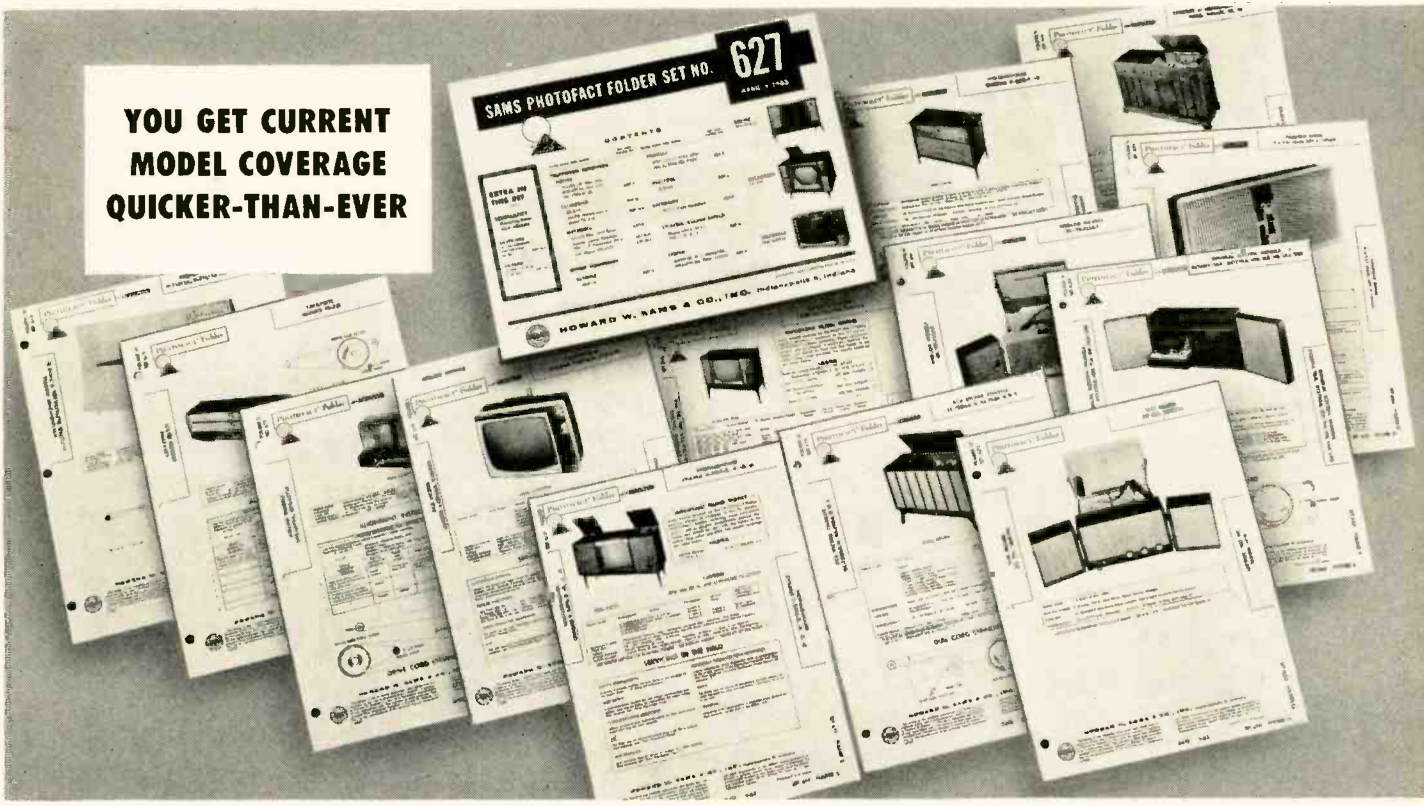

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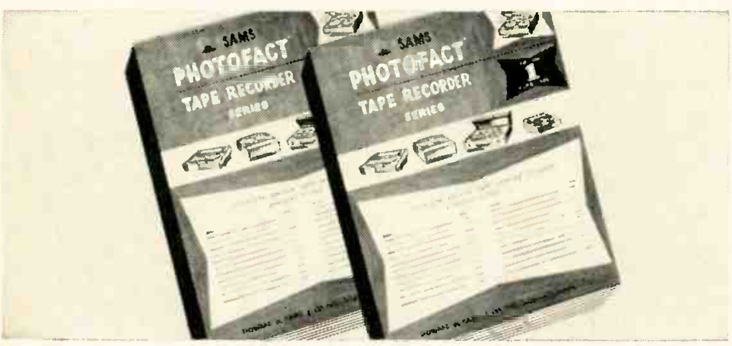

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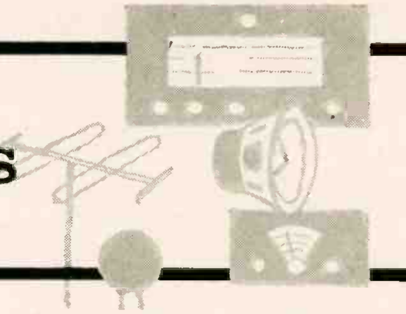


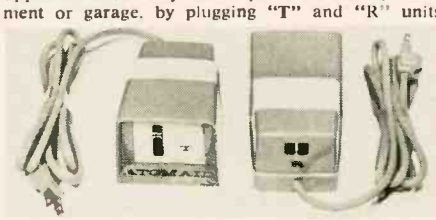
SOLID-STATE LINEAR SAWTOOTH GEN. *Model L3SG* generates time variable sawtooth voltage function with constant slope, linear to .1% over voltage rise. Seven selectable full-scale time periods 100 μsec–100 seconds. Each full scale period has vernier adjustment for 1.000 discrete divisions. *Model L3SG-1* provides for any single full-scale time period 100 μsec–100 seconds, 1,000-division vernier. Both units self-compensating. stable periods and slope linearity for temperature and line voltage variations. Mode selector switch pro-

vides free-running repetitive sweep or external triggered sweep. Voltage swing 0 to +10; temperature −20°C to +70°C; period resolution 1 part in 1,000 min. period on lowest range 10 μsec; power requirements +25 v ±10%, 50 ma, −5 v ±10% 10 ma. Output impedance 100,000 ohms.—**Waddell Dynamics, Inc.,** 5841 Mission Gorge Rd., San Diego 20. Calif.

CONSTANT VOLTAGE DC POWER SUPPLY, *Model RPS-5.* Continuously variable, delivers any voltage to 30 vdc. For applications up to 4 watts. Zener-regulated transistorized circuit maintains constant voltage with no overshoot over wide load variation. Panel light indicates short circuit. Reads output in ranges 0–1.5, 0–15, 0–30 v;

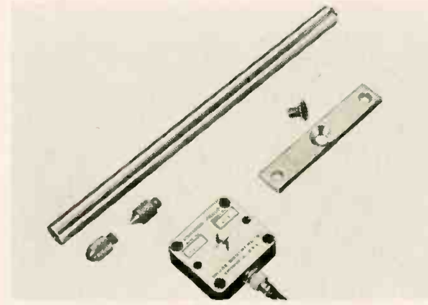
reads load current in 0–30. 0–150 ma ranges. Current metering does not affect output impedance. Special bias taps 0–1.5 and 0–7.5 v provided for simultaneous use with main supply. Regulation .5% average (1% max.) to load. 5% to line. Output impedance 1 ohm; meter accuracy 2% full scale; response time 2 μsec.—**Seco Electronics. Inc.,** Dept. 164, 1201 S. Clover Dr., Minneapolis 20, Minn.

ELECTRONIC REMOTE CONTROL SYSTEM, *Atomaid.* Allows remote operation of any appliance from any other place in house, basement or garage. by plugging "T" and "R" units



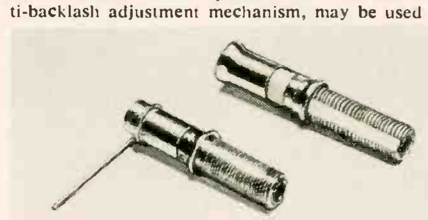
into 110 volt outlets. No additional wiring. Power handling capacity 1 kva.—**Gentronics,** 3224 16th Ave. W., Seattle 99, Wash.

VIBRATION PICKUP, *Model 61CP.* Withstands temperatures −40°F–180°F, 0–100% humidity. Lead zirconate titanate generating element



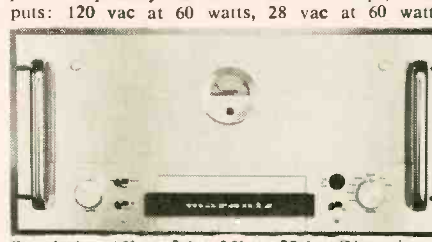
inertially actuated. May be permanently mounted or hand-held, using probe to transmit vibration. Use of probe allows measurement in temperatures above 180°F. Supplied with complete set of adapters, 8-inch extension rod, ball tip, point tip, conductor cable and mounting bracket. Output voltage directly proportional to acceleration due to vibration throughout linear range. Signal proportional to velocity from R-C integrator. Normal sensitivity on axis: 85 mv/g ±2.0 db. Cross-axis sensitivity less than 7% of on-axis sensitivity. Internal impedance 9,000 pf. Linear frequency range to 1,000 cycles. Resonant frequency 3.000 cycles ±15%. Dynamic range 100 g.—**Shure Bros., Inc.,** 222 Hartrey Ave., Evanston, Ill.

MINIATURE TRIMMER CAPACITORS, *Plus-C.* Panel mount capacitors have modified anti-backlash adjustment mechanism, may be used as



replacements for older components of corresponding part number. Gradual multi-turn adjustment, 500-cycle adjustment life. Special units available with capacitance range to 180 pf.—**JFD Electronics Corp.,** 6101 16th Ave.. Brooklyn 4, N. Y.

CONSTANT VOLTAGE AMPLIFIER, *Series 9120.* May be fed any frequency 20–20.000 cycles via external audio sig gen; max. continuous duty power capability 60 watts (60 volt-amps). Outputs: 120 vac at 60 watts, 28 vac at 60 watts.



Regulation 1% to 5 kc, 3% to 20 kc. Distortion at full output less than 1/10% at mid frequencies, less than ⅓% at 20 cycles and 20 kc. Response −1 db at 50 kc, −3 db at 100 kc. Drives small shaker tables. varies speed of small synchronous motors. tests aircraft instruments and equipment requiring line-voltage frequency other than 60 cycles. Power requirements 105–125 vac. 50/60 cycles.—**Marantz Co., Inc.,** 25-14 Broadway, Long Island City 6, N. Y.

HI FI TAPE RECORDER, *Model 660.* 3-channel, portable unit has ac bias circuit for record, playback, erase heads. Remote control mike, earphone, batteries, cartridge, roll of tape and take-up reel. Ac adapter available as accessory. Two hours playing time; can be operated inside

(Continued on page 76)

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Make a Priceless Family Heirloom—*The Easy Tarzian Way*

Next time the family gets together for a special occasion... and everytime a high point comes along in the lives of the children and grandchildren...be sure to record the events on long-lasting Mylar*-base Tarzian Tape. The tape will last indefinitely—and so will your pleasure—with a priceless heritage of voices and events unique to your family. Such moments can seldom be repeated, but thanks to Tarzian Tape they can always be remembered.

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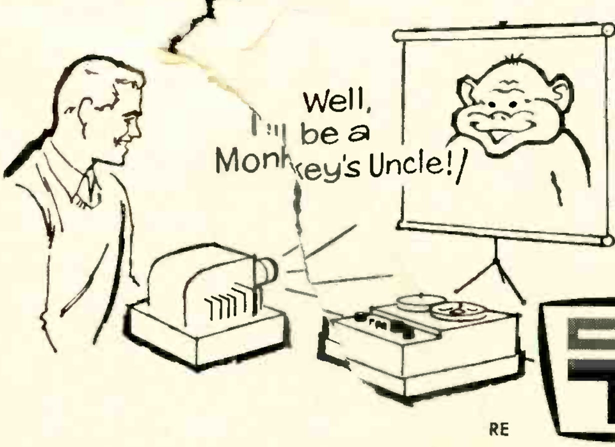
Tape recorders and Tarzian Tape pep up your movie and slide shows just as Rodgers worked with Hammerstein—good separately, outstanding together. In addition to straight commentary and music, other voices and sounds can be taped from radio and TV for use as needed—applause, traffic, etc. Speaking of taping from radio and TV, if you use a microphone try wrapping it lightly in a handkerchief to cut down on unwanted outside noise. You're even better off to eliminate the microphone. Obtain a recorder accessory cord with input plug on one end, and alligator clips on the other. The clips can be attached directly to the speaker voice coil.



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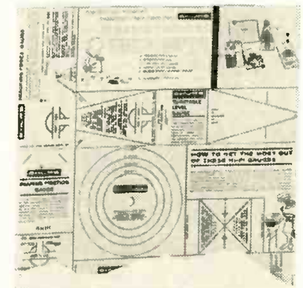
(Continued from page 70)

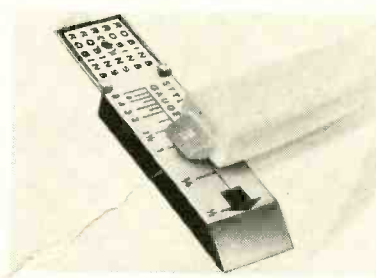
case.—**Citroen Electronics Corp.**, 729 N. Highland Ave., Los Angeles 38, Calif.

GADGET GAUGE. For do-it-yourself record-player testing. Perforated card with assembly instructions forms tools to test tracking force, bearing friction, turntable level, arm set-down, stack



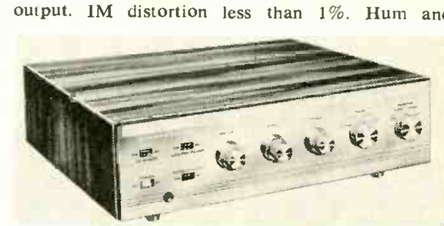
clearance, stroboscopic disc.—**Shure Bros., Inc.**, 222 Hartrey Ave., Evanston, Ill.

STYLUS GAGE, *Model SG-2.* Measures tracking force any stylus/cartridge assembly 8 grams to ½ gram. Calibrated in ½-gram increments, works



on balance principle with permanently placed counterbalance weights.—**Robins Industries Corp.**, 15-28 127 St., Flushing 56, N. Y.

22-TRANSISTOR STEREO AMP—KIT, *Model KT-900WX.* Music power output 120 watts into 8 ohms, 60 watts per channel; 76 watts into 4 and 16 ohms, 38 watts per channel. Response 10–25,000 cycles ±1 db, .5% harmonic distortion at rated output. IM distortion less than 1%. Hum and



noise —68 db. Front panel controls: separate concentric bass, treble, volume; 4-position input selector, rumble filter switch, loudness control, scratch filter switch. Two ac outlets in rear. For 105–120 volts, 50/60 cycles ac.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

CERAMIC MICROPHONE, *Model C47D Hot Head.* For CB, amateur, marine, commercial, other communications applications. Average output level —48 db over 300–4,000-cycle range. Polar pick-up pattern, differential to 600 cycles, cardi-

oid 600–4,000 cycles. Dpdt push-to-talk switch can be rewired for special applications; 3-conductor

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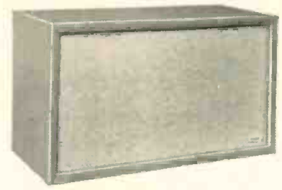

ACOUSTIC SUSPENSION SPEAKER Kit version of the AR, Inc. AR-2A with genuine AR-2A speakers; 10" woofer, two 5" mid-range, 1⅜" super tweeter. **AS-2A, from $89.95**

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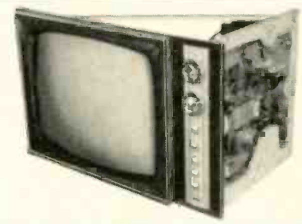

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City____________________ Zone______ State______ neoprene coil cord, spring hang-up clip.—**Euphonics Corp.**, Guaynabo, Puerto Rico.

MICROPHONE SHOCK MOUNT, *Model VM-1*. Has male and female ⅝-inch 27 thread for insertion between mike and stand. Made of die

castings, brass turnings, chrome finish. 4¾ x 1 in. diam.—**Atlas Sound Div.,** American Trading & Production Corp., 1419-51 39 St., Brooklyn 18, N. Y.

CB MIKES. Response 80–7,000 cycles, output —54 db. *Model 356C* has hanger button and standard dash mounting bracket; 11-inch retracted, 5-foot extended coil cord, wired for relay operation. *Model 254C* (*illus*). Desk type ceramic

mike for CB base station use. Extra set of contacts allows wiring into any amateur or CB set. Touch-bar and lever-lock on-off switch.—**Turner Microphone Co.,** 901 17 St. N.E., Cedar Rapids, Iowa.

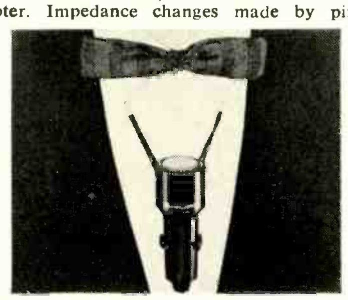
WOOFER, *Model G12P*. Heavy cone stock in parabolic shape. Directional-grained, dual-diameter Alnico V magnet produces flux density equal to 21.5 oz. Alnico V as used in conven-

tional magnetic circuit. 1½-in. diam. voice coil, 4-way terminals. Response 25–1,500 cycles, peak power handling capacity 30 watts. For use with 8-ohm, 600-cycle crossover.—**Utah Electronics Corp.,** 1124 E. Franklin St., Huntington, Ind.

8-INCH, DUAL-CONE LOUDSPEAKER, *Model C-835*. Profile depth 2 13/16 in. Supplementary apex radiating element integrated with primary radiating diaphragm (cone) and driving coil. SYNTOX-6 ceramic magnet. Optional 70.7- or 25-volt factory-installed transformer, KWIKON

instant connectors for input and power tap adjustment. Power rating 10 watts, response 35–18,000 cycles, 95 degree coverage angle, sound pressure level 84 db at 10 ft. for 1-watt input. Nominal impedance 8 ohms, resonant frequency 70 cycles.—Commercial Sound Products Dept., **Jensen Mfg. Co.,** 6601 S. Laramie Ave., Chicago 38, Ill.

LAVALIER MICROPHONE, *Model 560*. Dual-impedance, dynamic mike may be used hand-held, on floor or desk, with *Model A25B* Swivel Adapter. Impedance changes made by pinjack-



terminal setup inside case. Response 40–10,000 cycles, rising characteristics to 4,500 cycles. Omnidirectional polar pattern. Impedance: high and 150–250 ohms. Non-detachable 18 ft, 2-conductor shielded cable. Wt. 5 oz.—**Shure Bros., Inc.,** 222 Hartrey Ave., Evanston, Ill.

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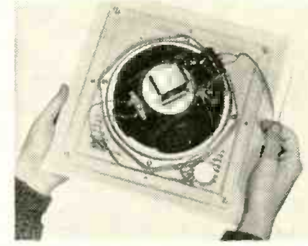
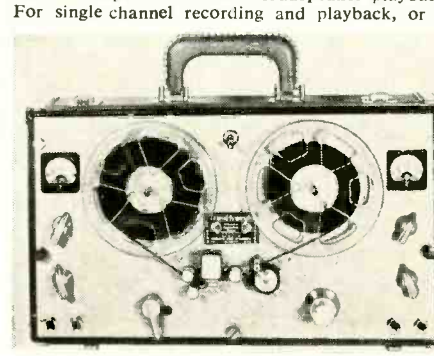


former, L-pad, on-off switch, volume control, etc. Selection of Jensen and Oaktron speakers.—**Wald, Inc.,** 119 Prospect Ave., Burbank, Calif.

MOBILE TEACHING LAB, *Vocalette*. For small classes, study groups. 12 noise-cancelling headphone/mike units for individual student use.

Console-type instructor's control panel has tape recorder, switch panel, student switches for 12 stations. Teacher can monitor, record and correct student practice.—**Rheem Califone Corp.,** 5922 Bowcroft St., Los Angeles 16, Calif.

BATTERY-OPERATED STEREO TAPE RECORDER, *Series 314*. Portable unit for field use. Two channels for stereo recordings, independent gain adjustment. Recordings fed into any dual-channel amplifier for stereo loudspeaker playback. For single channel recording and playback, or 2-

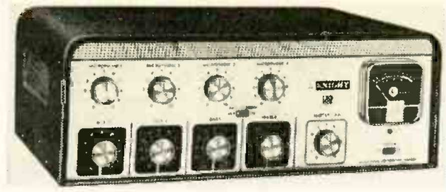


channel stereo recordings may be played non-stereo on any half-track recorder. Electric motor operates from small dry replaceable or rechargeable batteries. 22 transistors, 2 diodes, 2 isolated inputs. Separate VU meters. Multiple-shielded motor uses special auxiliary noise suppressors. Single and multi-speed models.—**Amplifier Corp. of America,** 398 Broadway, New York 13, N. Y.

AUTOMATIC DEMAGNETIZER for manufacturer's tape recorders, *Models 997* and *1057*.

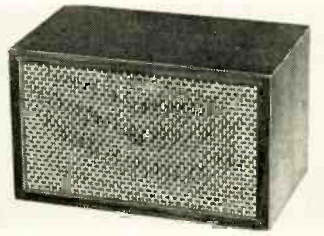
Self-contained head demagnetizer used once a week eliminates residual magnetism.—**Roberts Electronics, Inc.** 5920 Bowcroft St., Los Angeles, Calif.

50-WATT PA AMPLIFIER, *Model KN-3050*. Full mixing of 4 mikes, remote mixing facilities, sockets for plug-in low-impedance mike transformers, calibrated sound level meter, separate bass and treble controls, master gain control. Balance controls for output tubes and hum; boost and cut-type tone controls; anti-feedback control, pilot light. Output jack for simultaneous recording.



Response ±1 db, 30–20,000 cycles at rated output. Hum and noise 75 db below rated output. Input required for rated output: mike .006 v; auxiliary .25 v; mag phono .012 v. Outputs 4, 8, 16 ohms; 25 and 70.7 volts; tape recording output. Power consumption 160 watts at 120 volts, 60 cycle ac.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago.

MINIATURE HI-FI SPEAKER SYSTEM, *Kit AS-81U* unfinished, *Kit AS-81W* walnut, *Kit AS-81M* mahogany. Response ±6 db 65–14,500 cycles. 6-inch woofer has mass-loaded cone, 10-oz.

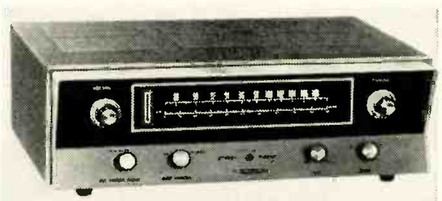


Syntox magnet. 3-inch tweeter. Power-handling capacity 6 watts peak. 8-ohm impedance. 10¾ x 6½ x 6⅜ in.—**Heath Co.**, Benton Harbor, Mich.

FM/AM POLICE RECEIVERS. *Model HE-51*, 30–50 mc, crystal-controlled and tunable. *Model HE-52*, 145–175 mc, tunable only. 3-stage

i.f., built-in squelch circuit. 4-in. speaker can be cut out with slide switch for headphone operation.—**Lafayette Radio Eectronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

FM/FM MULTIPLEX TUNER, *Model AJ-12*. Receives mono FM and FM multiplex stereo. Built-in FM multiplex converter on circuit board, stereo indicator light, stereo phase control, adjustable afc, bar-type "eye" tuning indicator, edge-



lighted slide-rule tuning dial, flywheel tuning mechanism. Each output filtered to eliminate interacting beatnotes for off-the-air stereo tape recording. Front end of tuner factory assembled and aligned. Unit matches AA-151 stereo ampl.—**Heath Co.**, Benton Harbor, Mich.

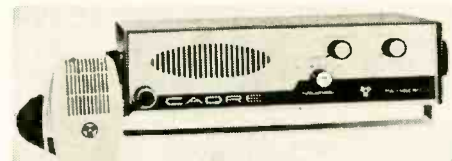
TRANSISTORIZED CB RADIO, *Model CB-5*. For auto installation. 6-channel coverage,

5-watt input, battery drain 1.9 amps. Transistorized superhet receiver, noise limiter, push-to-talk mike, self-contained speaker, agc, squelch circuit. Transmitter uses 3 instant-heating miniature tubes. —**Hallicrafters Co.**, 4401 W. 5th Ave., Chicago 24.

6-CHANNEL MOBILE CB TRANSCEIVER, *Drake M-506*. 8 x 3 x 9-in. unit can be converted to 23 channels with manufacturer's all-channel switch. Rear-lighted channel indicator. Transistor dc power supply may be mounted in any location in vehicle. 5-watt plate power input, 3.5-watt power output to antenna. Harmonic suppression 50 db down, frequency stability .005%, receiver

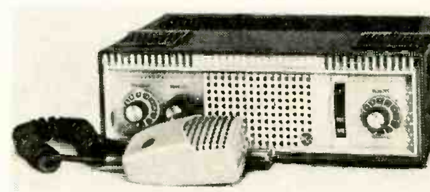
sensitivity 0.4 μv for 10-db signal-to-noise ratio. Selectivity 5 kc at 6 db, adjacent channel 60 db down. Mike and one crystal included.—**Browning Labs, Inc.**, 100 Union Ave., Laconia, N. H.

5-WATT CB RADIO. *Model 515*. Transistor, modular construction. Five crystal-controlled channels, miniature crystals available for any of 23 channels. Dual-conversion superhet receiver with tuned ceramic filters, built-in dual power supply 12 vdc/110-220 vac. Audio frequency response 300–3,000 cycles ±3 db. Built-in speech



limiting, squelch, agc, noise limiting. Miniature jack for earphones or external speaker. Complete with ac and dc power cords, mounting bracket, dynamic mike. Separate matching rechargeable battery pack adapts unit to lightweight portable transceiver.—**Cadre Industries Corp.**, Commercial Products Div., 20 Valley St., Endicott, N. Y.

CB RADIO, *Mark VIII*. 27-mc 2-way radio operates on 115-vac power supply. Separate dc power supplies available for 6- or 12-volt mobile operation. Nine crystal-controlled transmit and receive channels; continuously tunable receiver



picks up all 23 CB channels; tuning dial shows both channel number and frequency. Max. transmit power 5 watts plate input, 3 watts output. May be mounted on dashboard.—**RCA Electron Tube Div.**, Harrison, N. J.

STEREO FM TUNER, *Model 314A Emperor Royale*. Front panel controls for afc, interstation squelch, multiplex, noise filter, ac power. Inertia-type flywheel, edge-lighted dial, horizontal tuning indicator for on-frequency tuning and signal strength indication. Mono audio output jack permits all material to be supplied to separate mono amplifier for remote or outdoor locations. FM

sensitivity 1.2 μv, 20 db quieting. 300-ohm antenna, built-in multiplex. Separation 30 db, 50–15,000 cycles.—**Altec Lansing Corp.**, 1515 S. Manchester Ave., Anaheim, Calif.

EXPANDED-RANGE CB TRANSCEIVER, **Range Gain.** 23 crystal-controlled transmit and receive channels; 4-way illuminated meter with two scales; illuminated channel selector; antenna-matching adjustment for resistive antenna loads 30–75 ohms; 4 function switch settings for power checks; plate tuning for final amplifier, adjustable squelch. Delta tuning. ±5 kc channel center frequency, brings in stations slightly off frequency due to crystal tolerance. Speaker terminals for external speaker use with or without internal speaker. Built-in power switch activates universal

EACH TUBE ATTRACTIVELY BOXED & BRANDED RAD-TEL

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
	0Z4	.79		6AU8	.87		6K6	.63		12CU5	.58
	1AX2	.62		6AV6	.41		6S4	.52		12CU6	1.06
	1B3	.79		6AW8	.90		6SA7GT	.99		12CX6	.54
	1DN5	.55		6AX4	.66		6SH7	1.02		12D4	.69
	1G3	.79		6AX5	.74		6SJ7	.88		12DE8	.83
	1J3	.79		6BA6	.50		6SK7GT	.95		12DL8	.88
	1K3	.79		6BC5	.61		6SL7GT	.84		12DQ6	1.04
	1R5	.77		6BC8	1.04		6SN7	.65		12DS7	.84
	1S5	.75		6BE6	.55		6SQ7GT	.94		12DT5	.76
	1T4	.72		6BF5	.90		6T4	.99		12DT7	.79
	1U5	.65		6BF6	.44		6T8	.85		12DT8	.78
	1X2B	.82		6BG6	1.70		6U8	.83		12DW8	.89
	2AF4	.96		6BH8	.98		6V6GT	.54		12DZ6	.62
	3AL5	.46		6BJ6	.65		6W4	.61		12ED5	.62
	3AU6	.54		6BJ7	.79		6W6	.71		12EG6	.62
	3AV6	.42		6BK7	.85		6X4	.41		12EK6	.62
	3BC5	.63		6BL7	1.09		6X8	.80		12EL6	.50
	3BN6	.75		6BN6	.74		7A8	.68		12EZ6	.57
	3BU8	.78		6BQ6	1.12		7AU7	.65		12F8	.66
	3BY6	.58		6BQ7	1.00		7EY6	.75		12FA6	.79
	3BZ6	.56		6BU8	.70		7Y4	.69		12FM6	.50
	3CB6	.56		6BX7	1.11		8AU8	.90		12FR8	.97
	3CS6	.58		6BZ6	.55		8AW8	.93		12FX8	.90
	3DG4	.85		6BZ7	1.03		8BQ5	.60		12GC6	1.06
	3DK6	.60		6C4	.45		8CG7	.63		12J8	.84
	3DT6	.54		6CB6	.55		8CM7	.70		12K5	.75
	3GK5	.99		6CD6	1.51		8CN7	.97		12L6	.73
	3Q4	.63		6CG7	.61		8CS7	.74		12SF7	.69
	3S4	.75		6CG8	.80		8EB8	.94		12SK7GT	.95
	3V4	.63		6CL8	.79		8FQ7	.56		12SL7	.80
	4BQ7	1.01		6CM7	.69		9CL8	.79		12SN7	.67
	4CS6	.61		6CN7	.70		11CY7	.75		12SQ7GT	.91
	4DT6	.55		6CQ8	.92		12A4	.60		12U7	.62
	4GM6	.60		6CR6	.60		12AB5	.60		12V6	.63
	5AM8	.79		6CS6	.57		12AC6	.55		12W6	.71
	5AN8	.90		6CS7	.69		12AD6	.57		12X4	.47

RAD-TEL TUBE CO. NOT AFFILIATED WITH ANY OTHER MAIL ORDER TUBE COMPANY

Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price	Qty.	Type	Price
	5AQ5	.54		6CU5	.58		12AE6	.50		17AX4	.67
	5AT8	.83		6CU6	1.08		12AE7	.94		17DQ6	1.06
	5BK7	.86		6CY5	.70		12AF3	.73		18FW6	.49
	5BQ7	1.01		6CY7	.71		12AF6	.67		18FX6	.53
	5BR8	.83		6DA4	.68		12AJ6	.62		18FY6	.50
	5CG8	.81		6DE6	.61		12AL5	.47		19AU4	.87
	5CL8	.76		6DG6	.62		12AL8	.95		19BG6	1.39
	5CQ8	.84		6DJ8	1.21		12AQ5	.60		19EA8	.79
	5EA8	.80		6DK6	.59		12AT6	.50		19T8	.85
	5EU8	.80		6DN6	1.55		12AT7	.76		21EX6	1.49
	5J6	.72		6DQ6	1.10		12AU6	.51		25AX4	.70
	5T8	.86		6DT5	.81		12AU7	.61		25C5	.53
	5U4	.60		6DT6	.53		12AV6	.41		25CA5	.59
	5U8	.84		6DT8	.94		12AV7	.82		25CD6	1.52
	5V6	.56		6EA8	.79		12AX4	.67		25CU6	1.11
	5X8	.82		6EB5	.73		12AX7	.63		25DN6	1.42
	5Y3	.46		6EB8	.94		12AY7	1.44		25EH5	.55
	6AB4	.46		6EM5	.77		12AZ7	.86		25L6	.57
	6AC7	.96		6EM7	.82		12B4	.68		25W4	.68
	6AF4	1.01		6EU8	.79		12BD6	.50		32ET5	.55
	6AG5	.70		6EV5	.75		12BE6	.53		35C5	.51
	6AH4	.81		6EW6	.57		12BF6	.60		35L6	.60
	6AH6	1.10		6EY6	.75		12BH7	.77		35W4	.42
	6AK5	.95		6FG7	.69		12BK5	1.00		35Z5	.60
	6AL5	.47		6FV8	.79		12BL6	.56		36AM3	.36
	6AM8	.78		6GH8	.80		12BQ6	1.16		50B5	.69
	6AQ5	.53		6GK5	.61		12BR7	.74		50C5	.53
	6AS5	.60		6GK6	.79		12BV7	.76		50EH5	.55
	6AT6	.49		6GN8	.94		12BY7	.77		50L6	.61
	6AT8	.86		6H6	.58		12BZ7	.86		70L7	.97
	6AU4	.85		6J5GT	.51		12CN5	.56		117Z3	.85
	6AU6	.52		6J6	.71		12CR6	.67		807	.75

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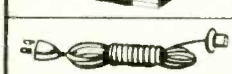

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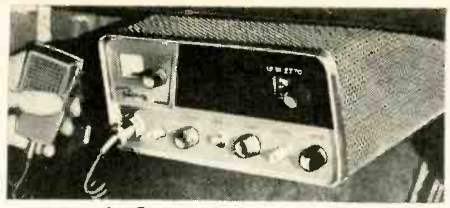


power supply. Separate volume control, adjustable automatic noise limiter. Mike input with screw-type connector permits positive connection of ceramic mike with coiled cord.—**Regency Electronics, Inc.**, Range Gain Dept., 7900 Pendleton Pike, Indianapolis 26, Ind.

SHORT-WAVE RECEIVERS, *Models WR-1500 & WR-1000*. Each has three sw bands plus extended-range broadcast band. Slide rule dial, headset jack for private listening, beat frequency oscillator. *WR-1000* (illustrated) has sw bands

1.6–30 mc. *WR-1500* has sw bands 1.6–31 mc, covers long-wave navigation and weather band. Special jack connects with hi fi system; unit acts as tuner of radio broadcasts or amplifier/speaker for record player.—**Hallicrafters Co.**, 4401 W. 5th Ave., Chicago 24, Ill.

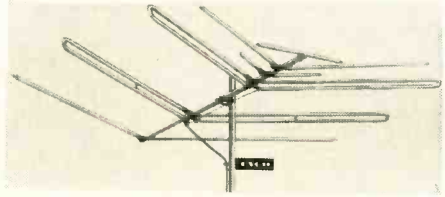
STEREO MULTIPLEX FM/AM TUNER KIT, *Model KG-50.* Pre-wired FM front end, pretuned i.f. coils, point-to-point wiring. FM tuning eye, edge-lit dial, rear-panel channel separation

control. Rf stage, 2 i.f.'s, afc. AM circuit has 10-kc i.f. bandwidth. IHFM sensitivity 3 μv, 30 db quieting. Response ±1 db, 50–15,000 cycles. I.f. and detector bandwidth 200 kc, hum and noise 40 db below 1 volt. Channel separation 30 db, FM antenna 300-ohm twin-line. AM specifications: Sensitivity 3 μv, 10 db signal-to-noise ratio; hum and noise 40 db below 1 volt; AM antenna ferrite loopstick.—**Allied Radio Corp.**, 100 N. Western Ave., Chicago 80, Ill.

ELECTRONIC FILTER, *"Q" Multiplier, Kit Model HD-11.* Built-in power supply, power light indicator. For use with any communications type receiver with i.f. frequency 450–460 kc. Produces

sharply-peaked i.f. curve for CW reception, broad peaked i.f. for phone operation or deep rejection notch to eliminate closely interfering heterodyne. Peak and notch positions tunable to any point in receiver's i.f. bandpass. Complete with connecting i.f. cable, plug and socket.—**Heath Co.**, Benton Harbor, Mich.

BROAD-BAND VHF ANTENNA, *Model*

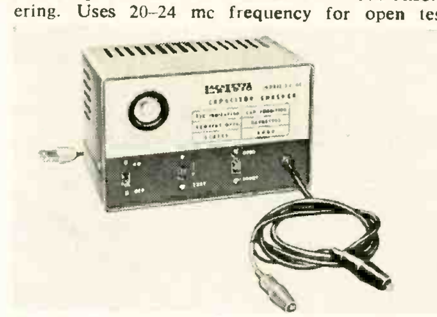


C-33, Color Guard. Average gain 10.5 db on high-band channels, 8.5 db on low-band. Uniformly flat response. Folded dipole construction, heavy phasing brace. Made of chrome aluminum alloy, gold conductive coating.—**TACO,** Technical Appliance Corp., Sherburne, N. Y.

HIGH-MODULATION FM SIG GEN, *Model 1066 B/M1.* Accepts modulating frequencies from dc to 100 kc, produces deviations to ±100 kc.

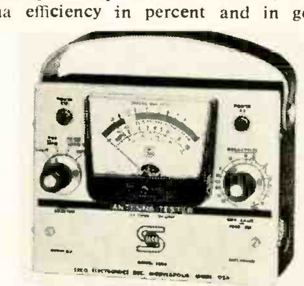
Carrier frequency variable 10 mc–470 mc in 5 bands. Direct carrier-frequency generation without amplifiers, frequency stability 0.0025% over 10-minute period. FM on CW less than 100 cycles. FM deviation variable to 100 kc, using built-in 1- and 5-kc oscillators or external modulating signals.—**Marconi Instrument Corp.**, 111 Cedar Lane, Englewood, N. J.

CAPACITOR CHECKER, *Model TE-44.* Tuning eye indicator, checks capacitors 10 pf–2,000 μf for open or shorted conditions without unsoldering. Uses 20–24 mc frequency for open test,



60-cycle for short test. Built-in power supply uses selenium rectifier. For 105–120 volts, 60 cycles ac. Complete with test leads.—**Lafayette Radio Electronics Corp.**, 111 Jericho Turnpike, Syosset, N. Y.

IN-LINE ANTENNA TESTER, *Model 520A* (illustrated). Reads antenna efficiency plus rf power output. Top scale reads in swr 1:1–8:1, antenna efficiency in percent and in good-poor.



Bottom scale, calibrated in 3 ranges, reads directly in watts—0–10, 0–100, 0–1,000. For 50-ohm coax lines. Dual air coupler rated at 1,000 watts max. Kit of accessory adapters *(Model 520AP)* has 24-inch coax cable with phone tips to coax adapter.—**Seco Electronics, Inc.**, Dept. 164, 1201 S. Clover Dr., Minneapolis 20, Minn.

SWEEPING OSCILLATOR, *Sona-sweep 1141-A.* Beat-frequency device for measurement and alignment of ultrasonic amplifiers in sonar

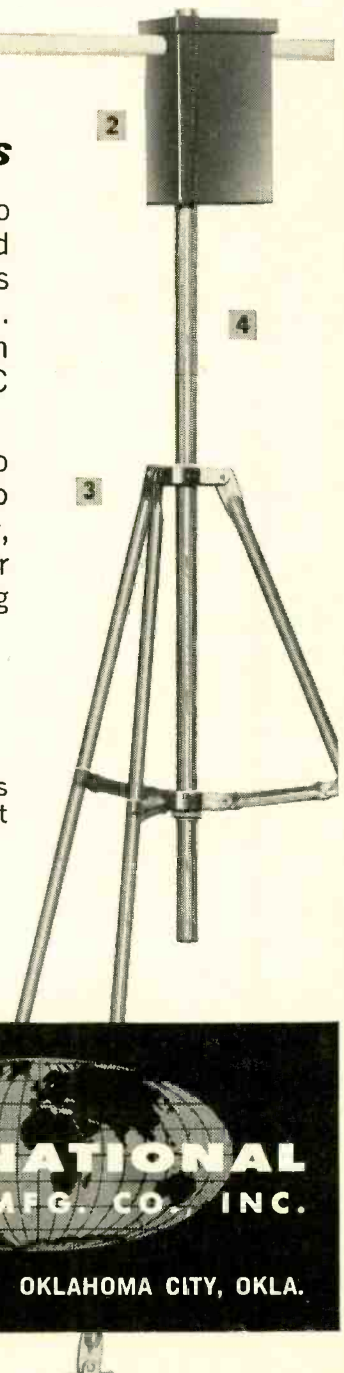
and communication systems. Frequency range 20 cycles–200 kc, available at 5-cycle sweep rate.

NEW!

INTERNATIONAL EXECUTIVE TRANSCEIVER

Model *1500*

1



Designed for the Hobbyist . . . Complies with FCC Part 15 (no license) requirements

Here is International's new Model 1500 Executive transceiver for radio communication within the 27 mc frequency range. Designed and engineered for phone and cw (code), you can talk from 1 to 10 miles with other Part 15 stations depending on the height of the antenna. You are also permitted to work skip signals 1,000 miles or more with other Part 15 stations when a band opening occurs. And . . . no FCC license is required.

This feature packed transceiver puts the maximum RF power into the antenna by combining the transmitter and antenna for rooftop mounting. A second unit houses a supersensitive receiver and exciter, while a preamplifier at the antenna boosts weak signals for better reception. Other features include a special crystal filter for reducing interference from adjacent channel Class D two-way radios.

- **100 milliwatts input / 60″ antenna**
- **115 vac operation**
- **Phone and CW**
- **Eight channels . . . crystal controlled**
- **27 mc frequency range**

A complete, "ready to go", package. 1 receiver/exciter complete with 8 sets of crystals, 2 transmitter/antenna assembly, 3 antenna mount, 4 5 foot mast, 5 100 feet of control cable, 6 microphone, 7 key for (CW)

Model 1500 transceiver complete..............................$299.50*

See the Model 1500 transceiver at your International dealer.
* other models from $80.00

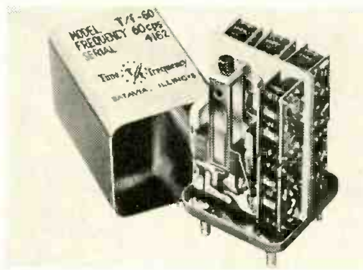
INTERNATIONAL CRYSTAL MFG. CO., INC.

18 NORTH LEE • OKLAHOMA CITY, OKLA.

Write today for International's 1963 catalog.

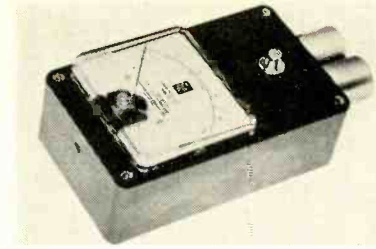
Sweep width 0–2 kc, 100 cycles–20 kc; sweep rates 30 cycles locking in line, 5–25 cycles manually variable. Crystal-positioned, pulse-type standard markers at 50, 100, 200 kc, usable singly or collectively, may be varied with specs. CW oscillator may be used to generate variable pulse marker. Attenuation switched 20, 20, 10, 6, 3 db plus 6 db variable. Rf output 0.25 volts rms into 70 ohms flat to ±0.5 db. Power supply input approximately 160 watts, 117 volts, 50/60 cycles ac B+, electronically regulated. Sweep output has regular sawtooth synchronized with sweeping oscillator, approximate amplitude 7 volts. Marker amplitude positive pulse, continuously variable 0–10 volt peak. Separate marker output.—**Kay Electric Co.**, Dept. R E, Maple Ave., Pine Brook, Morris County, N. J.

TUNING FORK OSCILLATOR, *Model T/f-60.* Subminiature, 60-cycle oscillator has accuracy ±.00001%, stability ±.0025%, over temperature range −56°C–+100°C. Accuracy maintained without use of oven heat. Hermetically sealed in a



1-19/32-in. square, 2⅜-in. high steel case. Output signal 60 cycles, square wave output 14v p-p from specified input 12–60 vdc. Current drain less than 60 ma. In military and commercial models.—**Time & Frequency**, 127 S. Batavia Ave., Batavia, Ill.

PORTABLE ELECTRONIC TACHOMETER, *Model 24.* Transistor unit measures speed of any revolving or reciprocating device (0–2,400 rpm) without electrical or mechanical contact. Accurate to ±2% of full scale reading of 2,400 rpm. Self-contained, portable. Built-in battery power sup-

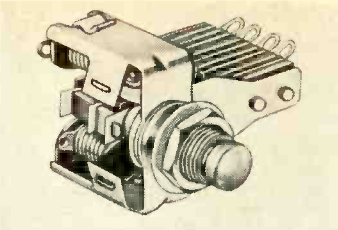


ply.—**Pioneer Electric & Research Corp.**, 743 Circle Ave., Forest Park, Ill.

CRT CHECKER/REJUVENATOR, Model *CR125.* Dc used on all checks to correlate with tube manual data. Makes inter-element shorts test, cathode emission, dynamic control grid check, life test, cathode and control grid rejuvenation, shorts removal, cathode welding. Tube rejuvenation and short removal done with special R-C timing network. All tests performed without spe-

cial adaptors by use of cable with all six crt sockets. Color guns checked and rejuvenated individually.—**Sencore, Inc.**, 426 S. Westgate Dr., Addison, Ill.

ILLUMINATED PUSH-BUTTON SWITCHES, *NF-Lite.* Flat-frame, leaf-type momentary action switches for control panels and press-to-test applications. Wide range multiple pole switching from single spst normally open to 3pdt.

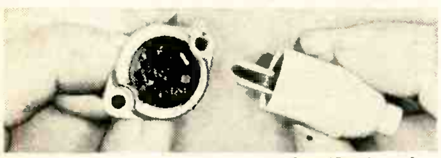


Contacts fine silver, rated at 3 amps, 120 volts, ac, non-inductive load. Lamp voltages 6 and 28; Lamps in snap-out assembly. *Series 4100* single lamp, *Series 4200* (*illustrated*) dual-lamp switch. Both mount in single 3/8-in. diameter hole.—**Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago 30, Ill.

EPOXY CONDUCTIVE CEMENT, *K20*. Two-part filled epoxy system. Initial volume resistivity 0.02 ohm-cm holds constant to over 100°C. When cement is aged at 150°C, initial

resistivity drops to 0.0007 ohm-cm, rises to 0.0009 ohm-cm at 150°C. Mixing ratio one-to-one by volume. Available in self-metering tube kit (illustrated) or in bulk. Cures in 24 hours at room temperature, optimum properties obtained when cured 2 hours at 60°C.—**Hysol Corp.**, Olean, N.Y.

LOUDSPEAKER PLUGS, SOCKETS, *Series*

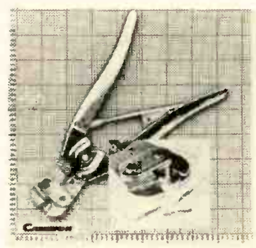


8-8145. Available with off contact at 180° changeability; without off contact; without changeable contact, to be used in place of closed-circuit phone jack. 9/16 x 9/16-in. plug has snap-action assembled plastic housed 2-pin configuration with metal strain relief. Sockets of molded phenolic. Metal mounting brackets in 9 configurations provide screw holes and/or rivet flanges.—**Telephone Dynamics Corp.**, 32 Sunrise Highway, Baldwin, N. Y.

ANTI-STATIC RECORD CLEANER, *Foam Coat*. Round polyurethane sponge, treated with manufacturer's Lubri-Stat, cleans record surfaces.

Twelve packs mounted on easel-type display board for wall hanging or counter display.—**Fidelitone, Inc.**, 6415 Ravenswood Ave., Chicago 26, Ill.

CRIMPING TOOL, *Part No. 3525*. Heavy, nickel-plated steel. Handles pull apart to open jaws to full distension. Once crimping starts, jaws



will not release until closed completely. **Cambridge Thermionic Corp.**, 445 Concord Ave., Cambridge 38, Mass.

Specifications from manufacturer's data.

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with apologies to Shakespeare — however, the VALUES we offer, can make a BUYER'S fondest dreams come true!

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- ☐ 1—LB SPOOL ROSIN-CORE SOLDER 40/60 — $1
- ☐ WEBSTER STEREO CARTRIDGE #SO-2, standard for all pickups — $1
- ☐ 6—TV ALIGNMENT TOOLS — $1
- ☐ 6—TRANS. RADIO BATTERIES 9 volt, same as Eveready #216 — $1
- ☐ 1—EMERGENCY AUTO LAMP Red dome blinker, incl Battery — $1
- ☐ 1—6" x 9" OVAL PM SPEAKER (one to a customer) — $1
- ☐ 1—5" PM SPEAKER Alnico #5 magnet — $1
- ☐ 1—4" PM SPEAKER Alnico #5 magnet — $1
- ☐ 10—SPEAKER PLUG SETS Deluxe 2 cond wired value $5.00 — $1
- ☐ 3—AUDIO OUTPUT TRANSFORMERS 50L6 type — $1
- ☐ 3—AUDIO OUTPUT TRANSFORMERS 6K6 or 6V6 type — $1
- ☐ 3—I.F. COIL TRANSFORMERS 456kc, most popular type — $1
- ☐ 15—RADIO OSCILLATOR COILS standard 456kc — $1
- ☐ 3—I.F. COIL TRANSFORMERS 10.7mc for FM — $1
- ☐ 2—G.E. #RTL-143 I.F. COIL TRNSFRMRS 456kc w/flange — $1
- ☐ 3—I.F. COIL TRANSFORMERS 262kc for Auto Radios — $1
- ☐ 4—OVAL LOOP ANTENNAS assorted popular sizes — $1
- ☐ 3—LOOPSTICK ANTENNAS hi-gain, ferrite, adjustable — $1
- ☐ 3—½ MEG VOLUME CONTROLS with switch, 3" shaft — $1
- ☐ 5—ASST. 4 WATT WIRE-WOUND CONTROLS — $1
- ☐ 10 — ASSORTED VOLUME CONTROLS less switch — $1
- ☐ 5—ASSORTED VOLUME CONTROLS with switch — $1
- ☐ 5—50K VOLUME CONTROLS less switch — $1
- ☐ 5—½ MEG VOLUME CONTROLS less switch — $1
- ☐ 10—SURE-GRIP ALLIGATOR CLIPS 2" plated — $1
- ☐ 10—SETS PHONO PLUGS & PIN JACKS RCA type — $1
- ☐ 20—ASST. PILOT LIGHTS #44, 46, 47, 51, etc. — $1
- ☐ 50—ASSORTED TERMINAL STRIPS 1, 2, 3, 4 lugs — $1
- ☐ 100'—FINEST NYLON DIAL CORD best size, .028 gauge — $1
- ☐ 50—ASST. RADIO KNOBS screw and push-on types — $1
- ☐ 25—ASST. CLOCK RADIO KNOBS in colors — $1
- ☐ 25—ASSORTED PRINTED CIRCUIT SOCKETS best types — $1

- ☐ 100—ASSORTED ½ WATT RESISTORS some in 5% — $1
- ☐ 70 — ASSORTED 1 WATT RESISTORS some in 5% — $1
- ☐ 35 — ASSORTED 2 WATT RESISTORS some in 5% — $1
- ☐ 20—ASST. DIODE CRYSTALS fine assortment. Latest types — $1
- ☐ 2—SYLVANIA EPOXY SILICON RECTIFIERS 750ma-400 piv — $1
- ☐ 20 — ASS'TED WIREWOUND RESISTORS 5, 10, 20 watt — $1
- ☐ 10 — ASST. RADIO ELECTROLYTIC CONDENSERS — $1
- ☐ 5—ASST. TV ELECTROLYTIC CONDENSERS — $1
- ☐ 50—ASST MOLDED CONDENSERS short leads — $1
- ☐ 20—GOODALL TUBULAR CONDENSERS .047-600v — $1
- ☐ 30—MICAMOLD ASST TUBULAR COND. molded steatite — $1
- ☐ 300—ASST. ½ W RESISTORS Top Brand, Short leads, excellent — $1
- ☐ 10—6' ELECTRIC LINE CORDS with plug — $1
- ☐ 4—50' SPOOLS HOOK-UP WIRE 4 different colors — $1
- ☐ 50—STRIPS ASSORTED SPAGHETTI handy sizes — $1
- ☐ 100 — ASSORTED RUBBER GROMMETS best sizes — $1
- ☐ 200'—BUSS WIRE #20 tinned for hookups, special circuits, etc. — $1
- ☐ 250—ASST. SOLDERING LUGS best types and sizes — $1
- ☐ 250—ASST. SELF TAPPING SCREWS #6, #8, etc. — $1
- ☐ 150—ASST. 6/32 SCREWS and 150 6/32 HEX NUTS — $1
- ☐ 150—ASST. 8/32 SCREWS and 150—8/32 HEX NUTS — $1
- ☐ 150—6/32 HEX NUTS and 150—8/32 HEX NUTS — $1
- ☐ 8—ASST. LUCITE CASES hinged cover, handy for parts — $1
- ☐ 4—TOGGLE SWITCHES SPST, SPDT, DPST, DPDT — $1
- ☐ 10—ASSORTED SLIDE SWITCHES SPST, DPDT, etc. — $1
- ☐ 100—ASST RUBBER & FELT FEET FOR CABINETS best sizes — $1
- ☐ 50—100K ½ WATT RESISTORS 10% — $1
- ☐ 50—470K ½ WATT RESISTORS 10% — $1
- ☐ 50—ASST. MICA CONDENSERS some in 5% — $1
- ☐ 50—ASST. DISC CERAMIC CONDENSERS popular numbers — $1
- ☐ 25—ASSORTED MICA TRIMMER CONDENSERS — $1
- ☐ 3—SELENIUM RECTIFIERS 2—65ma and 1—75ma — $1
- ☐ 2—SELENIUM RECTIFIERS 1—100 ma and 1—250 ma — $1
- ☐ 2—SELENIUM RECTIFIERS 1—65ma and 1—450ma — $1

- ☐ $15.00 TELEVISION PARTS "JACKPOT" best buy ever — $1
- ☐ 90° TV DEFLECTION YOKE wired network, schematic diag. — $1
- ☐ 90° FLYBACK TRANSFORMER schematic shows many uses — $1
- ☐ 70° TV DEFLECTION YOKE wired network, long leads — $1
- ☐ 50—ASSORTED TV COILS I.F. video, sound, ratio, etc. — $1
- ☐ 1—$10 INDOOR TV ANTENNA hi-gain, 3 section, tiltproof — $1
- ☐ 5—TV CHEATER CORDS with both plugs — $1
- ☐ 3—ELECTROLYTIC CONDENSERS 50/30-150v — $1
- ☐ 100'—TWIN TV LEAD-IN WIRE 300 ohm. heavy duty — $1
- ☐ 50' — FLAT 4-CONDUCTOR WIRE many purposes — $1
- ☐ 20—ASSORTED TV KNOBS ESCUTCHEONS etc. $20 value — $1
- ☐ 6—ASSORTED STANDARD TUNER UHF STRIPS — $1
- ☐ 10—ASSORTED STANDARD TUNER VHF STRIPS — $1
- ☐ 100—ASST. CERAMIC CONDENSERS some in 5% — $1
- ☐ 2—TV VERTICAL OUTPUT TRANSFORMERS 16 to 1 ratio — $1
- ☐ 2—TV FILTER CHOKE TRANSFORMERS 1—52 ohms, 1—250 ohms — $1
- ☐ 20—WIREWOUND RESISTORS 15K—10 watts — $1
- ☐ 20—WIREWOUND RESISTORS 40 ohms—10 watts — $1
- ☐ 2—RATIO DETECTOR COILS 4.5mc or 10.7mc — $1
- ☐ 2—TV SOUND I. F. COILS 4.5mc or 21.25 mc — $1
- ☐ 2—SOUND DISCRIMINATOR COILS 4.5mc or 10.7mc — $1
- ☐ 50—ASSORTED TV PEAKING COILS all popular types — $1
- ☐ 4—ASST. TV ION TRAPS for all type TV Receivers — $1
- ☐ 10—TV PICTURE TUBE SOCKETS wired with 20" leads — $1
- ☐ 5—TV HI-VOLT ANODE LEADS 20" length — $1
- ☐ 10—DIODE CRYSTALS 1N34 — $1
- ☐ 10—ASST. DIODE CRYSTALS 5—1N60 and 5—1N64 — $1
- ☐ 3—SILICON RECTIFIERS Top Hat 500ma-400 PIV — $1
- ☐ 50'—INSULATED SHIELDED WIRE #20 braided metal jacket — $1
- ☐ 32'—TEST PROD WIRE deluxe quality, red or black — $1
- ☐ 50'—HI-VOLTAGE WIRE for TV, special circuits, etc. — $1
- ☐ STANDARD BRAND TUBES 0Z4, 1B3, 1X2, 5U4, 5Y3, 6AC7, 6AU6, 6AX4, 6CB6, 6CG7, 6J6, 6K6, 6SN7, 6U8, 6X8, 12AT7, 12AU7, 12AX4, 50C5, 50L6 .... Each Tube — $1

MARKET SCOOP COLUMN

- ☐ 1—CHAPT ZU DI MITZIA "JACKPOT" (pleasant surprise) you don't need a gambling stamp — $1
- ☐ 100—PRECISION RESISTORS asst. list price $50.00 less 98% — $1
- ☐ 2—IBM COMPUTOR SECTIONS loaded with valuable parts — $1
- ☐ 1000—ASST. HARDWARE KIT screws, nuts, washers, rivets, etc. — $1
- ☐ 1000—SOLID BRASS SCREWS #2/56, 3/8" long, flat head — $1
- ☐ 1000—BLACK NICKEL SCREWS #6/40, 1/2" long, fillister head — $1
- ☐ 100'—STANDARD ZIP CORD 2 conductor #18 white or brown — $1
- ☐ 100'—MINIATURE ZIP CORD 2 conductor, serves 101 uses — $1
- ☐ 50—G.E. FLASHLIGHT BULBS #PR-9, 2.7., .15A — $1
- ☐ 50—PILOT LIGHT SOCKETS bayonet type, wired — $1
- ☐ 20— BALL POINT PENS retractable, assorted colors — $1
- ☐ 10—BALL POINT PEN FILLERS black fineline for drafting and offset, fits 95% of all pens made — $1
- ☐ 1—HEARING AID AMPLIFIER incl 3 Tubes, Mike, Etc. (as is) — $1
- ☐ 10—PEARL NECKLACES (simulated) wired for Hearing Aid but serves as regular Necklace 25" long — $1
- ☐ 3—3" RECORDER TAPES quality acetate, 150 feet — $1
- ☐ 10—3" RECORDER TAPE REELS — $1
- ☐ 1—SQ. YARD GRILLE CLOTH most popular brown & gold design — $1
- ☐ 500'—CHOICE HOOKUP WIRE asst colors cut in handy lengths some stripped and tinned — $1
- ☐ 100—ASST TUBULAR CONDENSERS .001 to .47 to 600v — $1
- ☐ 100—RADIO & TV SOCKETS asst 7 pin, 8 pin and 9 pin — $1
- ☐ 100—ASSORTED FUSES 3AG and other popular sizes — $1
- ☐ 300—CERAMIC CONDENSERS Erie, tubular, 300 mmf—500v — $1
- ☐ 10—ASSORTED TUBES Radio, Television and Industrial — $1
- ☐ 20—RCA #954 TUBES — $1
- ☐ 10—RCA #12L8 TUBES — $1
- ☐ 3—STANDARD 35W4 TUBES — $1
- ☐ 3—STANDARD 12AT6 TUBES — $1
- ☐ 5—RCA #1U4 TUBES also serves as a 1T4 Tube — $1
- ☐ COMMODORE 5-TUBE RADIO AC-DC, complete ready to play — $6
- ☐ GLOBAL 6-TRANSISTOR RADIO Complete ready to play — $9
- ☐ GLOBAL 9-TRANSISTOR RADIO Complete ready to play — $14

HANDY WAY TO ORDER — Simply pencil mark items wanted in squares and enclose with money order or check - - - You will receive a new copy of these Offers for re-orders. ON SMALL ORDERS — Include stamps for postage, excess refunded - - - LARGER ORDERS shipped express charges collect

SAME DAY DELIVERY . . . SCIENTIFIC PACKING for minimum shipping cost.

In order to SELL, we must first BUY and that we do on a BIG SCALE. If you have any TUBES, CONDENSERS, RESISTORS or any other PARTS in quantity and new that you wish to sell . . . please send us samples . . . We pay SPOT CASH.

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N. Y. TELEPHONE COrtland 7-2359

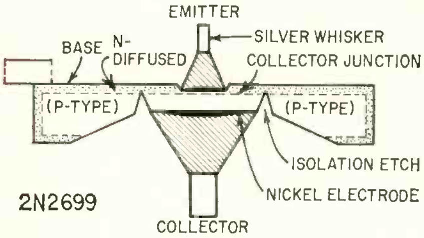
NEW SEMI CONDUCTORS & TUBES

2N2699

A new type of germanium transistor that combines a micro-alloy emitter junction with a diffused collector junction, and called a micro-alloy diffused electrode (MADE) transistor, was announced by Philco.

It's an avalanche-resistant, 150-mw switching transistor with an emitter breakdown of 4 volts, and a guaranteed open-base collector-to-emitter breakdown rating of 8 volts.

The 2N2699's collector output capacitance is 3.5 pf at 10 volts on the collector, and it offers a tightly specified base input voltage spread of 150 mv at 10 ma collector current and 1 ma base current.



The new structure provides high power dissipation because of a thick mechanical base width, together with high-speed switching because of the narrow electrical basewidth.

2N2381, 2N2382

With a total specified switching time (for 200 ma) of 67 nsec (nanoseconds) maximum, these may well be the fastest transistors of their kind. Designed for line and core-driver applications, these germanium epitaxial p-n-p units can switch up to half an amp.

The 2381 and 2382 differ in breakdown ratings (and price). Specifications:

	2N2381	2N2382
BV_{CBO}	30	45 volts
BV_{CEO}	15	20 volts
I_C	0.5	0.5 amp

Junction temperature, 100° C

Switching characteristics (both types):

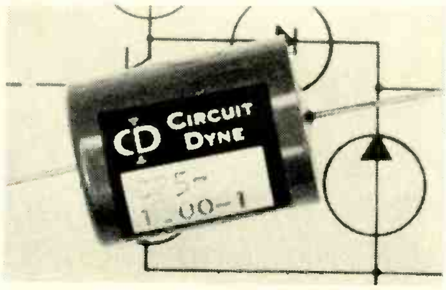
	typical	max
	8 nsec	15 nsec
t_s	20	30
t_f	8	15
t_A	1.6	3.0

The new transistors are made by Motorola.

CP-5 Current-Source Diode

Called a "Currector", this semiconductor is a constant-current diode capable of holding a current to within 2% of its nominal rating up to 25 volts.

It is 0.8 inch in diameter and 1.05 inches long and packaged in an epoxy-filled case. Both the CP-5, polarized,

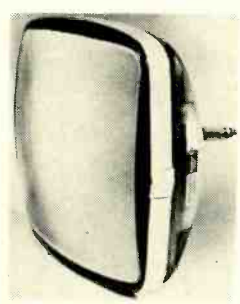


and the CN-5, nonpolarized, are available in current ratings from 1 to 20.5 ma in 5% increments. Leads may be specified axial or single-ended. The device is made by CircuitDyne Corp.

Safer, Shorter CRT's

Here's a new batch of TV picture tubes (19- and 23-inch) with single-panel windows, impregnated glass-fiber coating around the funnel, and steel bands around the periphery of the tube face.

The coating keeps the tube from turning into flying shrapnel in case of a break, and the steel bands keep stress



off the window. Tests made by Underwriters Labs verify that these tubes evacuate safely instead of imploding when cracked, according to Westinghouse, the manufacturer. No protective glass shielding is necessary, and the tubes are up to a half-inch shorter than conventional types.

The maker says that all standard electron-gun designs will soon be available in the new tube design.

8414

This is a sharp-cutoff subminiature vhf pentode intended especially for airborne equipment. Its plate and screen, as well as its heater, are made for 26.5-volt service. The Sylvania 8414 is designed to give dependable service under severe shock, high temperature and altitude, and vibration. It offers an unusually high transconductance for this kind of tube.

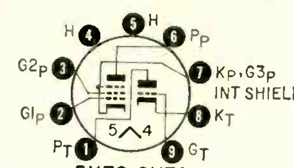
8414

A few of its more important characteristics:

Plate volts	26.5
Grid No. 2 volts	26.5
Grid No. 1 resistor	2.2 meg
Grid No. 3 volts	0
Plate current	4.5 ma
Grid No. 2 current	1.5 ma
Transconductance	5,000 μmhos
Plate resistance	50,000 ohms (approx)
Gride No. 1 bias for 10 μa plate current	—4.0 v

5KE8, 6KE8

The 'KE8 triode-pentodes differ only in heater rating (RCA "dark heaters", both). They're meant for TV oscillator-mixer service, and come in a standard



5KE8,6KE8

9-pin miniature envelope. The pentode section features high transconductance and frame-grid structure.

Characteristics, class A:

	Triode	Pentode
E_b	125	125 v
E_{g2}	—	125 v
E_{g1}	0	0
R_k	68	33 ohms
μ	40	—
R_p (approx)	5,000	125,000 ohms
g_m	8,000	12,000 μmhos
I_p	13	10 ma
I_{g2}	—	2.8 ma

END

"Stereo my foot. You're just wearing those so you can't hear me!"

TECHNICIANS' NEWS

Taxes and "Bait" in Pennsylvania

Harrisburg, Pa.—The Pennsylvania Federation of Television and Radio Service Associations has decided to seek clarification of the 4% state sales tax as it applies to labor and parts on warranty service.

The law is apparently not clear on the subject. Most of the time the service firm pays the tax, and yet the tax money is not included in the reimbursements from manufacturers and distributors. Because of the inconsistencies in the law, the group is seeking a definite ruling.

Veiled "bait" advertising in the yellow pages has also come under the FTRSAP's scrutiny, as it has in California and several other states (RADIO-ELECTRONICS, March 1963, page 93).

ESFETA Opposes Warranties

New York—The Empire State Federation of Electronic Technicians Associations, Inc., meeting in executive session at the Hotel Syracuse, Syracuse, N. Y., Jan. 20, 1963, passed the following motion: "ESFETA goes on record opposing manufacturers' extended warranties."

Max Leibowitz, liaison chairman, welcomes correspondence from all local, state and national electronic technicians' associations so that the activities of ESFETA can be coordinated with those of other interested groups. Mr. Leibowitz can be contacted at 2409 41st St., Astoria 3, N. Y.

Blue Ridge Hamfest

Greenville, S. C.—"Y'all come!" says the Blue Ridge Radio Society—their annual hamfest will be held on Sunday, May 5, at Paris Mountain State Park in Greenville. Tickets (which may be obtained there or in advance) are $3 for adults and $1.50 for children.

New National Group

Pittsburgh, Pa.—The nucleus of a new national radio and TV serivce organization, the National Electronic Associations of the United States, met in Columbus, Ohio to discuss future plans.

Twelve states were represented at the meeting by about 60 delegates and proxies (Minn., Mich., Calif., Kan., Iowa, Ind., Ohio, Penna., Texas, Ark. Ore., and Wash.). Elected president *pro tem* was Gregory Barkoukis, Akron, Ohio.

The ultimate purpose of the new organization will be the "elevation of the trade by working with and through manufacturers and distributors for the betterment of the entire industry".

FTRSAP Elects Officers

Harrisburg, Pa. — Pennsylvania's Federation of Television & Radio Service Associations re-elected Francis X. Finn of Philadelphia as president. The new vice president is Albert Kuhns of State College. Adam Deets, Kingston; L. J. Helk, Carbondale, and L. B. Smith, Hershey, were each re-elected to their former posts of recording secretary, corresponding secretary and treasurer.

The organization presented a plaque to Dave Krantz, who founded the federation in 1948, for his work in founding service associations in Pennsylvania.

FTRSAP joined with several other organizations in the country in protesting misleading classified phone directory advertising and the use of extended warranties as sales gimmicks.

St. Louis BBB Appoints TV Service Adviser

St. Louis—John O'Brien, President of the Better Business Bureau, has appointed Morton Singer (Schweig Engel Co.) trade adviser to the Bureau, representing the Television Service Industry of the Greater St. Louis Area.

The first action of the new liaison will be to review St. Louis' TV service Code of Advertising Ethics, in effect now for four years. Next will come a close working agreement between the TV sales and service industry and the BBB, in an attempt to enhance the industry's status with the public.

Judge Asks Consumer Protection

Seattle—Judge Evans O. Manolides, Seattle justice, stated in his closing remarks at the end of the preliminary hearing on *Washington vs Larry Allen* (R-E, March 1963, page 91) that the state should protect the consuming public by enacting suitable legislation to control TV service rackets.

Allen, charged with petty fraud, testified that he had been instructed by his firm to write up repair bills as large as possible. He pleaded not guilty. Allen also testified that *while on the service call* (the one that resulted in a complaint to the BBB and his arrest), he removed the rectifiers from the set and took them to a local appliance store to have them tested. "Removal and cleaning" of the rectifiers was itemized later as part of the service charge.

An expert witness testified that only one of the three tubes charged to the set owner was actually replaced,

New Heavy Duty RFI Suppression Kit For Mobile Radio

RADIO HAMS, fleet owners, and CB operators can now enjoy clearer, more readable, less tiring mobile communications at longer effective ranges.

Sprague's new Type SK-1 SUPPRESSIKIT provides effective R-F Interference suppression—at moderate cost—up through 400 megacycles. Designed for easy installation on automobile, truck, or boat engines with either 6-volt or 12-volt generators, the Suppressikit makes possible high frequency interference control by means of Sprague's new, extended range, Thru-pass® capacitors.

The components in the SK-1 Suppressikit are neatly marked and packaged, complete with easy-to-follow installation instructions. All capacitors are especially designed for quick, simple installation.

The generator capacitor is a heavy-duty unit rated at 60 amperes, and will operate at temperatures to 125°C (257°F). This means you'll have no trouble with an SK-1 installation in the terrific temperatures found "under the hood" on a hot summer's day. There's no chance of generator failures from capacitor "short outs," as with general purpose capacitors. The Thru-pass capacitors for use on voltage regulators are also rated at a full 60 amperes.

The Deluxe Suppressikit is furnished complete with an 8-foot shielded lead on the generator capacitor which can be trimmed to necessary length for any car or small truck, preventing R-F radiation from armature and field leads.

Containing only 5 easy-to-install capacitors, the Deluxe Suppressikit is a well-engineered kit. The net price is a little higher than that of many thrown-together kits, but it saves you so much time and aggravation it's well worth the slight extra cost.

For additional information on the Type SK-1 Suppressikit, see your Sprague Electronic Parts Distributor.

and that that one was coded with an expiration date over 4 years earlier. He also mentioned "unnecessary and unusual work" done on the set, and the workmanship was amateurish and sloppy.

Allen said that his firm required him to own his stock of tubes, and that he had to give the company 50% of all money left after he had taken out his cost on the tubes.

He quit a few days after making the call that aroused the BBB to action, because of complaints about excessive charges and callbacks for unsatisfactory work. He is now a landscape gardener.

Licensing

According to *TESA News*, St. Louis, the Indiana Electronic Service Association will try for a state bill to license service shops and technicians in the next legislature.

TESA News also reports "rumblings" that New Mexico is about to do the same.

The police department of Kansas City, Mo., announced recently that it will begin arresting TV and radio men who do not have the license called for by city ordinance. This license law was upheld not long ago by the Appeals Court in Kansas City. The case may go to the Missouri Supreme Court, but in the meantime, says the City Attorney of Kansas City, the law will be enforced.

In Wisconsin, Too

TESA of Wisconsin announces that it is ready to move with its Licensing Bill for the State of Wisconsin. The Licensing Committee met on Dec. 12 to draft the bill in its final form. The group has engaged Richard Gordon of Madison as legal counsel to assure proper procedure.

A comprehensive poll undertaken by TESA of Wisconsin, throughout the state, brought back a 90% affirmative response and encouraged the members to carry on.

TV Fees Rise in KC

Kansas City—TESA of KC reports that several TV service firms in the area have raised their home service fees to between $5.50 and $7, from older $5 to $6 rates. This is the first significant increase in call rates since around 1950, despite cost increases of over 30%, says *TESA News*.

The rise is attributed to dwindling parts sales and rising overhead. Do-it-yourselfers have cut heavily into service profits, along with drugstore tube checkers and the greater reliability of most TV parts.

King Camden, president of TESA, said that subsidization of service through parts is gone forever. A firm's service fee will have to be determined by its service volume against its overhead.

Seattle Broadcasts Praised

A series of broadcasts produced and aired by KIRO radio, Seattle, has received enthusiastic praise from the King County Television Service Association (Seattle area), and from Frank Moch, executive director of NATESA. "The Two-Eyed Monsters" exposed TV service racketeering in a way Moch called "judicious, informative and fair."

Public reaction to the programs has been tremendous, according to Seattle's *TSA Service News*. Many shops reported favorable comment from customers, and one of the outfits of the kind being "hit" by the broadcasts is said to have complained that its calls had fallen off to three a day.

While the series inevitably affects the business of honest shops by casting some suspicion on the entire service business, the programs emphasized that there *is* a difference between decent firms and fly-by-night operations.

Tapes of the entire series have been furnished to service associations in nearby states. END

NEW LITERATURE

CATALOGS • BOOKLETS • CHARTS

HIGH-TEMPERATURE WIREWOUND RESISTORS described in 4-page illustrated *Bulletin P-7*. Gives typical inductance values for each type, lists resistance values available with special temperature coefficients. Charts detail resistance change with ambient temperature and load for special TC resistors, design data for calculating cold and hot values.—**International Resistance Co.,** 401 N. Broad St., Philadelphia 8, Pa.

SPEAKER SYSTEMS, *1963 Sterling Series.* 4-page brochure pictures and describes one bookshelf and three slim (5 inches deep) enclosures. Complete specs.—**Anglo-American Acoustics Ltd.,** 129 Maryland Ave., Freeport, N. Y.

GUIDE TO BETTER FM STEREO PERFORMANCE. 8-page, 5½ x 7½-in. booklet. Drawings and text show importance of FM stereo-engineered outdoor antenna.—**JFD Electronics Corp.,** 6101 16th Ave., Brooklyn 4, N. Y.

4-POLE, HALF-SIZE CRYSTAL CAN RELAY, *Type SR*, shown in 2-page bulletin. Dimensioned drawings show case and header styles available, electrical schematic of relay. Complete electrical and mechanical specs.—**Branson Corp.,** 41 S. Jefferson Rd., Whippany, N. J.

TUBING SELECTION CHART. 8½ x 11-in. chart shows range of wire and cable diameters covered by various types and sizes of heat-shrinkable tubing.—**Alpha Wire Corp.,** 200 Varick St., New York 14, N. Y.

TRANSISTOR PRICE LIST includes 80 types of power transistors, plus silicon high-frequency, germanium high-frequency types. Offers six types of silicon-controlled rectifiers.—**Motorola Semiconductor Products, Inc.,** 5005 E. McDowell Rd., Phoenix 8, Ariz.

COIL FORM CATALOG. 4-page *Bulletin CO-8* details series XR-50, 60, 70, 80, 90 and new series XR-100. Complete specs, descriptions, breakaway illustrations, photos, engineering drawings on each series.—**National Radio Co.,** Dept. P, 37 Washington St., Melrose, Mass.

ELECTRONIC COMPONENTS. 4-page catalog presents constant-voltage transformers, constant-voltage dc power supply, constant-voltage frequency controlled solid state inverter, new *Semco* line. Complete specs, engineering drawings, photos. —**Supreme Electro-Magnetic Co.,** Dept. of Supreme Transformer, 2331 N. Washtenaw Ave., Chicago 47, Ill.

ELECTRONIC/HI-FI COMPONENTS offered in illustrated 40-page *Catalog 623*. Products include uhf converters, transistor code oscillators, 4-band communications receivers, hi-fi stereo amps, transistorized tape recorders, mikes, headphones, stereo components, replacement parts, experimental kits, transistor kits, ac-dc radio kits.—**Philmore Mfg. Co., Inc.,** 130-01 Jamaica Ave., Richmond Hill 18, N. Y.

MOLDED DIODE ASSEMBLIES presented in 4-page foldup booklet. Defines molded diode assembly, explains nomenclature system, lists diodes available for custom-designed molded assemblies. Illustrated with photos, block diagrams.—**Motorola Semiconductor Products, Inc.,** 5005 E. McDowell Rd., Phoenix 8, Ariz.

DIALS, DRIVES, REDUCTION MECHANISMS presented in 8-page *Catalog CO-6*. Offers vernier dials, planetary drive dials, dial locks, micrometer dials, uncalibrated dials, precision drives, right angle drives. Large photo, engineering drawing and complete specs of each item.—**National Radio Co.,** Dept. P, 37 Washington St., Melrose, Mass.

ELECTROLYTIC CAPACITOR REPLACEMENTS listed in 40-page *Manual K-106*. Covers replacements for sets of 256 manufacturers, including TV sets plus home, auto, portable radios made 1947 through 1962. Lists original part numbers, ratings, recommended replacements, list prices. Over 2,450 electrolytic capacitors in all.—**Sprague Products Co.,** 81 Marshall St., North Adams, Mass. **10¢.**

MICA DIELECTRIC CAPACITORS, molded, wire-lead type. 12-page bulletin contains complete engineering data, listings for commercial and military units. Illustrated by graphs and charts.—**Sangamo Electric Co.,** Springfield, Ill.

MICROMINIATURE ASSEMBLY TOOLS. 24-page *Bulletin B1* presents precision electronic pliers, superfine tweezers plus drills, taps, dies, pin vises, lathes. Photo and description of over a hundred items.—**Techni-Tool, Inc.,** 1216 Arch St., Philadelphia 7, Pa.

NEON GLOW LAMPS. 4 models illustrated in *Bulletin 110B*. Specs include breakdown voltage dc, maintaining voltage dc, design current, rated life.—**Signalite, Inc.,** Neptune, N. J.

FM-FM TELEMETERING SYSTEM. Catalog sheet describes model 5000 silicon transistor device for data transmission from systems in high acceleration. Photo, typical specs, typical measurement applications.—**Solid State Electronics Co.,** 15321 Rayen St., Sepulveda, Calif.

TERMINAL BOARDS, 16-page catalog *GEA-7317A* covers sectional and 1-piece boards. Complete description and application data, photos and dimension drawings. Details individual blocks, shows user how to make any type of sectional board. Also covers complete boards.—**General Electric Co.,** Schenectady 5, N. Y.

WELDED MODULE EPOXY INSULATION SELECTOR, *Bulletin E-107*. Chart gives electrical, physical, military specs, arranged in sequence, key properties high-lighted.—**Hysol Corp.,** Olean, N. Y.

PARTS MOTIVATOR described in 4-page illustrated bulletin. Feeds parts to processing or assembling machines. Photos, drawings, detailed text explain applications.—**Automation Devices, Inc.,** 3125 Brandes St., Erie, Pa.

CRYSTAL SPECS. 6-page bulletin gives technical data on A elements in ranges 500-1,400 kc, 1.4-20 mc, 10-125 mc. Covers frequency range, holder numbers, temperature range, frequency tolerance, oven operation, frequency temperature coefficient, maximum effective resistance, typical electrical equivalent parameters, military specs.—**Reeves-Hoffman,** Div. Dynamics Corp. of America, Cherry and North Sts., Carlisle, Pa.

CONDENSER MICROPHONES, *Series 4131/6*, detailed in 12-page technical bulletin. Many illustrations, complete specs on mikes and cartridges. Individual calibration, free-field corrections, cathode followers, data on measuring, recording, analyzing sound. 5 pages cover accessories.—**B & K Instruments, Inc.,** 3044 W. 106th St., Cleveland 11, Ohio.

POLYESTER FILM DIELECTRIC CAPACITORS outlined in 4-page *Bulletin 524*. Illustrations, complete description. Mechanical and electrical specs.—**Erie Resistor Corp.,** Erie, Pa.

SPECIAL ELECTRON TUBES. 12-page illustrated brochure describes resources, facilities of firm's Electron Tube Dept. Gives details on special electron tube—research and development, test, evaluation, production.—**Electron Tube Dept., CBS Labs,** High Ridge Rd., Stamford, Conn.

DIGITAL DELAY LINES. 12-page manual outlines history, theory, design, application of glass ultrasonic delay lines for digital use. Text defines terms, describes data rates and attenuation, examines delay line response. Many tables and figures.—**Corning Electronic Components,** Corning Glass Works, Raleigh, N. C.

CAPACITOR SELECTION CHART shows 7-step specifying procedure for MIL-C-25 capacitors. 17 x 22-in. wall chart gives terminal types, circuits, temperature characteristics, voltage, capacitance and capacitance tolerance for each of 17 illustrated case styles. 5 types of terminal construction, 6 typical circuits illustrated in 2 diagrams. Temperature characteristics table cross-references impregnants, operating temperature range, dissipation factors, insulation resistance, temperature coefficients with MIL-C-25 characteristics E, F and K. Voltage and capacitance ratings given for various MIL-C-25 designations.—**Cornell-Dubilier Electronics,** 50 Paris St., Newark 1, N.J.

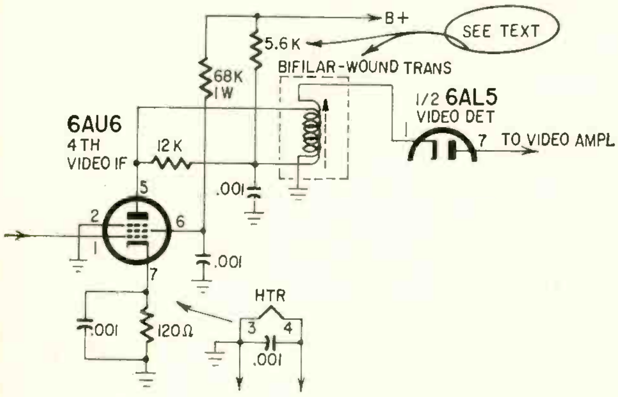
END

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. UNLESS OTHERWISE STATED, ALL ITEMS ARE GRATIS. ALL LITERATURE OFFERS ARE VOID AFTER SIX MONTHS.

Technotes

Early Raytheon (C-1401, etc.)

Several sets have come in with the same trouble: no sound or pictures, .25-amp fuse blown, 5U4-G out. After checking the power supply, trouble was found in the bifilar transformer coupling the 6AU6 fourth video i.f. amplifier to



the video detector. A short between windings allowed the full output of the power supply to be fed to ground through the 5,600-ohm plate decoupling resistor, which decreased to 100 ohms under the load.

Replacing the coil and resistor, the set worked well but plate voltage on the 6AU6 was high. Replacing the 5,600-ohm resistor with a 10,000-ohm, 10-watt unit brought the plate voltage to normal.—*G. B. Anglado*

Crosley 473

Complaint: Picture displaced three to four inches to the right, with slight loss of brightness. The trouble occurs after thirty minutes running time. All parts test OK. The trouble will probably be in the agc keying winding on the horizontal output transformer.

Double check by disconnecting the ground tap and the pulse lead to the keyer tube. Substitute a 3-volt negative battery to the agc line.—*William Porter*

Philco E-670/E-676

Some of these sets go into spurious oscillation apparently because of poor soldering between speaker and chassis.

To eliminate this complaint, scrape a clean, shiny spot on the chassis near the speaker and solder a flexible wire to it. Solder the other end of the wire to the metal speaker mounting, and you have a thorough ground path.—*A. von Zook*

Replacement for the 5MK9 Rectifier

You can substitute a 6X4 rectifier for the 5MK9 by re-wiring the socket, and connecting the 6X4 cathode to its heater and both plates together, as shown in Fig. 1.

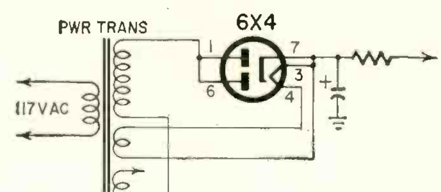


Fig.1

The lower heater voltage will not have any effect other than lengthening the warmup time a few seconds.

Fig.2

The 5MK9 is used principally in receivers and recorders manufactured in Japan. There is no standard replacement. Basing diagram for the 5MK9 is in Fig. 2.—*E. L. Deschambault*

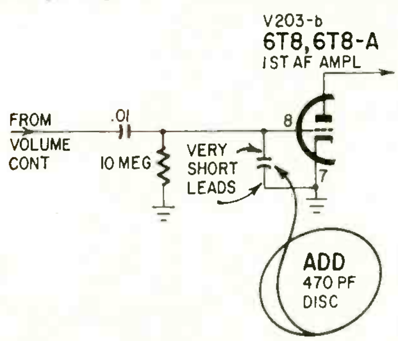
Emerson 888

Three points to check when you have intermittents:
1—On-off switch soldered to printed circuit has broken loose.
2—Personal listening attachment socket shorting bar does not make good contact.
3—Penlight battery holder contact springs are loose from contact plate. Solder the springs to the plate or replace the assembly.—*E. Spandorf*

RCA 21CS7815 (CTC5)

Interference signals are sometimes picked up and rectified in the PW200 board and its associated wiring. The result is noise in the audio output of the receiver—sometimes even with the volume turned all the way down.

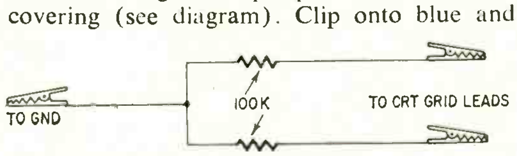
The signal pickup occurs on the long leads connected to



the volume control, and rectification is in the grid circuit of the first audio amplifier. The noise can be killed by inserting a 470-pf capacitor between the grid and cathode of the first a.f. amplifier (V202-6, a 6T8). Be sure to keep leads as short as possible and do not use anything but the cathode terminal of the tube socket for a ground.—*C. S. Lawrence*

Quick Purity Checker

Make a purity checker with just two 100,000-ohm resistors and three alligator clips, plus some plastic tape or rubber covering (see diagram). Clip onto blue and green



NB—INSULATE ALL LEADS & CLIPS

grids to observe red purity, and change to observe either blue or green purity. This eliminates disturbing CRT tracking by turning down the green and blue screen controls, and the subsequent resetting of these controls.—*A. R. Richman*

Motorola VTS505

Trouble: Picture and sound intermittent, raster constant. No regular recurrence.

Remedy: When trouble occurs, some tube heaters are dimmed. Sparking near filament transformer pointed the way; one transformer wire was soldered to a terminal strip and grounded through the strip's mounting foot. A good soldering job cured the trouble.—*Wade Lockey* END

Try This One—for Economy!

Every week we allot each technician a full complement of tubes for his service kit—$100 worth. And every week we inventory his stock. We're saving money right along.

What used to happen before this strict check was that a technician working on a set in the shop or at a customer's house might replace suspected tubes with new ones from his kit. If replacing a tube failed to clear up the trouble, he went on replacing tubes until he discovered those that were causing the set's outage. Chances are he'd charge for the one or two that had to be replaced to make the set work, but very often he'd forget the other new ones he'd stuck in the set's sockets. Consequence, lost tubes—and money. The new cartons we'd supplied to our technicians often came back holding the customers' good-but-old tubes, which we could not sell as new replacements.

Under our strict control, every new tube carton must contain a new tube—or be empty. If it contains a new tube, OK. If it contains an old one, the technician pays for it before he gets a replacement to refill his kit.—*Stanley Clark*

Plug-in Electrolytics

Experimenters will find it convenient when building breadboard circuits to have "plug-in" electrolytics. They save much time and polarity troubles as

well as prolong the life of the component's terminals. Just solder each capacitor to an old bakelite tube base and plug this into a socket on the breadboard chassis.—*Charles A. Cunningham*

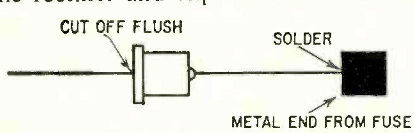
Odd-shaped Speaker Holes

Scribing a cutting line for elliptical speakers is next to impossible by ordinary means. Try this: slice off the upper layer of the laminated cardboard gasket cemented to the outer rim of almost all inexpensive speakers. This leaves you with a semi-rigid ring that you can stick or tack to the baffle-board-to-be. Run a pencil or awl around the inside of the ring and you have your guide line. If you wish, you can cement the ring slice back onto the speaker when you're done. A pencil mark on the slice and speaker frame, made before you cut the ring, will help you get the thing back the same way.—*C. C. Dodds*

Top Hat in a Fuse Clip

The "top hat" type of silicon rectifier is generally soldered into the circuit. Those who wish to use a "top hat" to replace the cartridge kind or would like the ease of the plug-in type can use this innovation.

Take an old fuse (or a new one) and break off the metal ends. Solder this metal end to the negative end of the rectifier and clip the lead flush with



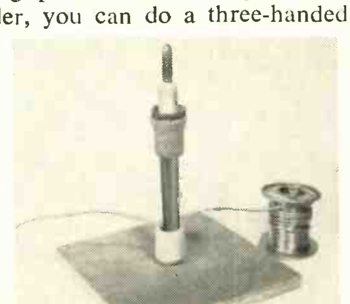
the positive end. If you are careful of the length of the negative end of the top hat and cut it to size, the silicon rectifier will plug right into the fuse holder.—*Don Dudley*

Kill SW on Old Sets?

Many prewar and early postwar radios were equipped with shortwave bands. In most cases the set is not very efficient on these bands since they were just tacked on as a sales feature. Sometimes such a set will come in for service with a broadcast reception complaint which is traced to the bandswitch. Before you repair or replace the switch, ask the customer if he's interested in shortwave reception. Most of the time, he won't be. Then you can simplify the service job by eliminating the bandswitch and wiring the set permanently for broadcast reception.—*Charles Erwin Cohn*

Pencil-Iron "Launching Pad"

Screw-fasten a rubber furniture leg tip to a block of wood and use this launching-pad type holder for your soldering pencil. With the pencil in the holder, you can do a three-handed job



easily with only the normal two hands. Used as a pencil rest when the iron is idle, heat from the tip rises upward and the handle stays cool.—*Joe C. Allan*

Battery-Polarity Reminders

The small printed polarity markings on most dry batteries are easily misread. Since reversed connections often destroy expensive transistors, it pays to attach larger and more readable

labels. Inexpensive pressure-sensitive labels are available at any stationery store. Mark them with bold plus and minus signs, using an instant-drying marker pen. Press the finished label into place alongside the appropriate battery terminal.—*William E. Bentley*

Record-Changer Work Stand

You can easily build this repair stand with just three large shelf brackets and a piece of plywood.

Mount the brackets on the ply-

wood as shown. Use just one wood screw in the end hole of each. This allows the brackets to swing around,

thus adjusting to fit just about any changer you have to work on.

Materials needed:

3—Large shelf brackets

3—¾ inch No. 10 filister-head wood screws

1—2 x 2-foot piece of ¾-inch plywood.—*Wayne Lemons* END

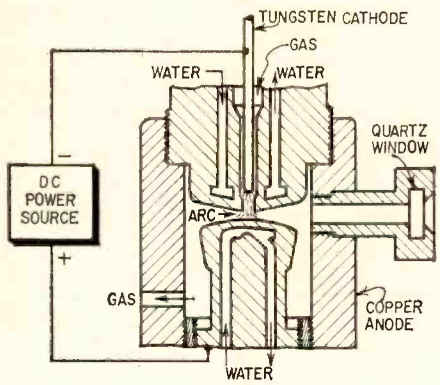
new PATENTS

ARC LAMP

PATENT NO. 2,972,698

Leo I. Dana, Larchmont, N.Y. and Harold S. Morton, Jr., Gaithersburg, Md., (Assigned to Union Carbide Corp.)

The tungsten cathode is inside a water-cooled nozzle. The copper enclosure serves as the anode. The arc operates under high gas pressure, preferably xenon at 25 atmospheres approximately. The gas stabilizes the arc and makes it uniform. The light intensity may be as high as 120,000 candlepower per sq cm, with a power source of 100 amps at 38 volts. This light source is suitable for motion-picture projection.

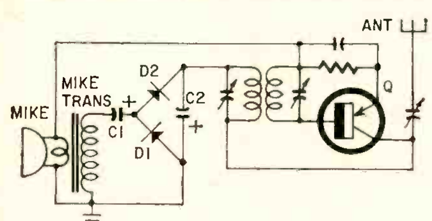


Sound-Powered Radio

PATENT No. 2,981,833

George W. Bryan, Jr., Wall Township, N. J. (May be used by US Government without payment of royalties)

The output of a sound-powered telephone is only a few milliwatts, but it is sufficient to energize a radio transmitter. The audio is first stepped up about 10 times, then fed to a voltage doubler comprising C1, C2, D1, D2, to power oscillator Q.



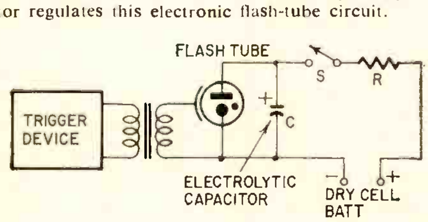
The audio signal is in series with the emitter, so it modulates the rf carrier. The range of this transmitter approaches line-of-sight in the 30-mc region.

Flash-Tube Circuit Regulator

PATENT No. 2,983,850

Harold E. Edgerton, Belmont, Mass. (Assigned to Edgerton, Germeshausen & Grier, Inc., Boston)

A resistor in series with an electrolytic capacitor regulates this electronic flash-tube circuit.



The leakage current through an electrolytic capacitor increases considerably near its rated voltage. This leakage current flows through R, producing a drop which prevents overloading the lamp. As the battery ages, the capacitor voltage begins to fall. Therefore the leakage is lowered, as is the drop across R. This permits more of the battery voltage to reach the tube.

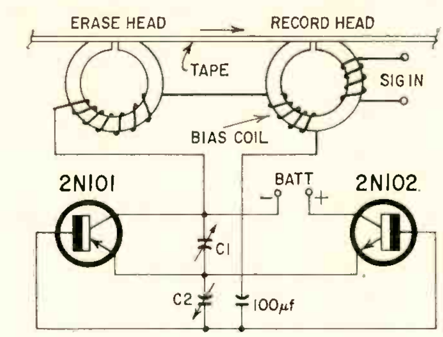
Although a higher initial battery voltage is needed, the battery's useful life is greatly extended.

Tape Recorder Oscillator

PATENT No. 2,980,768

Robert J. Ehret, Los Altos, Calif. (Assigned to Ampex Corp., Redwood City, Calif.)

Here a pair of transistors supplies ac bias and erase current for tape recorders. The circuit configuration is a complementary-symmetry Colpitts oscillator, using the bias and erase coils in series as tank inductances. These, together with C1 and C2, determine the operating frequency, which may lie anywhere between 4 and 80 kc.



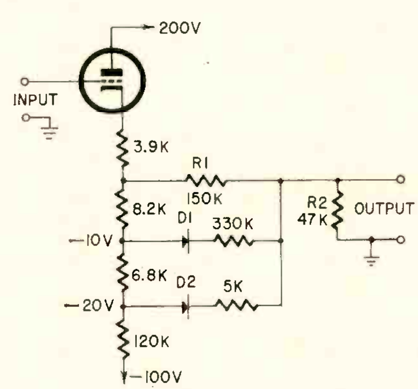
The inventor claims high efficiency for his circuit, because there are no resistors to dissipate power.

Expander

PATENT No. 2,986,708

Farrell A. Buckley, Manhattan Beach, Calif. (Assigned to Hughes Aircraft Co., Culver City, Calif.)

The output of this cathode follower increases faster than its input, which is a positive signal. Initially, with no signal, both diodes are back-biased due to negative voltages at their anodes.



Current flows through the load, R2, when the grid goes positive. At some definite value the drop across R1 will overcome D1's bias. Conduction opens a second path for the cathode current and increases the output. With an even greater grid signal, D2 conducts also. At this time nearly the entire cathode output will appear across R2.

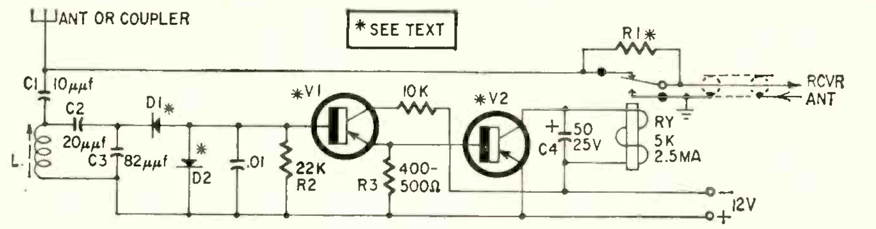
Diode conduction does not change abruptly, so the expansion effect is gradual throughout the range.

END

NOTEWORTHY CIRCUITS

Receiver Disabling Switch

This little T-R switch is ideal for amateur, mobile and marine use and in installations where the receiver operates from a separate antenna close to the transmitting antenna. It protects the receiver against overloading and prevents high rf voltages from damaging its antenna tranformer. Fully automatic, the device makes it unnecessary to connect the set's antenna through a relay tied into the transmitter's keying circuit.



Inexpensive general-purpose p-n-p transistors and diodes such as the 2N107, CK-722, 2N1191, 1N34, 1N46 and 1N51 can be used. With the constants shown, the relay pulls in when the applied rf reaches about 1.1 volts rms.

Rf from the antenna or transmission line is fed through C1 to tank circuit L-C2-C3 tuned to the transmitter's frequency. C2 and C3 form a capacitive voltage divider feeding detector diodes D1 and D2. When the transmitter is keyed, the diodes conduct and develop a negative bias on V1's base. V1 conducts and develops a negative voltage across R3. This turns on V2, pulling in the relay so it shunts the transmission line with R1 and grounds the receiver's antenna terminal. R1 should match the transmission line impedance. If you operate CW, select C4 to match your average transmitting speed and desired break-in characteristics.

The circuit can be modified to operate on lower antenna voltages by changing the ratios of C2-C3 and R2-R3. R2 can be eliminated and R3 raised to around 5,000 ohms. If the unit is installed in a spot where temperature is high reduce R2 to 10,000 ohms. This reduces sensitivity so you must compensate by adjusting the values of C2 and C3.—*Keith C. Morton, W1NDH*

Rf Q Multiplier

Does your short-wave receiver need more gain? You can obtain it by constructing and connecting a simple regenerative stage tuned to the desired rf band. Simply connect the regenerator to the antenna that feeds the receiver and adjust the regenerator for optimum. The regenerator multiplies the Q of the set's input circuit. Therefore, it increases circuit gain. The improvement in selectivity is not noticeable because the operating frequency is high.

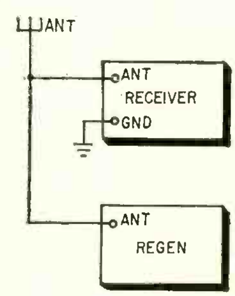


Fig.2

Fig. 1 shows a typical regenerator for approximately 7 to 16 mc. It is connected as shown in Fig. 2. Tune C1 to the desired frequency and set C2 just below oscillation. Coils are wound on a 1-inch form, and each winding is about 1/16 inch from the next.

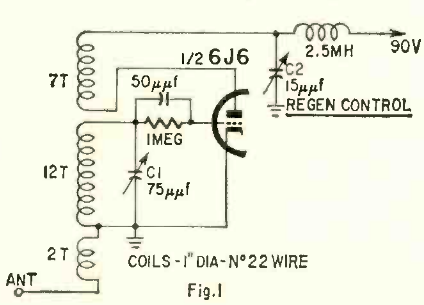
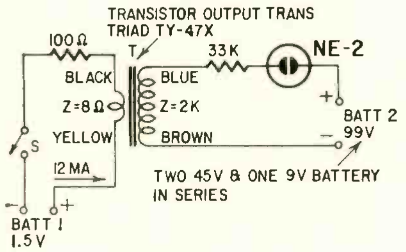


Fig.1

You will be amazed at the results. An S1 signal will come up to S7 or more with optimum adjustment of the regenerator. Of course, if your receiver already has high gain and goes down to the noise level, this setup cannot help you. As with any amplifier (including the maser) the noise will come up along with signal.—*I. Queen*

Neon Baffler

Here is a simple circuit in which a neon lamp is controlled by a 1½-volt battery. We know that a transformer does not pass dc, but the behavior of this circuit might give the impression that it does. When switch S is closed, the lamp lights and stays on as long as S is held closed. When the switch is opened, the lamp goes out. (The polarity of BATT 1 and the transformer connections are critical—this action is not obtained when BATT 1 is reversed or transformer leads transposed.)



What is the explanation? BATT 2's voltage is too low to fire the lamp. When S is closed, the sudden start of the primary current induces a momentary secondary voltage in the transformer, and this voltage adds to BATT 2 and fires the lamp. By nature, the neon lamp, once fired, will remain on until its circuit is opened; the steady primary current (12 ma) has nothing to do with it. However, when switch S is opened, the sudden cessation of primary current induces a back voltage across the secondary. This voltage bucks BATT 2, reduces the lamp voltage momentarily, and extinguishes the lamp.
—*Rufus P. Turner* END

"He says he was trying to pull a car radio."

new BOOKS

HAVING FUN WITH TRANSISTORS, by Len Buckwalter. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis 6, Ind. 5½ x 8½ in., paper. 127 pp. $2.50.*

A number of simple and interesting electronic projects, including items like a home broadcaster and a musical oatmeal box. All projects are clearly described and illustrated with pictorial diagrams.

ELECTRONIC, RADIO AND MICROWAVE PHYSICS, by D. E. Clark and H. J. Mead. *MacMillan Co., Fifth Ave., New York 11, N.Y. 6 x 9¾ in., 521 pp. Cloth, $25.*

A detailed reference book with a mathematical approach for college seniors and engineers.

MODERN COMMUNICATIONS COURSE (Vol. 1), by Edward M. Noll. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis 6, Ind. 5½ x 8½ in. 256 pp. $4.95 paper.*

A self-study course plus experimental projects covering rf amplifiers, oscillators, antennas and measurements.

HI-FI HANDBOOK (second revised edition), by Steven Hahn. *Thomas Y. Crowell Co., 201 Park Ave. So., New York 3, N.Y. 5½ x 8 in., 216 pp. Cloth, $4.95.*

This illustrated guide is intended to help you select your tuner, recorder, changer or amplifier.

SERVICING ELECTRONIC ORGANS, by Carl R. Pittman and Eugene J. Oliver. *Howard W. Sams & Co. Inc., 1720 E. 38 St., Indianapolis 6, Ind. 5½ x 8½ in. 191 pp. $4.95 paper.*

The theory and data that radio technicians need to understand, tune and repair these instruments. Typical commercial types are discussed.

INDUSTRIAL CONTROL ELECTRONICS, by Matthew Mandl. *Prentice-Hall Inc., Englewood Cliffs, N. J. 6 x 9 in. 344 pp. Cloth, $10.65.*

A basic introduction of the fundamental principles and practices of modern electronic control circuits.

HOW TO AVOID LAWSUITS IN TV, RADIO, APPLIANCE SALES AND SERVICE, by Leo T. Parker. *John F. Rider, Publisher Inc., 116 W. 14 St., New York, N. Y. 5½ x 8½ in. 72 pp. Paper, $1.*

A brief but detailed technician's guide that could have been titled "How To Stay Out Of Court".

FUNDAMENTALS OF ACOUSTICS, 2nd ed., by Lawrence E. Kinsler and Austin R. Frey. *John Wiley & Sons, Inc., 440 Park Ave. South, New York 16, N.Y. 6 x 9 in., 524 pp. Cloth, $10.75.*

A concise survey of basic theory and modern applications, for graduate classrooms as well as home study.

BUILDING UP YOUR HAM STATION, by Howard S. Pyle, W7OE. *Howard W. Sams & Co., Inc., 1720 E. 38th St., Indianapolis, Ind. 5½ x 8½ in. 128 pp. $2.50.*

A valuable aid to the new ham selecting equipment for a basic ham station that can be upgraded with minimum expense. Includes information on new, used, kit and

(Continued on page 105)

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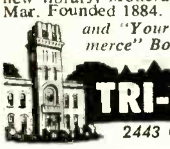

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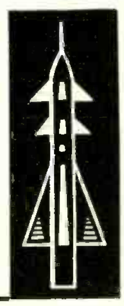

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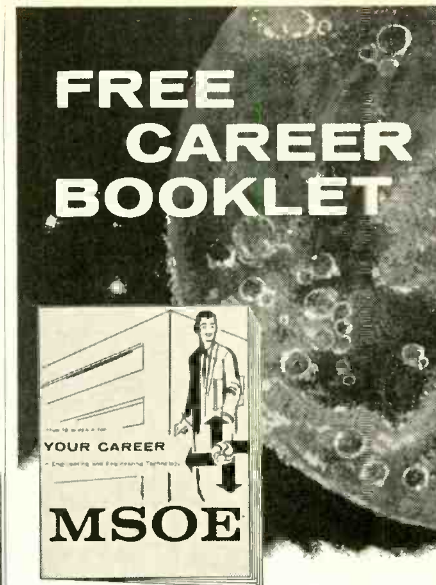

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(Continued from page 102)

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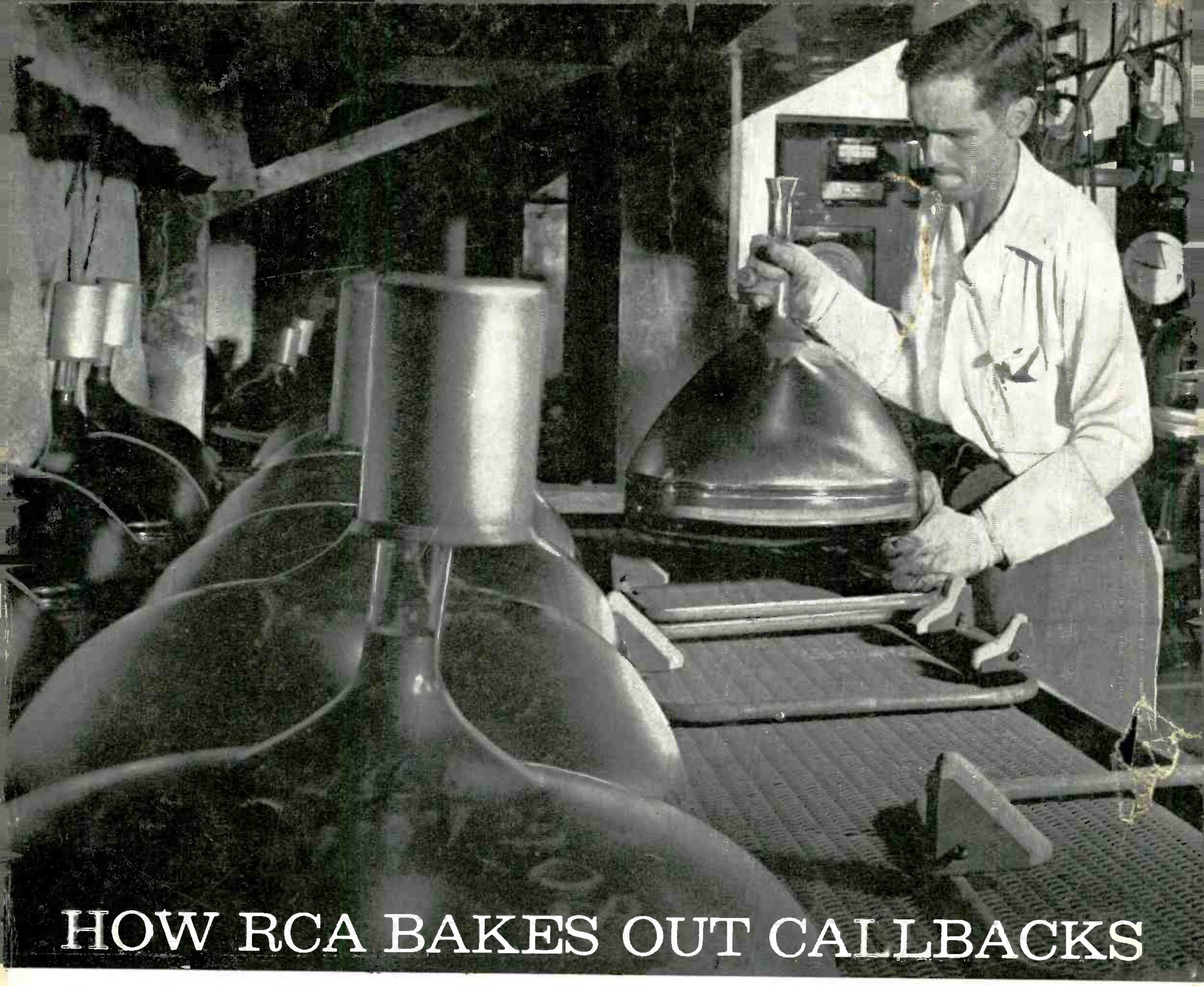

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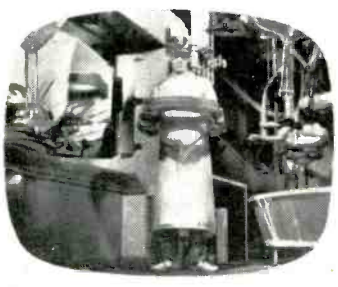

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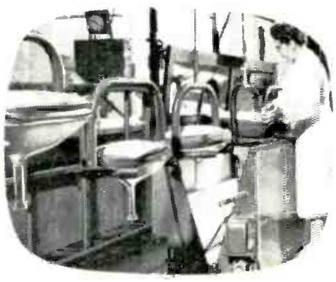

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