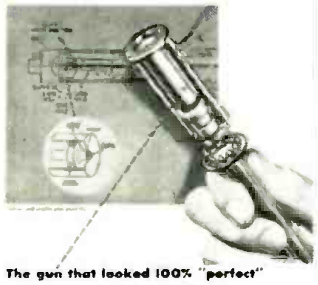
RADIO-ELECTRONIC ENGINEERING EDITION

RADIO & TELEVISION NEWS

JANUARY 1953

IN THIS ISSUE



The gun that looked 100% "perfect"
. . . yet never "fired a shot"

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How we spot "shady characters"
before they can damage your business

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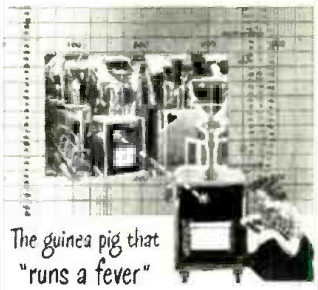

The guinea pig that
"runs a fever"
to bring you better picture tubes

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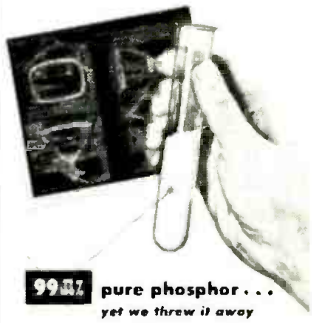

99.8% pure phosphor . . .
yet we threw it away

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The evidence is clear...

RCA safeguards your reputation...
with tubes of unequaled quality

In RCA Tubes and Kinescopes
the difference is top-quality control

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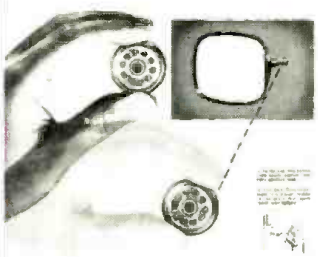
HARRISON, N. J.

TMK. ®



A DOUBLE-TAKE
to safeguard your reputation

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The Torture Chamber
that tests the strength
of RCA Picture Tubes

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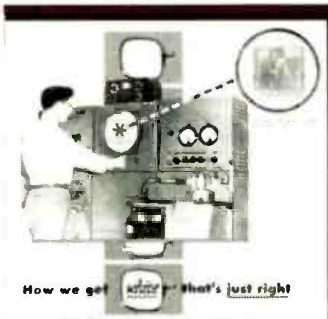

How we get [color] that's just right
for RCA picture-tube screens

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Quality control by feedback
. . . the secret of RCA tube performance

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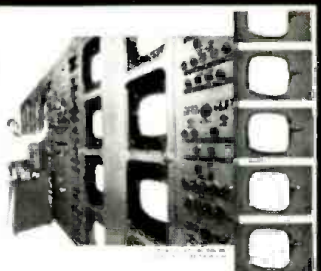

The Million-Dollar Test Equipment
. . . that pays off in better picture tubes

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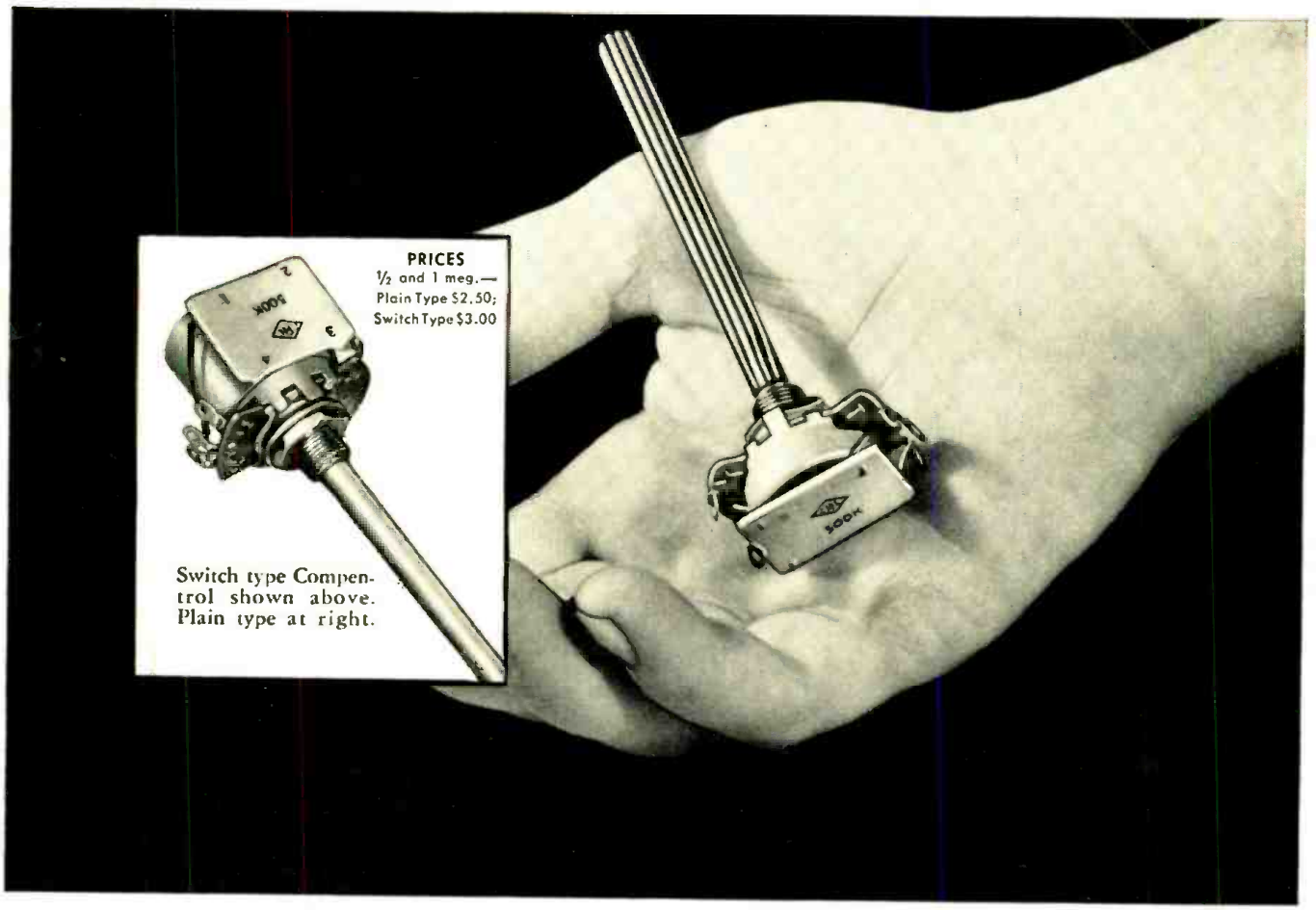
Take a look at quality being born

RADIO CORPORATION of AMERICA

For faithful tone reproduction . . . high fidelity at low volume level — use Centralab's Compentrol



Centralab components are safest for guaranteed servicing

YOU can stake your service reputation on the Centralab Compentrol. That's because this combination volume control and Printed Electronic Circuit faithfully reproduces the high-pitched tones of the operatic soprano — or the deep bass notes of the boogie woogie beat . . . when volume is set at low level.

In fact, Compentrol was especially developed to better reproduce the apparent bass and treble response of radios, audio amplifiers, phonograph combinations and television sets. Use it as a business builder as well as for replacement service. It actually improves original performance! What's more, its low price will fit any pocketbook.

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The Centralab Compentrol is furnished in ½ or 1 meg. —plain or switch types. Switch is SPST, and an insulated switch shield is furnished for a-c shielding. Most amplifiers use a plain type. For complete details, ask your Centralab distributor, or use the coupon.

Make your Centralab distributor headquarters for exact electronic replacements

Centralab

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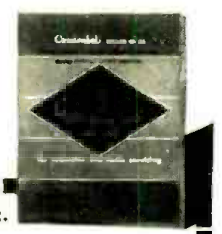
The Centralab Compentrol is only one of the more than 470 *new* items listed in Centralab's new Catalog 28. Get your copy of this 32-page index to the latest developments in the fast-changing electronic field, plus a 16-page booklet telling the whole Compentrol story. See your distributor or use the coupon.



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Company.....

Address.....

City.....State.....

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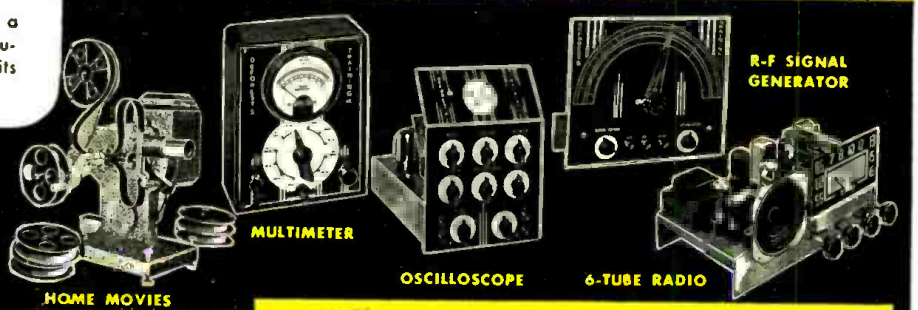

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performance proven!

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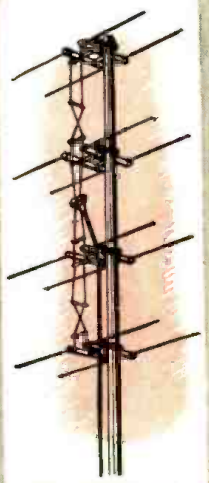
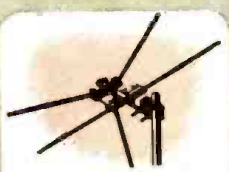


THE UHF COLINEAR

A high gain all-channel fringe area antenna. Here is the mighty mite of all-channel UHF reception and considered by a leading TV set manufacturer as the finest UHF antenna yet perfected. Rugged four-bay construction of solid aluminum elements with fiberglass cross arms. List $11.10 Also available in side-by-side stack.

THE YAGI

UHF Yagis for primary and fringe areas in two models—an all-aluminum eight-element and a twelve-element with special weather-resistant fiberglass boom. Both antennas provide high gain and wide band width. Model LJ-U $6.15 List Model LLJ-U $7.65 List



THE VEE-D-X "V"

All-channel primary area antenna. Excellent broad band characteristics. Supplied as a straight UHF antenna or with Vee-D-X Mighty Match for use in combination with a VHF antenna using a single transmission line. The plain "V" lists $2.75

VEE-D-X UHF ADAPTING BRACKET

Permits addition of UHF antenna to existing VHF installation. Can be mounted three different ways to mast or antenna boom. Fast, easy, inexpensive to install. Supplied plain (list $1.50) or with Mighty Match MM-30 list ($5.50)

VEE-D-X MIGHTY MATCH (Model MM-30)

Provides a most efficient method of combining VHF-UHF antenna systems with a single transmission line. Entirely automatic in action. Employs new printed circuit filters. List $4.00

VEE-D-X ALL-CHANNEL UHF-VHF ANTENNAS

The Ultra Q-Tee

THE ULTRA Q-TEE and its new companion the ULTRA Q-TEE *Suburban* combine both UHF and VHF into a single antenna using a single transmission line. Both contain eight patented* printed circuit channel separators. The Ultra Q-Tee is designed for primary areas and will receive all channels 2-83 VHF-UHF. Lists for $14.25

*Lic. A.A. K. Pats. 2,422,458; 2,282,292; 2,611,086; others pending.

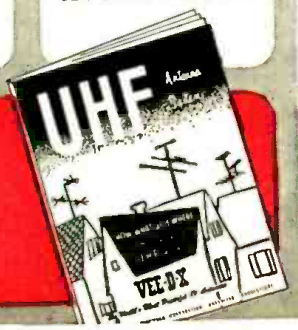
The Ultra Q-Tee Suburban

THE ULTRA Q-TEE SUBURBAN is designed for all-channel VHF and fringe area UHF. Lists for only $17.60

FREE!

UHF ANTENNA GUIDE

An authentic guide to UHF antenna systems. For your copy, write the LaPointe-Plascomold Corp., Rockville, Conn.



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hallicrafters

For the RECORD

BY THE EDITOR

THE MAGIC OF GERMANIUM AND PRINTED WIRES

THE year 1953 will, without a doubt, usher in a new concept of electronic circuitry made possible by man's ability to utilize tiny specks of germanium crystal. Progress in the development of the transistor has been remarkable in recent months. The transistor has emerged from the laboratory into the realm of mass production—all within the span of four short years.

No longer is it necessary to spend a day's salary or to stand in line to purchase one of these pea-sized electronic wonders. Now available in quantity are commercial-quality transistors which are capable of performing many of the functions of the vacuum tube.

Take, for example, the conventional hearing aid with its three subminiature vacuum tubes and its other components all housed in a case slightly smaller than a pack of cigarettes. Now, visualize this same instrument using transistors and printed circuitry in a case no larger than a cigar lighter and one can readily appreciate the tremendous possibilities for ultra-compact electronic devices.

It takes little imagination to visualize a complete radio receiver contained in a fountain pen case or an audio amplifier built inside of a phono pickup arm; even "Dick Tracy's" wristwatch transceiver looms as a practical commercial product rather than the figment of a cartoonist's imagination.

In order to become familiar with the transistor, one must not only read the literature and study the theory and applications of the device but he must experiment with the circuitry and use the transistor in workable equipment. This publication has, in past articles, set the stage for a complete understanding of the transistor —its applications and limitations. Logically, the next step is to show "how to use" the transistor in a series of home experiments with construction details supplied for building several receivers, transmitters, audio amplifiers, and television circuits.

It is our hope to bring you the first details on the use of transistors in electronic equipment in a series of practical articles scheduled to begin in the February issue of RADIO & TELEVISION NEWS, or as soon thereafter as possible. Several working units are now under test in our lab.

The year 1953 will find an ever-increasing acceptance of printed circuit techniques and applications. The development of printed circuitry has, like the transistor, emerged from the drafting board stage and has become an accepted circuit technique. Never before in the history of electronics have two developments (the transistor and printed circuits) been better suited for a happy marriage.

The experts are now anticipating a tremendous field of applications that will probably require an annual production of transistors in the billions. Crystal diodes, too, are finding almost unlimited fields of conquest. These germanium devices, now widely used in television circuitry, have done much to speed the development of mass production techniques of the transistor.

Although these tiny germanium devices do open the door to many new electronic applications it is doubtful that they will eventually replace the vacuum tube entirely. Further knowledge and control of the characteristics of transistors is essential before the engineer can fully appreciate their future potential.

Students and technicians of today have a wonderful opportunity for experimenting with transistors in many different types of devices. These experimenters will discover new applications for the transistor in the fields of medicine, commercial radio, audio, industrial devices, and communications.

Today we stand at the threshold of a new era in electronics—one made possible by man's discovery and control of germanium crystals. The door is open to new and greater opportunities for those who know and understand these revolutionary techniques. . . . O. R.

As we go to press, we have just witnessed a demonstration of transistor techniques, sponsored by RCA. See page 122 for further details.

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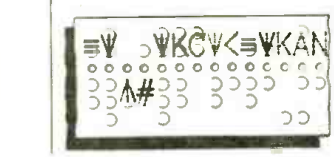
These signals find the way



SENDING

RECEIVING

When you dial a telephone number, high-speed switching mechanisms select your party and connect you. Through a new development of Bell Telephone Laboratories, similar mechanisms are doing the same kind of job in private wire teletypewriter systems which America's great businesses lease from the telephone company.

Company X, for example, operates an air transportation business with scores of offices all over the country. At one of these offices, a teletypewriter operator wishes to send a message, let us say, to Kansas City. Ahead of the message, she types the code letters "KC". The letters become electric signals which guide the message to its destination.

Any or all stations in a network, or any combination of stations, can be selected. Switching centers may handle 50 or more messages a minute . . . some users send 30,000 messages a day. Delivery time is a few minutes.

Defense manufacturers, automobile makers, airlines and many other American businesses are benefiting by the speed and accuracy of the new equipment — another example of how techniques developed by the Laboratories for telephone use contribute to other Bell System services as well.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.

Booster performance depends on noise figure!

Gain alone is NOT enough!

TV "snow" is noise generated by the set and booster. The amount of noise present depends primarily upon the first tube in the receiving system.

This means that where a booster is used, the amount of "snow" in the picture depends almost entirely upon the performance of the booster, and the tube(s) it uses. Most single channel boosters on the market today have poorer Noise Figures than modern TV front ends. Therefore, while these boosters may contribute gain, they actually deteriorate picture quality by adding noise.

Katy-B is the first *modern* single channel booster. It employs the famous, low-noise 6BQ7 tube in a Cascode-type circuit, which gives the lowest Noise Figure and highest gain ever obtained in a television booster.

CHANNEL MASTER

a new kind of SINGLE CHANNEL TV BOOSTER

with the

Highest gain **Lowest noise**

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- GAIN: 12 Times (22 DB), low band; 8.5 Times (18.6 DB), high band.
- NOISE: 4.5 DB, low band; 6.5 DB, high band.
- The only single channel booster with CASCODE-type CIRCUIT
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- Double-tuned transformers for peaking both video and sound.
- Antenna by-pass switch.

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	KATY-B	Booster A	Booster B	Booster C
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Noise (low no. preferred)	6.5	14.3	8	9.1
VSWR (low ratio preferred)	1.5:1	9:1	2.6:1	3.8:1
Balance-to-Unbalance Ratio (high ratio preferred)	10:1	1.4:1	5.8:1	7.1:1

Typical Comparison on Channel 12

list price $24.40

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RCA WO-56A

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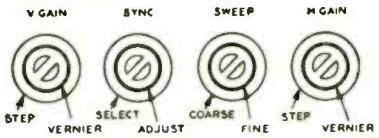

No hunting or fumbling for controls when adjusting Vertical Amplifier Gain, Sweep Frequency, Sync Injection, and Horizontal Amplifier Gain.

ONLY $217.50

Suggested User Price

Complete with direct probe, 10-megohm low-capacitance probe, and ground cable.

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- Giant, 7-inch cathode-ray tube.
- Direct-coupled, 3-stage, push-pull, vertical and horizontal amplifiers.
- Frequency-compensated and voltage calibrated attenuators on both amplifiers.
- A set of matched probes and cables. Panel-source of 3 volts peak-to-peak calibrating voltage.
- Identical vertical and horizontal amplifiers with equal phase-shift characteristics.
- Retractable light shield for convenience and visibility.
- New *green* graph screen with finely ruled calibrations.
- Magnetic metal shield enclosing CR tube to minimize hum-pickup from stray fields.

SPECIFICATIONS—

- Deflection Sensitivity: 10 rms millivolts per inch.
- Frequency Response: Flat within -2 db from dc to 500 kc; within -6 db at 1 Mc useful response beyond 2 Mc.
- Input Resistance and Capacitance: 10 megohms and 9.5 uuf with low-capacitance probe.
- Square-Wave Response: Zero tilt and overshoot using dc input position. Less than 2% tilt and overshoot using ac input position.
- Linear Sweep: 3 to 30,000 cps with fast retrace.
- Trace Expansion: 3 times screen diameter in vertical and horizontal axis, with 3 times centering control.
- Size 13⅜" h, 9" w, 16⅜" d. Weight only 31 pounds (approx.).

ADVANCED SWEEP FACILITIES—

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- Positive and negative syncing for easy lock-in of upright or inverted pulse waveforms.
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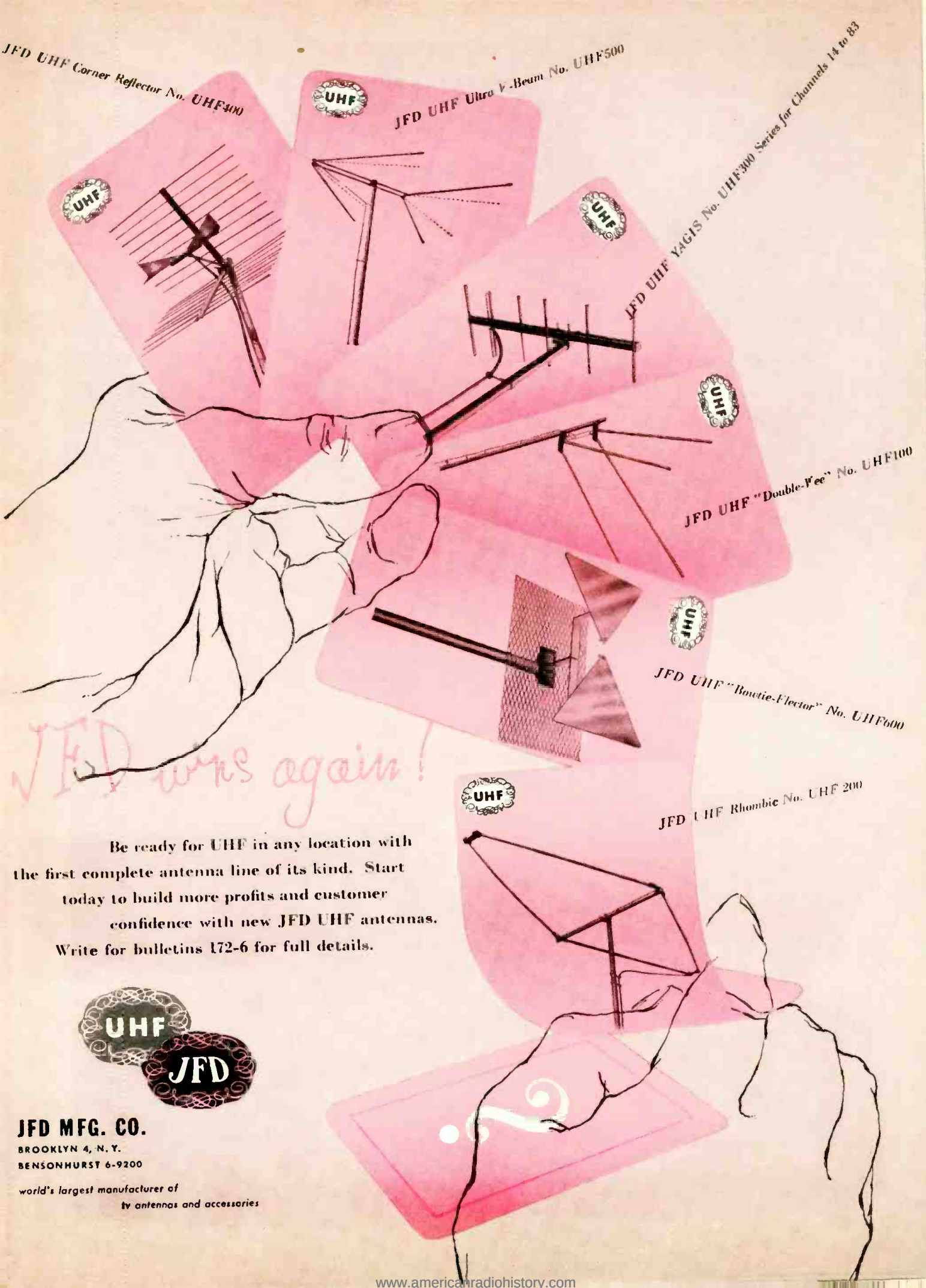

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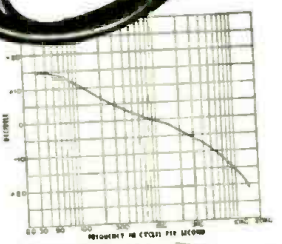
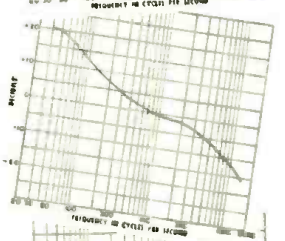
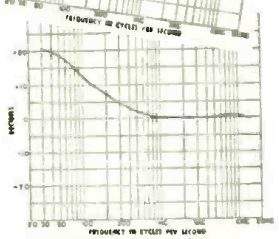
LP POSITION. The LP (Long Playing) playback response is intended basically for use with Columbia 33⅓ RPM recordings and modern Columbia 78 RPM shellac pressings. This position is used with any record having the LP recording characteristic.



AES POSITION. The AES (Audio Engineering Society) playback response has been proposed as a compromise response for all modern recordings. It has somewhat greater bass (below 100 cps) and treble response than the LP curve, and may be used in preference to the LP when such increased response is desired. It may be used to advantage with RCA 33, 45, and 78 RPM recordings, and with many other recent recordings.



FLAT POSITION. The flat position has no roll-off or attenuation of response beyond 1000 cps, which results in maximum high frequency response. Records having low background noise and distortion may be reproduced in this position with maximum brilliance. This position has no effect on the circuit, and the corresponding curve is therefore the response curve of the preamplifier and G.E. cartridge (with no cartridge loading resistor) based on constant stylus velocity.



GOOD (early 78). This position is intended for records having a noticeable amount of high frequency distortion or where the background noise is excessive and composed of frequencies higher than those recorded. It is particularly useful for 78 RPM shellac pressings that are in good condition. Brilliance is obtained through the useful portion of the response with sharp attenuation occurring at all frequencies beyond 7500 cps.

POOR (early 78). This position is intended for early 78 RPM shellac records having limited high frequency response and a high noise level. Moderately sharp attenuation occurs at all frequencies above 4000 cps.

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GENERAL ELECTRIC

Spot Radio News

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

By RADIO & TELEVISION NEWS' WASHINGTON EDITOR

THE POUNDING BATTLE FOR TV frequencies, delayed for over four years by the cease-allocation order of September '48, erupted with a fury during the late Fall months, as applicants buried the Commission's offices with demands to be heard on the channels they earnestly thought they should be awarded. And as this column was being prepared, the arguments were still loud and furious, and will probably grow in vigor and number during '53.

Competition for very-high bands in the far west set the stage as the hearings began, with four applicants asking for a pair of v.h.f. channels in Denver, and a dozen serving notice that they wanted three very-high rights plus the authority to operate a u.h.f. station, too.

Channel 7 was the tug-of-war victim during the initial sessions, with Aladdin Radio and Television, operators of KLZ and some theaters, and Denver Television, who also owns a chain of theaters, asking for the choice spot. The popular channel 4 was also in the contest ring, with KMYR Broadcasting and Bob Hope's associates seeking the rights; Hope and his colleagues became owners of KOA in the late summer, paying over $2,500,000 for the Denver property.

An assortment of legal entanglements appeared as the contestants pleaded their case. Anti-trust suits, entered earlier, against and by the theater interests involving substantial damage claims, were hotly debated as issues which must be considered before channels are approved. While, it was noted, the individual suits cannot be afforded a trial during the hearings, it was said to be necessary to evaluate the factors involved and balance them against an ultimate decision. Supporting the interests of Denver TV was none other than the former assistant general counsel in charge of the broadcast division of the Law Department, Harry M. Plotkin, this time serving as a member of the law firm of Arnold, Fortas and Porter.

A revealing study of station costs emerged as the contestants were examined. In an exhibit, submitted by KLZ-TV, it was disclosed that the total cost for facilities alone would be close to $600,000, and over $600,000 would be spent for operation. Over a quarter of a million dollars will be used to meet the annual payroll for around 60 persons. During the first year, it was admitted that a loss would be suffered, but the second year should provide a satisfactory profit. Testimony also disclosed that a substantial portion of the money required will be supplied by a bank loan plus loans from stockholders.

The south and midwest were embroiled in another brace of hearings; Tampa and St. Petersburg, Florida, contestants seeking channels *8* and *13*, and Wichita, Kansas, applicants asking for channels *10* and *16*. Two newspapers and some ad men served notice that they would like to have the channel *8* TV spot, while a newspaper, department store operator, and a group of business men sought channel *13*. In support of its claim to channel *8*, WFLA, owned by the *Tampa Tribune*, indicated that nearly a million dollars would be spent to build a station if they received the green light. A staff of 72 would be employed, and expenses were estimated as over a half-million dollars for the first year. The *Petersburg Times*, operators of WTSP, also asking for channel *8*, declared that they would spend over a million dollars for construction of a new TV station, and over six hundred thousand dollars for operations, with a staff of 55.

Not only were law and finance headlined at the sessions, also covered were the technical qualities of personnel at the engineering helm, antenna sites and their relation to coverage and possible interference, and program preparation. It certainly appears as if an extremely sincere effort is being made to investigate every facet of potential management control and technical facilities before the rich channel awards are made, a task that will truly demand shrewd decisions.

AS THE FIGHT FOR CHANNELS roared on, the Commission continued to grant approvals for ultra-high and very-high frequencies. At this writing, the south and west were still holding on to their leadership in the race for initial awards. Texas was again particularly prominent on the grant calendar: KEPO in El Paso received channel *13* and will operate with an *erp* of 120 kilowatts; KGNC, Amarillo, won channel 4, and will use 100-kilowatts *erp*; KFDA, also in Amarillo, received approval for channel *10*, and

will have a 56-kilowatt output; KCBD, Lubbock, will be allowed to use channel *11* with a power of 92 kilowatts, while the Texas Telecasting Company, also located in this city, will use channel *13* with an *erp* of 31 kilowatts. Out in Sioux City, Iowa, the Great Plains Television Properties, received channel *36* and permission to operate with a 18.5-kilowatt output. In Pueblo, Colorado, KCSJ received channel *5* and authority to use a 12-kilowatt output. KFOR, Lincoln, Nebraska, received approval for channel *10*, and will have an output of 56 kilowatts. WLBC, Muncie, Indiana, received authorization for channel *46* and a 16-kilowatt output. In Asheville, N. C., WISE will go on the air on channel *62* with an output of 23 kilowatts. St. Petersburg, Florida's WSUN, was told they would be able to use channel *38* with a power output of 83 kilowatts. KTTS, Springfield, Missouri, received a channel-*10* award and will operate on 12.5 kilowatts. The eastern sector also appeared on the award schedule, with several interesting grants: WFPG, Atlantic City, received an okay for channel *46* and an *erp* of 18 kilowatts; WATR, Waterbury, received channel *55* and approval for an output of 245 kilowatts; and WEST, Easton, Pennsylvania, won channel *51* and a power of 2.25 kilowatts. The latter approval was won only after a bitter contest, which resulted in dissents from three Commissioners; Headman Paul Walker, Eugene H. Merrill, and Frieda Hennock. WKNB, New Britain, Connecticut, who had received one of the earliest approvals for channel *30*, and then was told it could not proceed with construction until channel reallocations in six cities had been studied to correct for table deficiencies, finally received the go-ahead and is expected to proceed with construction immediately.

DOZENS OF CHANNEL WINNERS waxed quite optimistic on starting dates in their target schedules submitted to the Commission. Many assured Washington that they would be on the air before the year is out. Among those who were certain that they would begin telecasting soon were: WBRE-TV, Wilkes-Barre, Penna., (channel *28*); WHUM-TV Reading, Penna. (channel *61*); KTBC-TV, Austin, Tex. (channel *7*); WROV-TV, Roanoke, Va. (channel *27*); KDEN (TV), Denver (channel *20*); WKAB-TV, Mobile, Ala. (channel *48*); WJTV, Jackson, Miss. (channel *25*); WSBT-TV, South Bend, Ind. (channel *34*); WHYN-TV, Holyoke, Mass. (channel *55*); WAKR-TV, Akron, Ohio. (channel *49*); WKST-TV, New Castle, Penna. (channel *45*); WILK-TV, Wilkes-Barre, Penna. (channel *34*); WNOK-TV, Columbia, S. C. (channel *67*); and WEEK-TV, Peoria, Ill. (channel *43*).

THE ELECTION OF GENERAL EISENHOWER to the Presidency has

(*Continued on page* 133)

RADIO-ELECTRONIC Engineering SECTION

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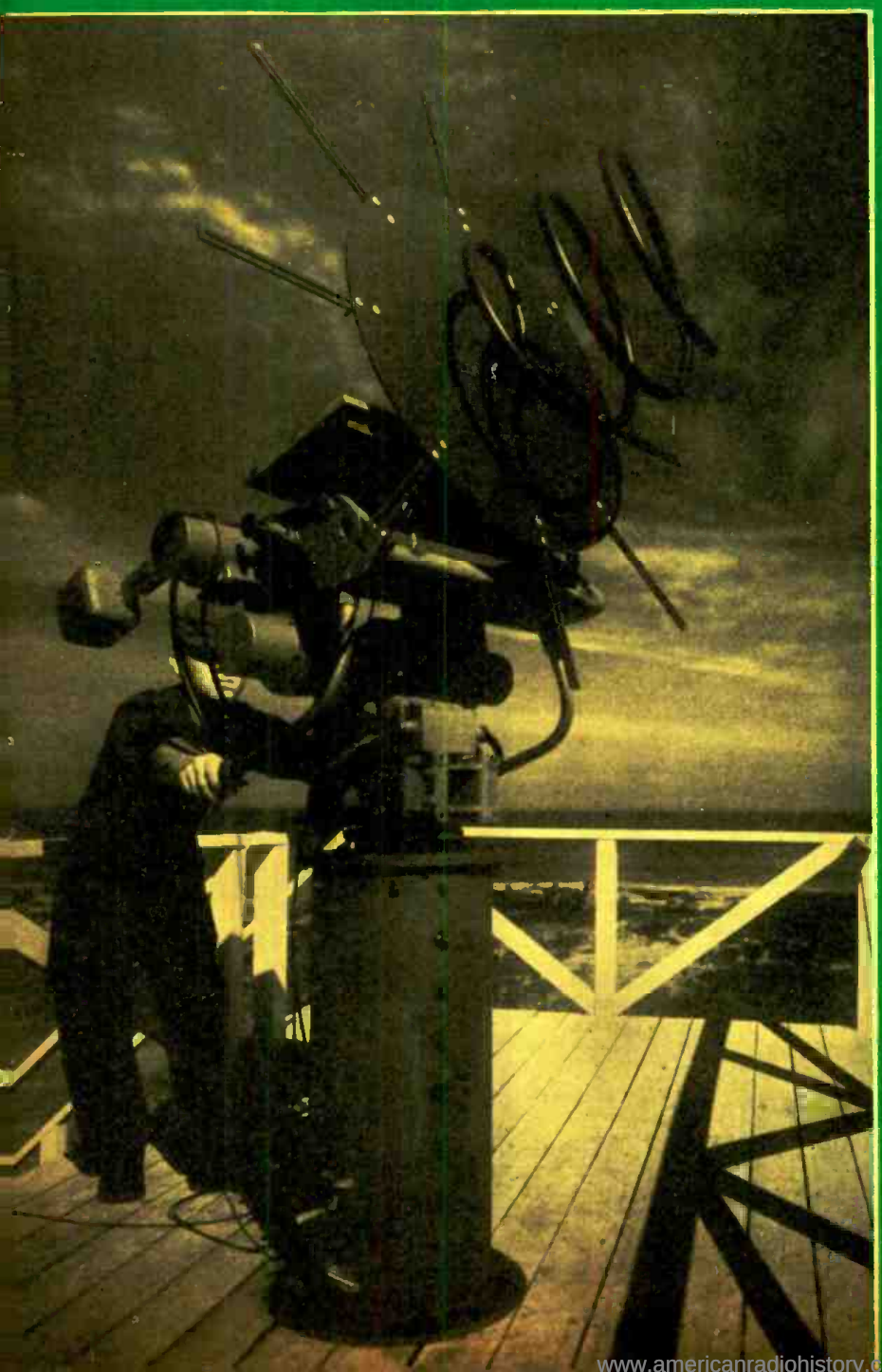

JANUARY, 1953

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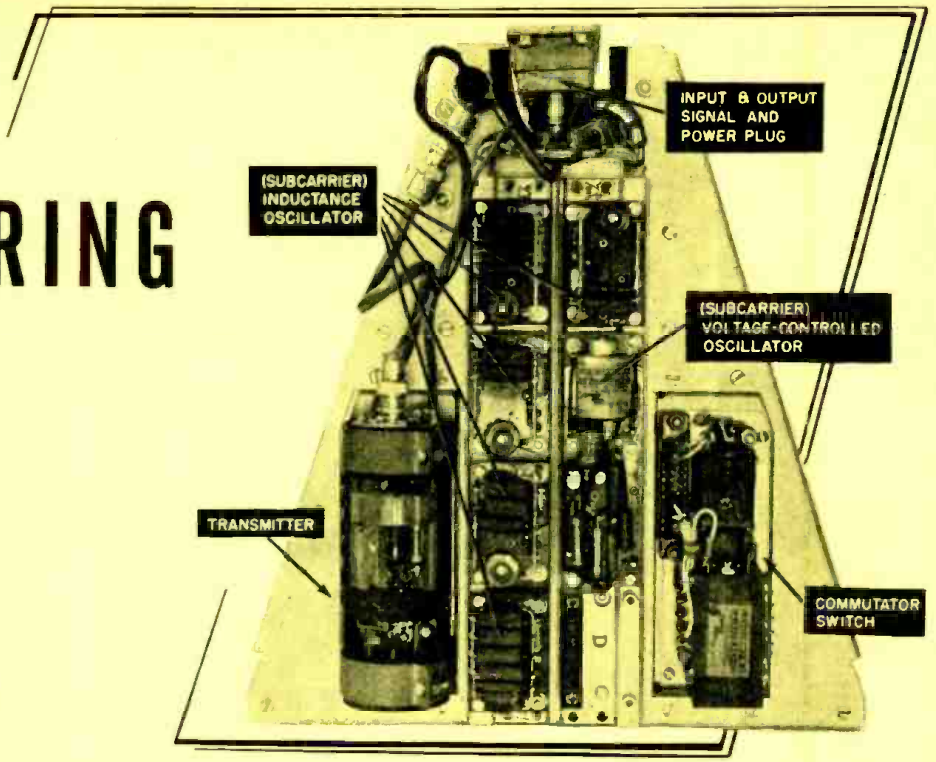
Edited by H. S. RENNE
and the Radio & Television News Staff

Helical antenna for receiving telemetering information from guided missiles. This installation is at the Air Force Missile Test Center, Cape Canaveral.

RADIO TELEMETERING SYSTEMS

By **DAVID FIDELMAN**



Guided missile FM-FM telemetering assembly which includes a voltage-controlled subcarrier oscillator, a number of variable-inductance oscillators, a commutator switch (for further multiplexing on any one subcarrier), and the FM transmitter.

Equipment and techniques used in telemetering data over long distances, as in guided missile research.

MODERN industrial and engineering techniques often require transmission of measurement data to some remote point at which central control and analysis functions must be performed. Telemetering of data from remote points is often important in applications where large distances are involved, as in the transmission of power, in railroading, and in aircraft and guided missile research. Some applications require the transmission of a relatively small amount of information over wires which are already in existence, and present no really serious problems. However, a great many important applications require the transmission of a large amount of data over radio links, necessitating very efficient use of the radio-frequency band. Such applications are encountered in much of the present aircraft and guided missile research program, in meteorological exploration, and wherever else it is impossible or impractical to connect wires for transmission of data.

The electronic installations that perform this telemetering function use equipment of considerable complexity, and must be compact, rugged and reliable, since in most cases weight and size are important factors, and often the data can be obtained only once. A number of different methods can be used to obtain the data at the remote point, to transmit it to the central receiving station, and to analyze and record it for control and further analysis at a later time. The specific setup and operation of the telemetering system depend primarily upon the requirements of the individual application. Factors that are important in determining the characteristics of the system are: the type of data which is to be transmitted; the rate at which the measured quantities vary in time; the required noise level and accuracy of measurement and transmission of the measurement data; and the number of variables which are to be transmitted.

Because of the wide variety of problems that require the telemetering of data, a number of different systems have been developed to meet the needs of the various applications. For example, some applications call for the transmission of data at extremely high speed with very good high-frequency response, others might require transmitting the result of a single measurement for a long period of time with moderate frequency response, while a great many applications demand the transmission of several different sets of data simultaneously to maintain the exact time relationship between them. The design of the different telemetering systems will, of course, be quite different, depending upon the type of data for which they are to be used. This article will illustrate some of the design principles of radio telemetering systems by describing the essential elements of systems for the transmission of a number of simultaneous sets of data on a single radio channel. The transmission of single-channel information also has many important applications, but since the multichannel systems may have all the features of single-channel systems and be at the same time much more versatile and general in their application, the multichannel systems will be emphasized.

Any radio telemetering system contains the basic component units shown in the block diagram of Fig. 3. It consists essentially of a number of transducers for converting each of the metered quantities into electrical signals, a device for combining the several electrical signals into a single composite signal, and a radio transmitter whose carrier is modulated in some manner by this composite signal. The signal from the transmitter is picked up by the receiver at the central receiving station and demodulated to give the original composite signal. This composite signal is then separated into the individual signals which, after being detected, operate an indicator to record the values of the metered quantities by means of a recorder.

The data are generally measured by some form of electromechanical transducer which changes mechanical and certain electrical quantities into corresponding electrical currents or voltages. Some of the basic physical parameters which may be measured are:

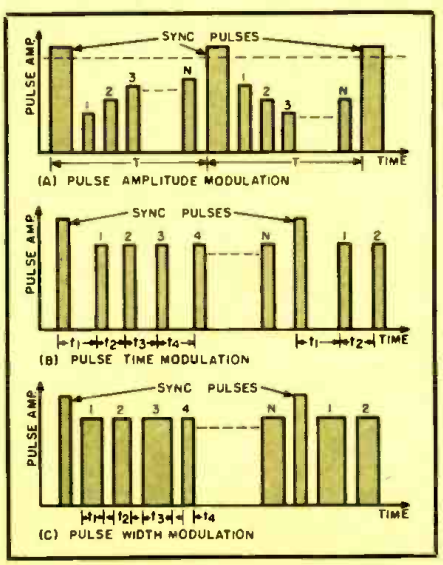
Displacement or position
Velocity
Acceleration
Temperature
Pressure
Flow
Force
Weight
Light or emissivity

A 7-track portable data recorder.

The development of several different types of compact and flexible transducers for measuring these quantities and converting them into corresponding electrical signals simplifies the design and setup of the complete system, and makes it possible to engineer telemetering systems on a unitized basis using standard units instead of having to design a completely new system for each different application.

Transducers may, in general, be designed so that the value of the measured quantity can be represented as a value of voltage or current, or as a variation in the value of a reactance. The specific type of transducer to be used in any specific application depends primarily upon the manner in which the various signals are combined, and upon the type of modulation which is to be used in the transmitter. When the type of modulation and the circuit operation require a voltage or current to be proportional to the magnitude of the measured quantity, thermocouples, variable resistance elements, and various forms of electromechanical servos are useful types of transducers. When frequency-modulated subcarrier systems are used, variable-reactance types of transducers are most convenient because they can directly modulate the frequency of an oscillator.

Fig. 1. Typical pulse trains showing composite signal for different types of time-division multiplex systems.



There are a number of possible methods for transmitting several simultaneous measurement channels on the same carrier. These methods may be divided into two general classifications:

1. *Time-division methods*, in which the various signals are transmitted on a single carrier by sampling the various signals in succession, using a sampling or switching device
2. *Frequency-division methods*, in which the various signals are transmitted on a single carrier by modulation of a number of different subcarriers in a multiplex system

Each of these methods may be employed in a number of different ways, depending largely upon the requirements of the specific applications and the manner in which the original data are derived. Considerable work and effort have gone into developing and perfecting systems of telemetering by each of these methods.

The specific types of time-division and frequency-division radio transmission systems may best be classified according to the method of modulation that is used:

Time-Division Systems

PAM-AM—pulse amplitude modulation on an amplitude-modulated carrier

PAM-FM—pulse amplitude modulation on a frequency-modulated carrier

PWM-FM—pulse width modulation on a frequency-modulated carrier

PPM-AM—pulse position modulation on an amplitude-modulated carrier

PCM-AM—pulse code modulation on an amplitude modulated carrier

Frequency-Division Systems

AM-AM—amplitude-modulated subcarrier on an amplitude-modulated carrier

FM-AM—frequency-modulated subcarrier on an amplitude-modulated carrier

AM-FM—amplitude-modulated subcarrier on a frequency-modulated carrier

FM-FM—frequency-modulated subcarrier on a frequency-modulated carrier

Although other variations and combinations are possible, these methods represent the majority of those in general use at the present time.

Since the method of modulation and the transmission system determine the signal-to-noise ratio, the maximum range obtainable with a fixed amount of power, and the amount of information that can be transmitted in a given amount of time, certain of the modulation methods give better results than others. In general, PAM-FM, PWM-FM and PPM-AM are the best time-division methods, while FM-FM is the most widely used frequency-division system.

In the basic time-division method of transmitting information, signals in the various channels are sampled in sequence by means of some sampling or switching device. This may be done by either a mechanical or an electronic switch. The signal to be recorded will, therefore, consist of a series of pulses, each of which represents the magnitude of a single channel at that particular instant of time.

When time-division telemetering is used for the transmission of information, the various inputs as shown in the block diagram of Fig. 3 are applied to the inputs of a commutator sampling device. This commutator may be either a mechanical or an electronic channel switch. The output signal from the commutator consists of a series of pulses of one of the types shown in Fig. 1. In *pulse amplitude modulation* systems, the various pulses have essentially constant width and position but vary in amplitude; in *pulse time modulation* systems, all the pulses have constant amplitude (except for the synchronizing or reference pulse), but their relative time position varies; in *pulse width modulation* systems, the amplitude and relative time position of the pulses remain constant with the pulse duration varying. *Pulse code mod-*

ulation is essentially a specialized form of pulse amplitude modulation (or of any of the other systems) in which the data signal is converted into a sequential group of pulses representing a binary code.

The resulting series of pulses from the output of the commutator is a single-channel signal which modulates the r.f. carrier and is transmitted on a single radio channel to the receiver. When the signal is received and demodulated, it consists of the same series of pulses as shown in Fig. 1. This series of pulses must then be separated into the correct channels. The decommutator for performing this function is usually an electronic switching circuit which can be properly synchronized, since a mechanical switch would have too much inertia for correct synchronization. After the pulses have been demodulated, the information they contain is in the form of pulses as shown in Fig. 5. These pulses must be integrated in order to deliver the original signal again as a continuous waveform. By the sampling theorem, if the time interval between pulses is T, then the highest frequency component which can be reproduced is $1/2T$ cycles per second (although a higher number of samples is, of course, preferable for high accuracy systems). This limitation determines the requirements of the commutator switching system and of the transmission system.

Mechanical switches are commercially available which are capable of as many as 60 contacts at rates up to 60 rps—i.e., 3600 contacts per second—and experimental switches have been able to sample as many as 12,000 contacts per second. Thus, assuming 3600 contacts per second with each alternate contact left blank to give break-before-make isolation between adjacent channels, and connecting the contacts in groups to give maximum frequency response in each channel, a ten-channel system would then be sampled every 1/180-second per channel while a five-channel system would be sampled every 1/360-second per channel. This would permit a frequency response up to 90 cps for the ten-channel system and up to 180 cps for the five-channel system. When the required frequency range falls within the limits obtainable with such switches, it is often simplest and most convenient to use mechanical commutation inasmuch as these switches are compact, reliable, quite versatile because of the many wiring combinations possible, and result in simpler circuits than electronic switching methods. A photograph of a standard commercial sampling switch designed to sample 60 contacts at rates up to 60 rps is shown in Fig. 2.

When better high frequency response is required, and for systems where this type of switching is not applicable, electronic switching systems must be used. Practical electronic commutator circuits have been developed which can provide 16 data channels with 6400 information samples per second in each channel. In electronic commutators for pulse amplitude modulation, the input voltage is applied to the grid of an amplifier tube which is gated to conduct at the proper time by means of a proper synchronizing pulse generator. In pulse width and pulse time modulation systems, the input voltage signal controls the time of firing of a multivibrator, a thyratron, or of some similar circuit whose timing can be made to depend upon input voltage.

The frequency-division system makes use of a number of subcarrier oscillators of different frequencies which are modulated by the signals to be transmitted, and the modulated subcarriers are then combined into one composite signal which can be transmitted on a single carrier. Modulation may be either AM or FM, depending upon the requirements of the system.

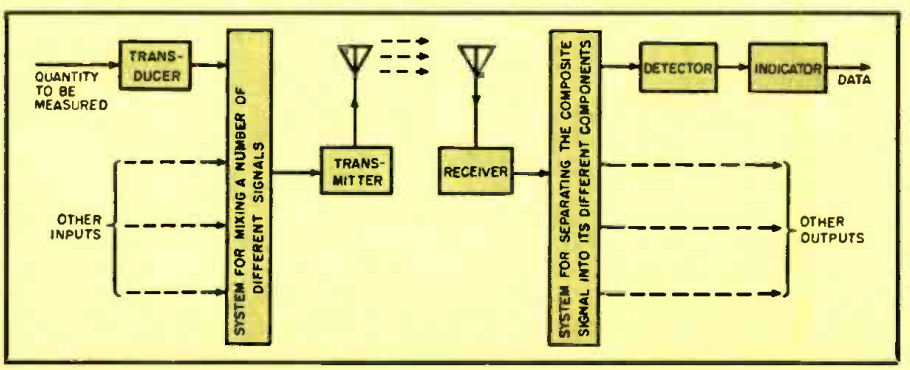
The basic block diagram for a frequency-division multiplex system is shown in Fig. 4. Each of the various input signals is applied to the modulation input terminal of a subcarrier oscillator. When amplitude modulation of the subcarriers is to be used, the measured signal should produce a proportional voltage which can be amplified, if necessary, and then used to amplitude-modulate the oscillator. If frequency modulation of the subcarriers is used, the output of the measuring transducer may be a variable voltage which can be connected to control the frequency of a multivibrator, or a variable-reactance transducer may be used as one element in a tuned circuit to control the frequency of a tuned oscillator. The modulated subcarriers are then combined in a mixing circuit which may, in the simplest case, consist of a number of resistors properly connected to add the various signals together and give proper isolation between the different channels.

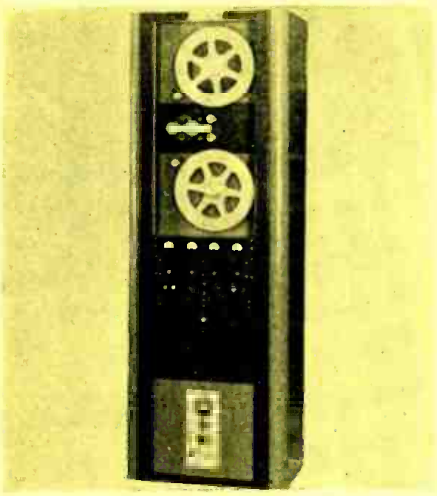
Fig. 2. The ASCOP Model 1-30-30S multichannel mechanical commutator.

Choice of the type of modulation and the design of the transmitter must represent a compromise between the required accuracy and frequency response of transmission, and the complexity, size and weight of the equipment involved. The methods of modulation are generally those which give highest accuracy and lowest noise level. As mentioned before, the PAM-FM, PWM-FM and PPM-AM are the best time-division methods, while the FM-FM is the most widely used frequency-division system. Superiority of one system over another is shown by the theoretical analyses of communication theory, taking into consideration the factors of transmitter power, range, signal-to-noise ratio, and interchannel cross-modulation.

The multiplexed signal, whether it is based upon the time-division or the frequency-division method, is then used to amplitude-modulate or frequency-modulate the carrier according to the transmission system which is being used. Nominal output power of the basic airborne telemetering transmitters generally ranges from 0.5 to 4.5 watts. Power amplifiers with outputs from 15 to 50 watts may be used with the transmitters where space and weight requirements permit, and where the transmission range is long enough to justify the increased size and weight. It has been found that a 3-watt transmitter will generally give a reliable range of from 60 to 120 miles under

Fig. 3. Block diagram of the basic telemetering system.





This Fairchild magnetic tape data recording system may be used to record telemetered data of various kinds.

line-of-sight conditions if a receiving antenna of reasonable gain is used at the receiving station.

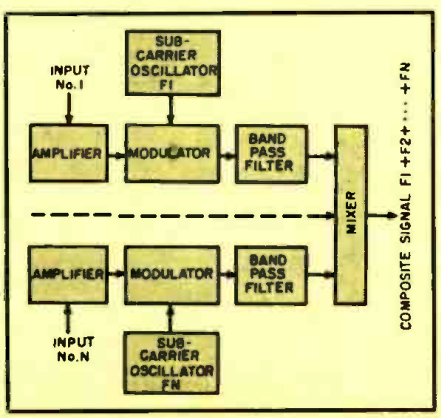
Antennas used in airborne telemetering systems represent a problem. The ideal transmitting antenna should have a spherical radiation pattern such that a uniform signal will be radiated regardless of the altitude of the transmitter, and at the same time it should not change the external surfaces of any aircraft on which it may be mounted. Radiation is often obtained by actually exciting the aircraft itself so that it acts as the radiator, by shunt exciting a control or lifting surface, or by means of faired-in slot antennas or electromagnetic wave directors such as polystyrene rods.

The requirements of the receiving station are generally much less difficult than those of the transmitter. Basically, the station consists of:

1. An antenna, high-gain and directional so that it can track the transmitter
2. A receiver suitable for detecting the type of modulation used in the transmitter
3. A decommutator or set of filters to separate the composite signal into the individual channels
4. A recorder with which to record the composite signal permanently for further study
5. A set of detectors and indicators for each channel to indicate the measured quantities as their values are being transmitted

Other components may also be included, according to the special needs of the particular application. The observing station may frequently be the control location for a missile or aircraft under observation and would therefore require special equipment for maintaining contact with the aircraft. Such equipment might consist of special aircraft instruments indicating the telemetered data for control observation by the control operator.

Fig. 4. Block diagram of basic system for frequency division multiplexing.



Antennas and receivers used at the ground stations make use of standard techniques, with the emphasis on high gain and low noise. The antennas are usually highly directive, and preferably should be circularly polarized to minimize polarization effects. Generally, 7 to 10 db gain can be obtained in the antenna with satisfactory beam width. In many installations, radio or radar tracking devices are used to follow a flight; such equipment may be used to control the antenna system so that it will be always directed toward the vehicle in flight.

A helical antenna for use in guided missile telemetering systems is shown in the cover photograph (page 1). The mounting is designed to facilitate tracking of the missile. This particular installation appears at the Air Force Missile Test Center at Cape Canaveral.

Receivers used at the observing station should have the highest possible performance, and noise should be held to a very low level. Usually, the sensitivities of telemetering receivers closely approach the theoretical. For FM receiving systems, the sensitivities are of the order of 2.7 microvolts for 20-db quieting, with noise held to 6 db or less.

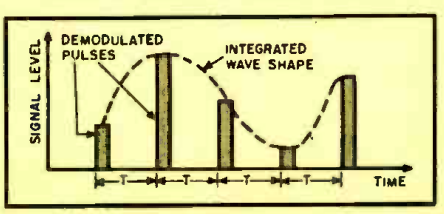
The output from the receiver will be the composite multiplex signal which must then be separated into the individual channels. The system to be used for this purpose depends upon the particular type of multiplexing that is used in the transmitter. If time-division multiplexing is used, a synchronized decommutator decodes the composite pulse signal. The various channels must be gated at the proper time, and a suitable detector provided for the particular type of pulse modulation. The pulse signal in each channel is then passed through a low-pass filter which cuts off just below the sampling frequency to restore the original signal.

Output signals from each channel may then be processed or observed in any desired manner. They may be presented on instruments for control purposes, indicated directly on paper-tape oscillograph records for study, or recorded for further study at a later time. When the signal is to be recorded for later study, the simplest and most satisfactory method is to record the composite signal from the receiver by means of a magnetic tape recorder. This method has the following advantages: a large amount of information can readily be stored on a relatively small volume of tape, it can be played back indefinitely without loss of information, and the exact time relationship of the various signals may be maintained. The composite signal may also be demultiplexed and recorded on a single magnetic tape by use of multitrack recorders, which have the same advantages and do not require further decoding of the multiplex signal.

Commercial tape recorders are available at present that have been designed specifically for the recording of telemetering information. These instruments have been designed for extremely stable motions and wide frequency response. Units are available which have as low as 0.1% peak-to-peak flutter and can be used for recording either the composite signal, several different channels simultaneously, or a combination of both. Multiple tracks can be recorded with frequency response of ± 3 db from 200 to 80,000 cps and signal-to-noise ratios of 40 db below 1% harmonic distortion for 16-minute or 32-minute recording time. More recently developed tape recorders are capable of recording as many as 14 separate channels with a frequency response in each channel of 0 to 5000 cps or 0 to 10,000 cps, depending upon the tape speed. Other information on data recording systems appeared in an article by Robert Endall entitled "Magnetic Tape Data-Recording Systems," in the March, 1952, issue of RADIO-ELECTRONIC ENGINEERING.

Use of these magnetic tape recording techniques greatly increases the flexibility of telemetering installations, for they make it possible to record the received information under conditions where it would be difficult to receive and process data immediately.

Fig. 5. Signal in each channel after decommutation and demodulation in any time-division multiplex system, showing integration of pulse amplitudes to give the original signal.



ELECTRONIC DEFIBRILLATOR

By
R. M. SHEPARD, M.D.
and
H. J. WHITEHILL JR.
Coleman Instrument & Mfg. Co.*

The instrument in its case, with the electrodes shown in front of the enclosure.

An instrument for applying a carefully controlled electric shock to the heart to halt fibrillation.

CARDIAC arrest is an acute emergency which may occur at any time in the operating room, and during any type of surgical procedure. It seems more prone to occur in cases where there has been a difficult induction of anaesthesia with cyanosis, respiratory obstruction or hypotension. Both the anaesthetist and the surgeon must constantly observe the pulse and the color of the blood so that cardiac arrest may be discovered as soon as it has occurred. The heart beat must be restored within three minutes of its cessation if it is to be successfully restored at all.

In such an emergency, the chest should immediately be opened and the pericardial sac incised. Usually the heart will be found to be still and large, having stopped in diastole. While the anaesthetist inflates the lungs, the surgeon squeezes the heart 60 to 100 times a minute. Appropriate drugs such as procaine, pronestyl, adrenalin and calcium chloride are given. Massage is continued until the heart has picked up a vigorous beat on its own.

Occasionally when the pericardium has been opened, the heart will not be found in arrest but undergoing a vigorous squirming movement. This condition is known as ventricular fibrillation, and there is no dependable way of arresting it except by the use of electric shock. In fibrillation, the writhing motions of the heart do not propel any blood, and since no medication will restore a normal beat, a defibrillator must be used if the patient is to be saved. By means of the defibrillator, a strong electric current is passed through the heart which causes all of its muscle fibers simultaneously to contract, and then relax. From this relaxed state a normal beat may be restored.

After a diagnosis of ventricular fibrillation has been made, the defibrillator electrodes are placed on each side of the heart, and a series of three shocks, lasting from 1/10 to 2/10 of a second each, are passed through the cardiac musclature. This will usually throw the heart into a period of arrest from which massage can restore a normal beat. If the heart continues to fibrillate, an additional series of shocks must be initiated until the fibrillation is stopped.

The Coleman Defibrillator

At the request of R. M. Shepard, M.D., of Tulsa, Oklahoma, *Coleman Instrument and Manufacturing Company* in July, 1952, proceeded to design a new and improved defibrillator for general use in hospital operating rooms —an instrument which would minimize risk to both the patient and the operating surgeon.

Design

This defibrillator, known as Model 173, is designed to deliver a 60-cycle output, adjustable between 0.5 and 2.5 amperes. The output is in the form of a pulse of adjustable length, automatically timed within the instrument; the pulse length interval is adjustable between 0.03 seconds and 0.50 seconds by means of a calibrated control on the panel.

The pulse network is designed so as to render impossible overtreatment of the patient through a personal error of the operator, and so that in the event of failure of any of its parts, such failure would be harmless to both the surgeon and the patient. The output of the defibrillator has no detectable electrical potential with respect to earth ground, i.e., it is impossible for the surgeon to receive a shock while simultaneously touching an electrode and a grounded object during treatment. All electrodes employed are easily sterilized and so designed as to minimize shock hazard to the user.

A test circuit is incorporated in the instrument to show that everything is in order before its application to a patient. Testing insures that the proper current intensity will be delivered to the patient's heart and also checks electrical continuity at the electrodes. These two tests are made automatically by pressing a "test" button. Under no circumstances do these tests strike an arc at the electrodes, as such an arc could conceivably touch off a disastrous explosion in a cyclopropane atmosphere.

Operation of the instrument is simple in the extreme; a previously unpracticed operator can successfully carry through a treatment.

Description

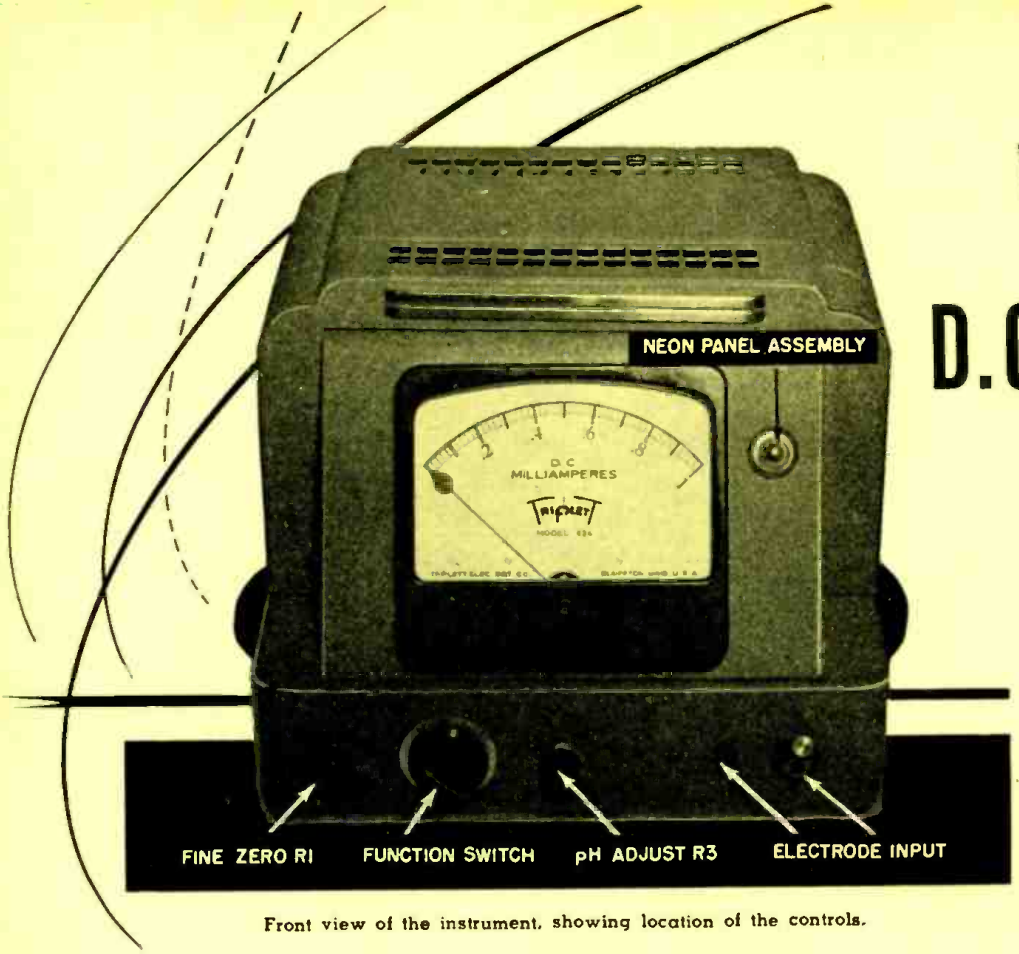
The current output to the electrodes

(*Continued on page* 30)

*716 *S. Troost St., Tulsa* 10, *Oklahoma.*

VERSATILE D.C. AMPLIFIER

By
J. S. DERESKA
Development Engr., Strong Cobb & Co.



Front view of the instrument, showing location of the controls.

Design and operation of two-stage d.c. amplifier for instrumentation purposes, such as pH indications.

DURING the course of analytical work in a shop or laboratory, the occasion often arises for measuring d.c. voltages and currents from high impedance sources. Using v.o.m.'s and standard v.t.v.m.'s for such measurements is an expensive proposition and these units, moreover, sometimes prove to be inadequate. The factor of expense particularly applies to the special commercial electronic instruments which could be used in these instances.

The problem of conveniently checking industrial temperature recorders and other instruments requiring a potentiometer for normal calibration was solved by the author through the construction of a straightforward, simple, two-stage, d.c. amplifier. This amplifier was adapted as a pH meter and has functioned as such for over two years with excellent results.

Designed to measure small currents and moderately low voltages from high impedance sources, the amplifier is well suited to electrometer tube applications. It may also be used as a fractional microammeter, a millivoltmeter, megohmmeter, pH meter, electronic polarized relay, recorder calibrator, voltmeter, and ammeter. Special features that were incorporated in the unit are: good linearity, good stability, two stages of push-pull amplification, simplicity, line operation, and the utilization of standard radio components throughout.

Tube selection was very important in the design of this amplifier since its application in pH measurements requires input tubes with very low grid current consumption for stable operation. From a survey of about 12 tubes, the 12BE6 and the 6C8G were among those readily available receiving tubes which had desirable characteristics as input tubes. According to tests made by the author, the 12BE6 has very low grid current consumption, only slightly higher than that of special electrometer tubes if used at a plate voltage of 12 volts, a screen voltage of approximately 7.5 volts, with control grid negatively biased to —2.5 volts, and with d.c. heater current reduced to 105 ma. from 150. The grid current under these conditions is about 10^{-13} amperes. The disadvantages of using the 12BE6 were that a special transformer of about 9 volts a.c. would be required, that d.c. filament operation would be essential for this degree of efficiency, and that two 12BE6's would be required for a single stage of push-pull amplification. Thus, simplicity would be sacrificed for the sake of efficiency.

On the other hand, the 6C8G has almost as low grid current with slightly reduced filament voltages and is less susceptible to line voltage fluctuations when a.c. heater-operated than the previously mentioned tube. This tube is a twin triode and hence suited to matched push-pull operation. Furthermore, it is larger and is capable of more efficient heat dissipation than the smaller tube. Also, the input grid is on top of the tube and affords better isolation than the miniature 12BE6.

After the selection of the 6C8G as the input tube, choice of a second-stage tube was made between the 6SN7 and the 7N7. Both are medium-mu twin triodes, but the 7N7 has two sections with more identical characteristics than those of the 6SN7, whose triode sections —it was found through testing—have different mutual conductances. However, sufficient adjustment range has been incorporated in the circuit of this amplifier to use the 6SN7. A 12AU7 can replace the 6SN7 if the plate circuit resistors for the input and output tubes are increased in value by about 5%.

There was considerable choice in the selection of the full-wave rectifier: types 6X5, 6X4, 6AX5, 6Z5, 84/6Z4, or even a full-wave selenium rectifier of at least 20-ma. capacity would be satisfactory. A 6H6 or 6AL5 could serve for light duty since the rectifier current does not exceed 10 ma.

Construction

On referring to the circuit diagram, it will be noticed that the circuit is straightforward; two stages of d.c. amplification boost currents of the order of fractional microamperes encountered in glass electrode measurements to over a milliampere. The circuit as shown is usable as a pH meter or millivoltmeter in the 0—250 mv. range. Use of smaller meters with less internal resistance than the one indicated will increase the sensitivity of the millivoltmeter so that the range is 0—100 mv. With more sensitive meters, greater instrument sensitivity is obtained. The range is

extendable by the use of appropriate input divider resistances.

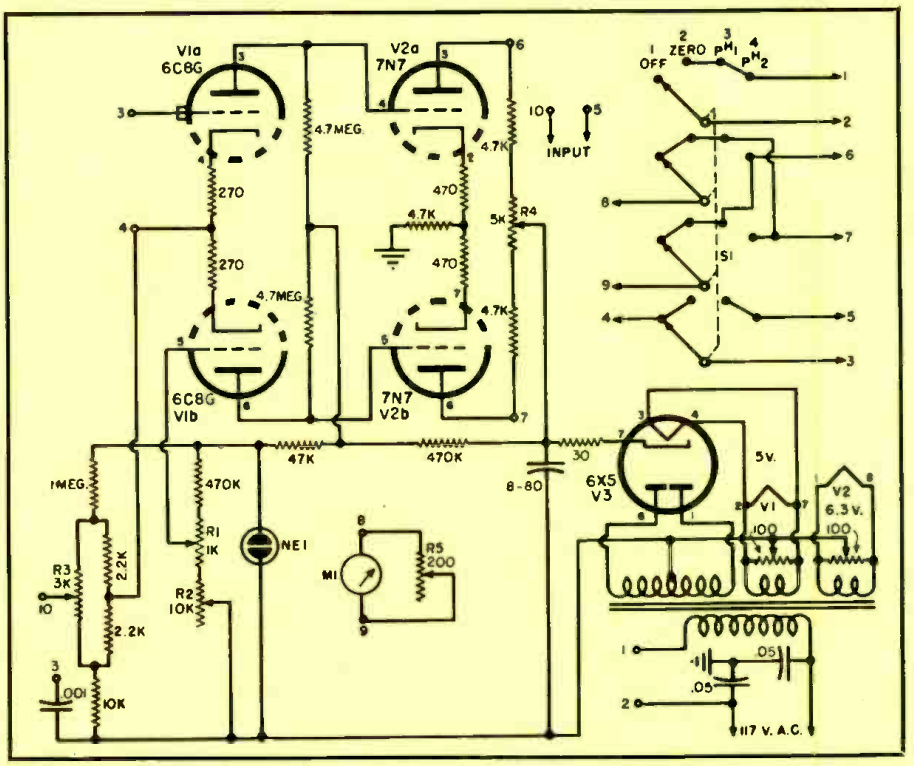
It is important in construction to keep input leads as short as possible. The insulation resistance of the switch circuit involving the grid lead of the 6C8G must be the highest possible to avoid leakage losses and instability when measuring potentials from high impedance sources.

This instrument was housed in a marine gray ripple, *ICA* "super" streamlined sloping front amplifier chassis, 10" x 12" x 3". An extra large milliammeter was used to facilitate easy reading at relatively large distances from the instrument.

Placement of parts is not too critical; however, in accordance with accepted wiring procedures, the power transformer and rectifier were located at the rear of the chassis to minimize temperature effects. The amplifier tubes were placed relatively close together in order to keep the leads short. A 10*K* "coarse zero" control was placed to one side of the 6C8G and is adjustable from the top of the chassis by means of a screwdriver.

The "fine zero" control R_1, with a knob at the left of the switch on the front panel, is available for convenient zero adjustment before a reading is taken. Some drift is inevitable and this is balanced out to obtain an initial zero reference for the amplifier. To the right of the switch on the front panel is the pH "adjust" control. This is used to calibrate the meter with buffer solutions for pH measurements, and to "zero in" the reference source.

The neon bias voltage regulator mounted on the front panel to the right of the meter serves as a pilot light; the series resistor must be removed from the panel light assembly. A standard glass electrode terminal plug adapter was made in the shop, but a similar one can be purchased from *Beckman Instruments, Inc.*, National Technical Laboratories, Pasadena, California. Special care was exercised in soldering to insure good low resistance connections.



Circuit diagram and parts values for the d.c. amplifier.

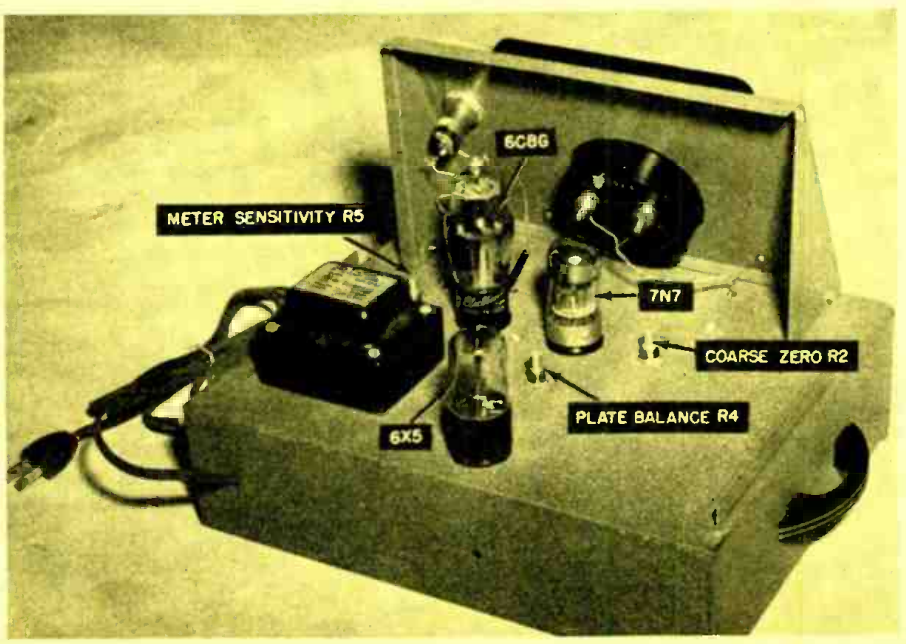
Calibration

After wiring has been completed and checked, the tubes are inserted in their proper sockets. The 6C8G is pretreated before installation; it is carefully washed in absolute alcohol and dried very carefully with a clean, dry cloth. Then a thin solution of polystyrene dope is applied to the top of the tube, just below the grid cap. The tube is rotated with the fingers at the base of the tube in such a way that the polystyrene flows around in an even film to at least one-half the length of the tube. After drying, the tube is inserted in its socket, being handled with a paper napkin in order to avoid touching the tube with the fingers. The grid cap is pushed onto the tube cap with a napkin or pliers so that it fits tightly.

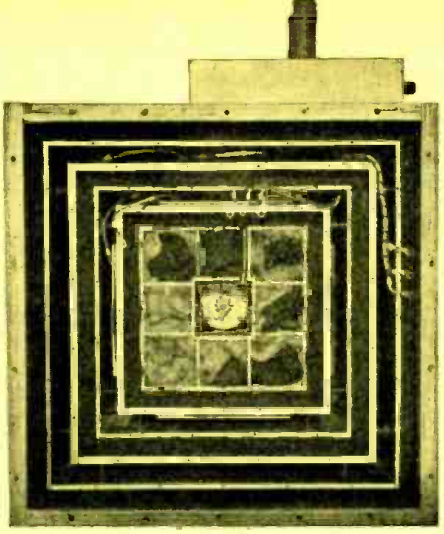
With the switch in the "off" or position 1, the line cord is plugged into a 115-volt a.c. power source, and all the potentiometers are adjusted to approximately their mid positions. Then the switch is turned one position clockwise from the normal "off" position. This second position is the "zero adjust" position. As the instrument warms up, the needle will swing over the scale and settle back close to zero. If it does not do this, the "coarse zero" can be adjusted with a screwdriver until the meter reads zero. This should be done with the "fine zero" control at mid position to allow external range control of any drift encountered. Next, the grid input lead to the pin jack should be shorted and the switch turned clockwise to position 3 or "pH adjust" on the positive polarity reading scale. The plate balance potentiometer R_4 should

(*Continued on page 28*)

Rear view of amplifier showing location of components.



Temperature control compartment containing crystal and temperature-sensitive components for one of the nine oscillators.



Temperature control compartment containing the resonator crystals of the primary standard of frequency. Crystals are in the center chamber.

THE NBS PRIMARY FREQUENCY STANDARD

Continuing investigation has improved the constancy and reliability of the NBS primary frequency standard.

By
JOHN H. SHOAF

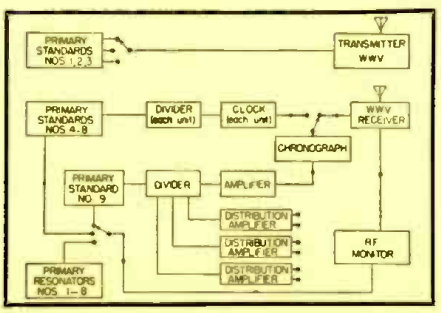
Central Radio Propagation Lab.
National Bureau of Standards

ACCOMPANYING the maintenance of the nation's primary standard of frequency is a continuing investigation by the National Bureau of Standards of methods for improving the constancy and reliability of the standard. Some modifications incorporated within the last few years include the use of resonator crystals to sustain the accuracy of the standard, more sensitive and reliable temperature controls, and precise clock mechanisms to monitor time signals. The use of new and improved components has resulted in a reduction in the number of replacement parts, and represents a considerable saving of time normally required for preventive maintenance procedures.

The NBS primary standard of frequency is the foundation upon which all time and frequency transmissions from the Bureau's radio broadcasting stations WWV in Beltsville, Maryland, and WWVH, Maui, Territory of Hawaii, are based. From these stations, standard radio frequencies of 2.5, 5, 10, 15, 20, and 25 mc. are transmitted continuously, night and day, with accuracies of 2 parts in 100 million. Two standard audio frequencies, 600 and 440 cycles (the standard musical pitch A above middle C) are broadcast on all of the radio carrier frequencies, and every five minutes they are interrupted for intervals of one minute. A pulse of 0.005-second duration occurs on each carrier frequency at intervals of one second. The time intervals, as transmitted, are accurate within ± (2 parts in 10^8 + 1 microsecond). An announcement of radio propagation conditions, pertinent only to transmission paths in the North Atlantic area, is broadcast in code on each of the standard radio frequencies.

The NBS standard consists of nine crystal-controlled oscillators and eight quartz crystal resonators. Three of the oscillators are located at the Beltsville installation of WWV—one acting as the main oscillator for all of the transmitters, the second as a standby, and the third as a spare. The remaining six oscillators and the eight quartz crystal resonators are maintained in the Bureau's Washington laboratories. All of the crystal-controlled oscillators are kept in continuous operation and the best ones—those having the least amount of deviation from 100 kc. for the immediately preceding six-month period or longer—are the units from which the standard frequency is determined.

Block diagram showing basic components of the NBS primary standard of frequency.



Oscillators are controlled by specially made GT-cut quartz crystals; the resonant frequency of each crystal is 100 kc. In examining the crystals, it has been observed that generally their performance curves (frequency vs. amplitude) have a flat region within which the crystal frequency is relatively constant. When the driving current reaches a value of about 150 microamperes, the frequency decreases sharply. In view of this fact, the driving current applied to the crystal units of the newer NBS oscillators is less than 100 microamperes. A decided improvement in performance occurs and is especially evident when compared to the older oscillators with driving currents of over 500 microamperes. In-

creased short-time stability and overall reliability have also been achieved.

The eight resonator crystals have been part of the frequency standard for about one and a half years. Each resonator's frequency is used in the analysis of the accuracy and constancy of the other nine oscillators. All eight crystals, each also with a resonant frequency of 100 kc., are installed in a single temperature-controlled oven. They do not incorporate additional components such as tubes, resistors or capacitors. They are not driven continuously but are used only once a day as part of a balanced-bridge network for comparison with one of the standard oscillators. Furthermore, the current driving the crystals is only 10 microamperes.

Once a day, the value of each resonator crystal and each standard oscillator is determined. First, a precision variable oscillator is adjusted to the frequency of one of the resonators. The variable oscillator is then compared to one of the standard oscillators, and the beat or difference frequency is counted on an electronic frequency counter with a precision of the order of parts in 10^{10}. The variable oscillator is readjusted to the second resonator crystal and again compared to the same standard oscillator. The difference frequency between these two oscillators is again recorded. This procedure is continued until data are available indicating the amount of frequency deviation present between the standard oscillator and each of the resonator crystals. One of the remaining eight oscillators is used as a reference against which all of the other oscillators are compared. Thus, data are available for determining precisely any changes, relative to the system, which may occur in any oscillator or resonator in the system.

The reference oscillator is also instrumental in obtaining a continuous record of the frequencies of the three standard oscillators at the WWV installation. Automatically, the main, standby, and spare oscillators are successively switched at preset intervals to a low power v.h.f. transmitter. The signals are beamed to the NBS laboratory in Washington and the received signals are compared to signals derived from the reference oscillator.

A more precise and reliable temperature control of the ovens enclosing the oscillators has been developed. Essentially, the oven comprises four concentric cubical chambers. The center chamber holds the oscillator unit, and the space of the next and outer chamber is filled with felt insulation. An air-chamber containing mat heaters separates the insulated chambers. The outer heater, designed for coarse temperature control, is controlled by a simple mercury thermostat. Control of the inner heater, designed to respond to very small changes in temperature, is achieved by using a network in which the heater element is part of the sensing circuit. In effect, one pair of arms of a resistance bridge is made up of wire with a high temperature coefficient, and the other pair is made up of wire of negligible temperature coefficient. Current through both pairs of wires supplies the necessary heat. An oscillatory circuit, composed of the bridge connected between the input and output of a high gain amplifier—essentially a feedback loop—controls the temperature. When the temperature is near the desired value—the bridge being slightly unbalanced—the amplifier is in a stable condition. As the outer temperature of the oven decreases, the bridge becomes further unbalanced and the amplitude of the output oscillations increases so as to supply more current to the bridge wires and, consequently, more heat to the oven. This condition will continue until the temperature regains the operating assigned value. Under normal room conditions, the temperature is controlled to better than 0.001° C.

The temperature-control oven for the eight resonator crystal units is constructed with six concentric cubical chambers. All eight crystals are enclosed in the one oven and the temperature control is achieved with mercury thermostats connected to both the inner and outer heaters. Inner temperature variation is less than 0.005° C for average variations in room temperature. The standard oscillators at the NBS transmitting station in Beltsville are installed in a room approximately 6 feet on a side built about 25 feet below the ground. The entire room is temperature- and humidity-controlled.

Each of the basic oscillators is equipped with an individual power supply and improved filter in order to achieve better regulation and control. The supplies all have plate and filament batteries that are continuously float-charged, and in the event of an a.c. power failure, they can carry the full load for many hours.

In order to monitor the time signals generated by the frequency standard accurately, one of the NBS standard oscillators is used to drive a synchronous clock. The 100-kc. output of each oscillator is electronically divided to a frequency suitable for driving a spark chronograph and chronoscope. The instruments are designed so that the

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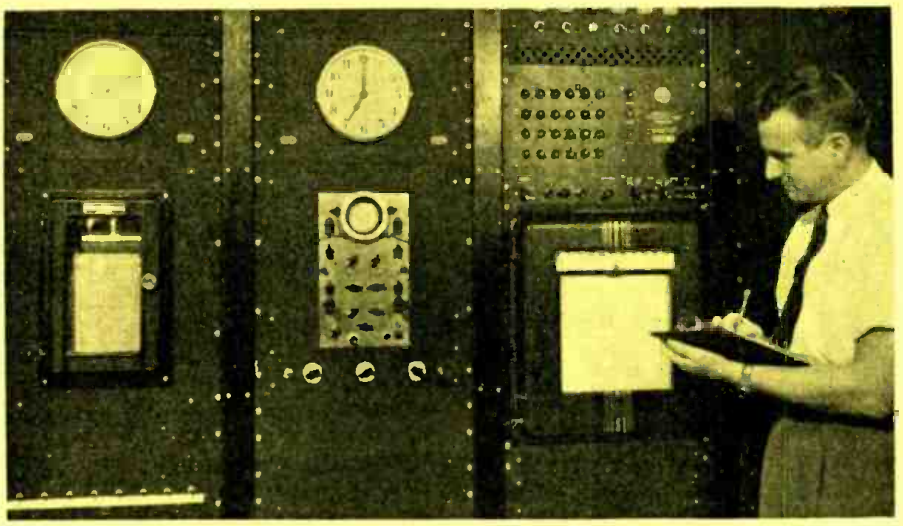
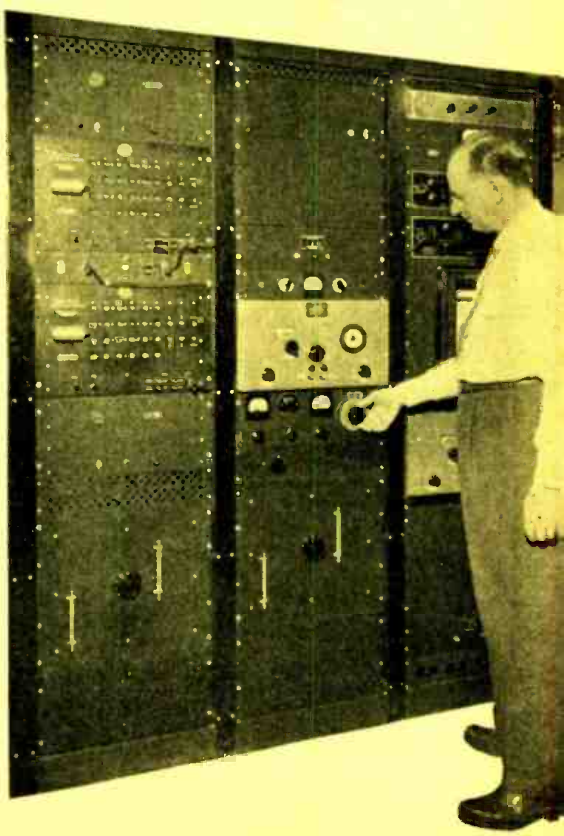


Frequency monitoring equipment of the NBS primary standard of frequency and time.

Primary resonator frequency standard.



WIDE RANGE FREQUENCY CALIBRATOR*

An unusual circuit is used to provide subharmonics and harmonics of a 2.5-mc. crystal over the range of 0.25–250 mc.

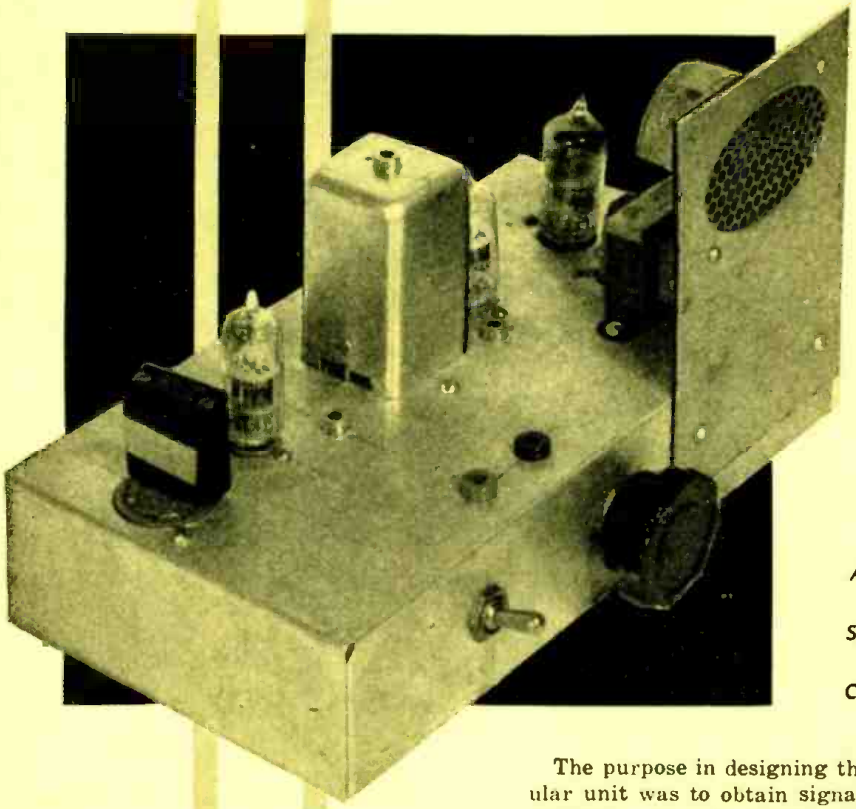


Fig. 1. Over-all view of the calibrator, showing location of controls and components.

By **J. F. STERNER**
Tube Dept., Radio Corp. of America

THE frequency calibrator described in this paper is a relatively simple calibrating device having a high degree of accuracy. It has been developed for use in u.h.f.-v.h.f. signal generators for both development laboratories and technical service shops. This calibrator may be used for determining the frequencies of unknown signals and for the production of usable signals from at least the tenth subharmonic to the harmonic more than one hundred times the fundamental of the crystal-controlled reference frequency.

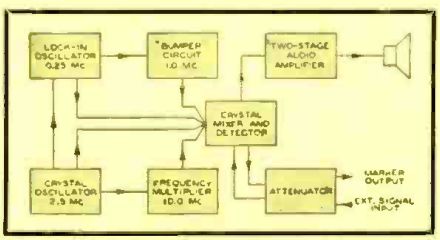
Fundamentally, the calibrator consists of a crystal-controlled oscillator circuit, a frequency-multiplier circuit, a lock-in oscillator, a germanium-diode detector and mixer, a germanium-diode detector, and a two-stage audio amplifier. Novel features incorporated in the calibrator are an *LC* multivibrator which locks in with the crystal oscillator at one-tenth the crystal frequency, a "bumper" circuit in the cathode of the lock-in oscillator which increases the output at frequencies that are direct multiples of the tenth subharmonic of the crystal frequency, and a one-tube, two-stage amplifier utilizing the pentode-triode type 6X8.

**This article is based on a paper presented at the National Electronics Conference which was held October 29, 30 and November 1, 1952.*

The purpose in designing this particular unit was to obtain signals having relatively even amplitude throughout the range of 0.25 mc. to 250 mc. from the harmonics of a 2.5-mc. crystal oscillator and a 0.25-mc. lock-in oscillator. It was also considered desirable to provide a method of detection having adequate sensitivity for determining the frequency of unknown signals that may be applied to the calibrator at levels of 100 millivolts or more. The 100-millivolt figure was a minimum sensitivity figure established for 100 milliwatts of audio output at 1000 cycles.

Figure 2 is a block diagram showing the basic arrangement of the three-tube frequency calibrator and its sectional functions. At the bottom left-hand side is the 2.5-mc. crystal oscillator, and adjacent to it is the frequency multiplier amplifier. Directly above the crystal oscillator is the lock-in oscillator, and adjacent to that is the 1-mc. "bumper" circuit. The output voltages of all four of these circuits are combined and fed into the crystal mixer and detector stage. The combined signals, after passing through the attenuator stage, are then available as a marker output. When an external signal input is applied to the attenuator, it is rectified and heterodyned at the mixer stage with the composite signal from the oscillators. The resulting beat-frequency signal passes through the two-stage audio amplifier and can be heard from the speaker.

Fig. 2. Block diagram of the calibrator.



Crystal Oscillator and Multiplier

Figure 7A shows the circuit utilizing the twin-triode type 6J6 for generating the fourth-harmonic 10-mc. signal. The 2.5-mc. oscillator using one triode section of the 6J6 is a "Miller" type oscillator. A trimmer capacitor is placed across the crystal to provide a small degree of adjustment for "zeroing in" on a primary standard signal, such as radio station WWV, during the initial adjustment of the calibrator. The second triode section of the 6J6 is a conventional multiplier stage with the plate circuit tuned to 10 mc. Sufficient driving voltage is applied to the grid of this section so that the harmonic output is about the same as that appearing in the plate circuit of the 2.5-mc. oscillator tube. Other twin triodes, such as the 12AT7 or the 6BQ7, produce about the same performance.

Figure 7B shows an alternate oscillator-multiplier circuit using the miniature pentode type 6AU6. This circuit works effectively, but appears to be more subject to variations in output activity from one crystal to another for a given fundamental and harmonic output. In addition, a high value of screen voltage was required to produce the same voltage level at 2.5 mc.

Lock-in Oscillator and "Bumper"

The lock-in oscillator circuit, together with the "bumper" circuit in the cathode, is shown in Fig. 4. Except for the addition of the tuned circuit in

the cathode, this is a conventional oscillator circuit of the multivibrator type. The free-running frequency of the oscillator is approximately 0.25 mc. The 2.5-mc. sychronizing voltage from the crystal oscillator is injected at the cathode of the lock-in oscillator. It was found experimentally, however, that synchronization was just as effective with the synchronizing voltage applied to either the control grid or the cathode. Before the addition of the 1-mc. tuned circuit, the amplitude distribution of the higher frequency harmonics of the 0.25-mc. signal showed a definite increase every 2.5 and 10 mc. These increases were attributable to normal sideband distribution resulting from modulation in the crystal diodes and modulation of the 2.5-mc. oscillator circuit from the 0.25-mc. oscillator due to the capacitive coupling between circuits. The 0.25-mc. current of the two triode sections of the 6J6 flows through the cathode network which consists of the cathode-coupling resistor and the tapped portion of the tuned coil in the "bumper" circuit. Resonant frequency of this circuit is 1.0 mc. The 0.25-mc. current flow causes the circuit to oscillate at its natural frequency of 1 mc. This frequency is determined by the Q, L, and C of the tuned circuit. The amplitude of the 1-mc. voltage is largely dependent upon the coupling factor of the network. Even though the 0.25-mc. oscillator has a tuned circuit for controlling the 0.25-mc. free-running frequency, it also has a tendency to develop considerable harmonic voltage.

Adjustment of the 0.25-mc. lock-in oscillator and the 1.0-mc. "bumper" circuit is relatively simple and can be accomplished by loosely coupling some of the output voltage from the 1.0-mc. circuit to the antenna input of a communications receiver tuned to that frequency. The signal heard when the c.w. oscillator of the receiver is turned "on" is quite rough. Under some conditions, particularly when it is out of synchronization with the 2.5-mc. crystal oscillator, it may sound like random noise. As the 0.25-mc. circuit is adjusted, the signal will appear to jump into synchronization at 1 mc., at which time a clean c.w. note will be heard. Adjustment of the 1-mc. "bumper" circuit is made by simply tuning it for maximum signal with the receiver tuned to 1 mc.

Figure 3 is a photograph of the voltages appearing at the cathode of the 6J6 in the 0.25-mc. oscillator circuit. The relative amplitudes of the signals at 0.25, 1.0 and 2.5 mc. can be seen. (It will be noticed that the amplitude of the 1-mc. signals is only about 10 or 15 per cent greater than that of the 2.5-mc. periods. This difference in amplitude is due to the frequency-response

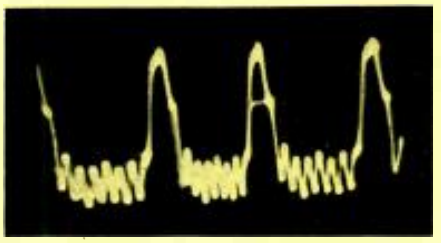


Fig. 3. Waveform of voltages at the cathode of the 6J6 in the 0.25-mc. oscillator circuit (Fig. 4).

characteristics of the oscilloscope used for photographing. In this oscilloscope, the 1-mc. response was down 6 db from that at 0.25 mc.)

Mixer-Detector Circuits

Figure 5 shows the germanium-crystal mixer-detector circuit. The four signals, at 0.25, 1.0, 2.5, and 10 mc., are coupled through isolating capacitors to the anode of a 1N34 crystal diode. Nonlinear characteristics of the crystal diode working into a reactive load provide a voltage output that is fairly even at all frequencies up to 250 mc. The potentiometer shunted by the capacitor forms the load across which an audio beat frequency is developed when an external signal is introduced. A second 1N34 crystal diode in series with the external signal functions in a manner similar to the first 1N34 except that its load includes the attenuator potentiometer as well as the load circuit of the first 1N34. The second 1N34 is used to reduce the loading effect that would be introduced if the impedance of an external signal source were applied directly across the first 1N34. Likewise, some control of the input voltage is obtained through the attenuator potentiometer. Application of external input-signal levels in excess of 100 millivolts will produce a noticeable one-half frequency beat. The level of this spurious beat will be down about 20 db or more from the correct one and can be easily recognized, particularly if the attenuator is used to maintain the level of the input signal at the minimum required for a given audio output level. In addition, the attenuator provides partial

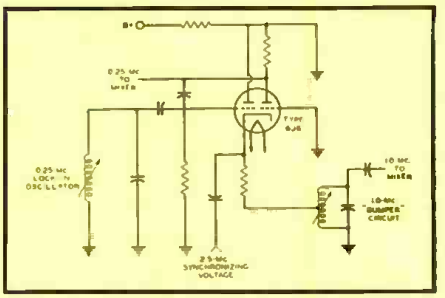


Fig. 4. Circuit of 0.25-mc. lock-in oscillator and 10-mc. "bumper."

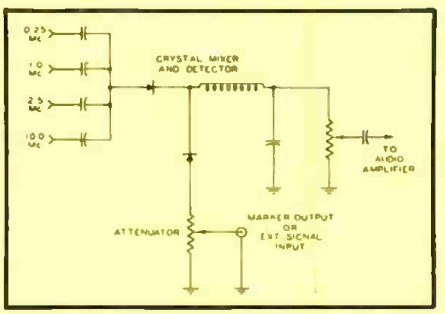


Fig. 5. Mixer-detector circuit.

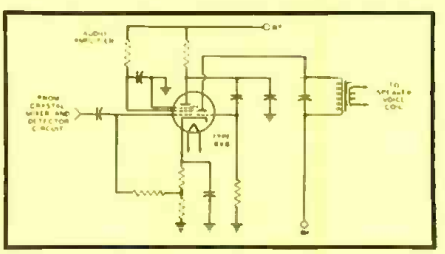


Fig. 6. Audio amplifier section.

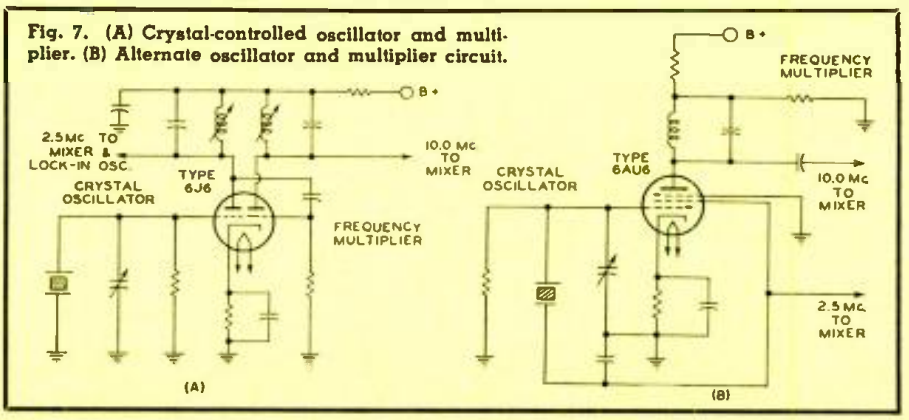
control of the marker output voltage for application to an external detector, such as a receiver. The detector circuit of the first 1N34 does not include any direct resistive return for the diodes. The current-path return circuit is dependent on the ratio of the crystal diode front-to-back resistance. Although this ratio varies considerably with individual diodes, the variation appears to have very little effect on performance.

Audio Amplifier Stage

A schematic of the audio amplifier section is shown in Fig. 6. Because it

(*Continued on page* 31)

Fig. 7. (A) Crystal-controlled oscillator and multiplier. (B) Alternate oscillator and multiplier circuit.



UNIVERSAL RECORDER-REPRODUCER

By **DOUGLAS H. CARPENTER**

The La Pointe-Plascomold Corp.

Operating details of a compact tape machine which will record continuously up to 24 hours.

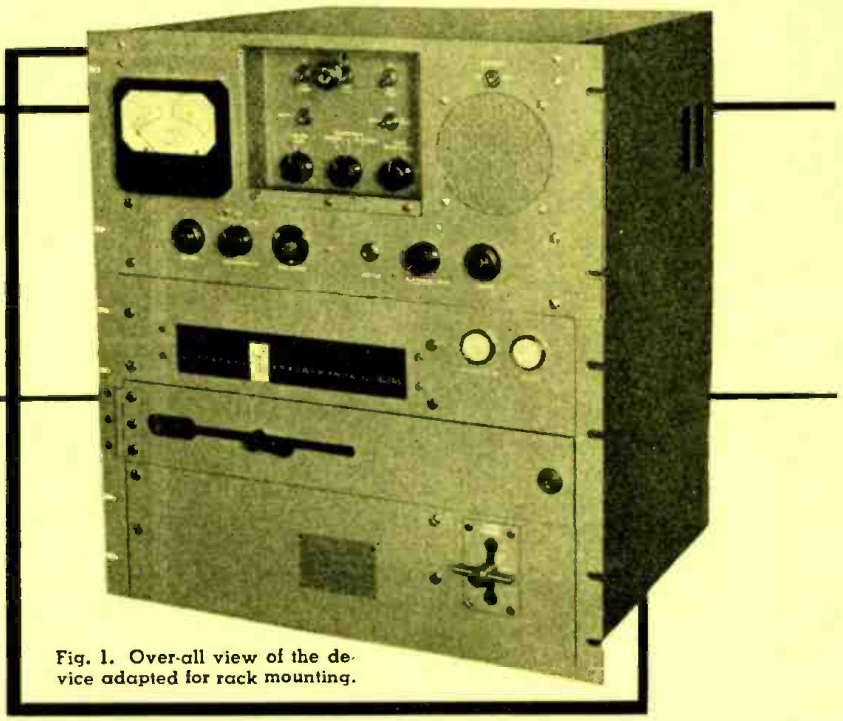


Fig. 1. Over-all view of the device adapted for rack mounting.

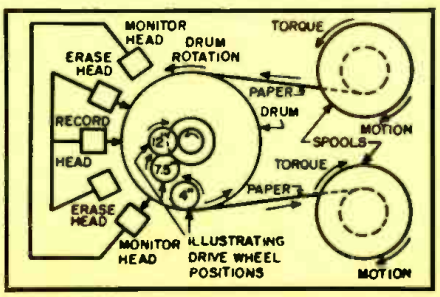
AN ENTIRELY new field in the art of audio transcription has been opened up by the invention of magnetic recorders. Their flexibility and economy of operation have proved them to be so outstandingly superior to former types of recorders that today tape recording is commonplace both in homes and in business. The armed forces were quick to recognize the many advantages of tape recorders and now use such equipment extensively. As a direct outgrowth of increasingly stringent military and commercial requirements, the *Press Wireless* Model RRP-24 was developed. To this writing, RRP-24 is the only instrument with a compact tape assembly that will record automatically and without attention for a complete 24-hour period.

The secret of the long-playing feature is directly related to the special recording medium employed, and to the rather ingenious motor drive and rewind system. Figure 2 is a simplified diagram of the basic elements comprising the recording-reproducing assembly and speed change mechanism. The recording medium used with the RRP-24 is an iron oxide coated cellulose acetate magnetic tape that is 8½" wide and 206' in length. An automatic reversing switch simultaneously changes the direction of tape travel and the amount of torque of the drum control motors; the total operation is accomplished in less than *1/40 of a second*. One roll of tape, capable of storing 24 hours of recorded intelligence, is only 3" in diameter and weighs only 2½ pounds.

The master recording head is mounted on a close-tolerance, mechanically secure carriage which also supports the two erase heads. An open view of the recording head and carriage assembly can be seen in Fig. 5. The two reproducing heads are positioned at the desired track by a control at the front panel. Each recorded track is .030" wide with .020" spacing between adjacent tracks. The carriages travel automatically from track to track on a special lead screw in such a way that the finished recording is a continuously folded track. To further clarify the exact nature of a completely recorded tape, an explanation of the mechanical and electrical control circuits is necessary. Reference to the block diagram, Fig. 7, will simplify the explanation of the control and switching circuits.

When the power switch is on, the two torque motors are energized and exert torques in opposite directions on the winding spools, keeping the tape taut on the recording drum. The Ledex cam operates switch S_{107} which alternately feeds each motor through a dropping resistor. This reduces the voltage across the torque motor and opposes the direction of paper travel, placing less drag on the drive motor. Included in the motor control circuit is a full-wave bridge type rectifier supplying d.c. for the drive motor armature and for a rotary solenoid. When power is applied to the motor circuit, a relay closes, shorting out the motor drive dropping resistor and placing the entire d.c. across the motor armature. This provides greater starting torque until a timing condenser charges and the relay opens. When the switch S_{103} is open, a type 12AU7 tube in the electronic motor control circuit tends to cut itself off, limiting plate current to a value too small to close the reversing relay. S_{103} is actuated by a silver strip located at each end of the tape. If S_{103} is closed, the 12AU7 is left with zero bias and plate current closes the reversing relay. The first section of this relay applies d.c. voltage to a rotary solenoid which in turn actuates mechanically switches S_{101}, S_{102}, S_{104} and S_{107}.

Fig. 2. Simplified diagram of the recording-reproducing system showing the action of the speed change mechanism.



Field windings of the motor are connected so that when the first is across the line, the second is in series with a condenser and a resistor. The first field voltage leads the second by some angle less than 180 degrees. When S_{104} is actuated by the Ledex cam, the two field coils are electrically interchanged, reversing the motor. At this instant, the second section of the reversing relay shorts out the dropping resistor, giving the motor an additional starting boost

in the reverse direction as was done when the motor was originally started. S_{103} is closed only for an instant as the tape stops and reverses direction. The control circuit then assumes its standby condition until the other silver patch at the opposite end of the tape initiates the same operation again.

Relative direction of spools and drum travel for an arbitrarily chosen drum rotation is indicated in Fig. 2. Each spool has its own torque motor, and these motors never change their sense of torque. However, less voltage is applied to the torque motor opposing paper travel by means of S_{107}. The Ledex cams revolve ¼-turn each time a silver patch trips S_{103}, actuating the four microswitches, S_{101}, S_{102}, S_{104} and S_{107}, as previously explained. The combination of the motor control and switching circuits just described determines the direction of tape travel. In conjunction with the lead screw, the recording head carriage assembly shifts the recorded track .020" at each tape reversal.

The exact nature of the "looped" end of the recorded track and the time required for the complete reversal are most important if the recorded intelligence is to be continuous. If one track is being recorded in the longitudinal tape direction (206 feet), the reversal time must be practically instantaneous or loss of intelligence will occur. Two different actions occur at the end of each recorded track. The motor control and switching circuits reverse the direction of tape travel in less than 1/40 of a second, and the lead screw assembly causes the recording head to inscribe a circular or "looped" end which connects the original and new track. Recording direction and tape travel have reversed, but no loss of recorded data can occur as the time involved is fractional compared to any recorded frequency. This process in the case of continuous recording repeats itself every ten minutes (24-hour speed), and a fully transcribed tape would contain 144 such tracks .030" wide separated from each other by .020".

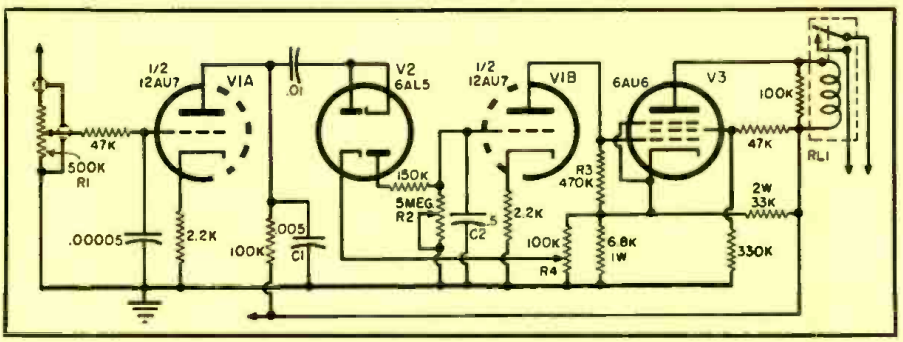


Fig. 3. Schematic diagram of the voice-operated relay portion of the circuit.

A coarse index (see Fig. 5) attached to the carriages references to a 24-hour scale calibrated in ten-minute segments. There is also a fine index which consists of a helix drawn indelibly upon the recording medium. As this line progresses laterally, being a spiral, it indexes to a ten-minute scale divided into increments of ten seconds. Accuracy of location of an earlier recording is better than ten seconds in 24 hours. To preclude the necessity of close supervision while recording, a compressor amplifier is incorporated in the audio input system. Its threshold level is preset to prevent a material increase in gain in the total absence of a signal. The audio input circuits permit both microphone and 600-ohm line connections.

Normal recording speed position for the 24-hour condition is 4" per second with a usable frequency range of 200—5000 cps. The speed change control lever is located at the lower right-hand side of the instrument, and permits a selection of speeds of 7½" and 12" per second. The high frequency response is increased to 7000 and 8000 cps respectively. Such an arrangement means that the RRP-24 can be instantly converted from speech recording to the wider ranges of music, high speed telegraph, etc.

The playback system is separate, and is comprised of two reproducing heads and a self-contained amplifier which develops three watts of audio output power. Control is automatic or manual, and can be effected by means of a foot switch. The reproducing head may be positioned to monitor immediately behind the recording head (on the same track) or, if it is desired, the head can be repositioned to reproduce a previously recorded track without disturbing the continuity of recording. Two high gain stages precede an inverter stage in the playback amplifier strip. Signal is introduced by either the monitor head (in monitoring) or the record head (in playback). The input incorporates a series resonant trap which removes the 30-kc. erase bias signal.

When intermittent recording is desired, an integral fast-acting, voice-operated relay (v.o.r.) may be switched

Fig. 4. Rear view of the amplifier section.

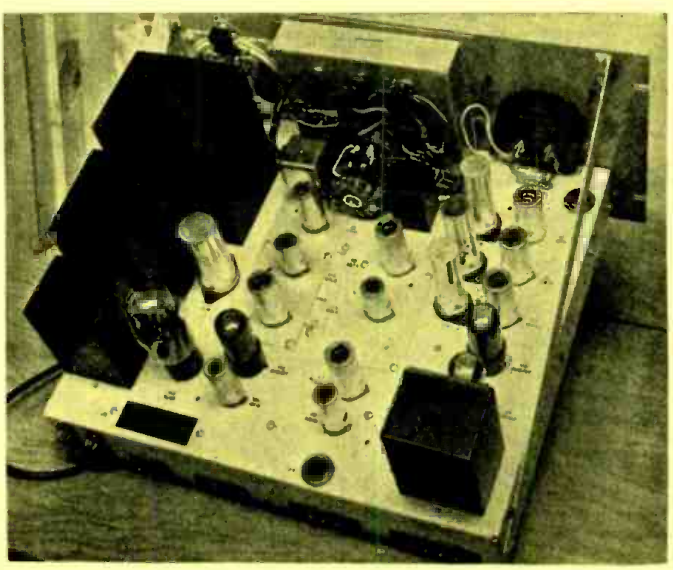
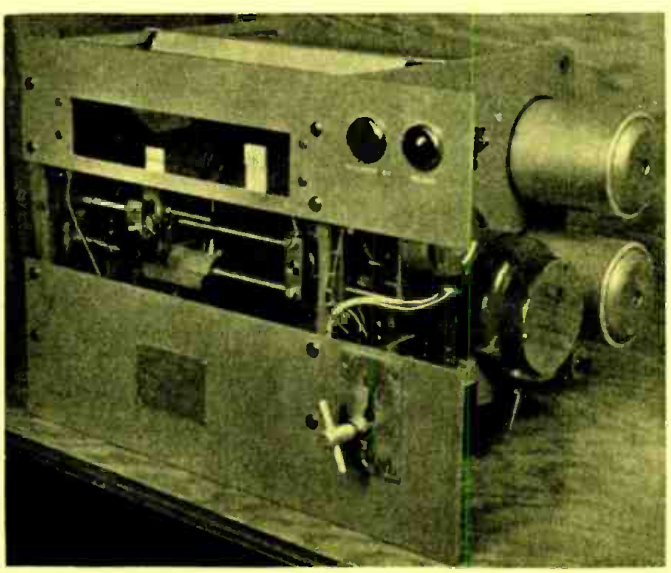


Fig. 5. Front view of the recorder section.



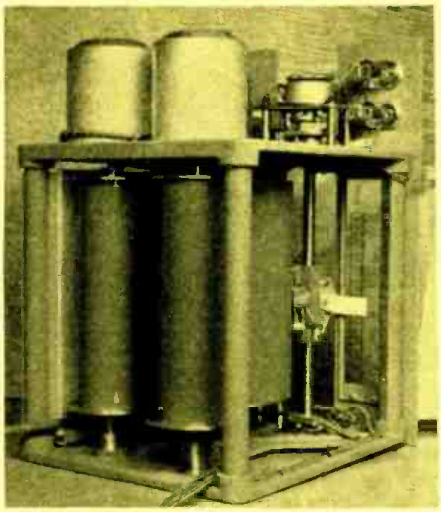


Fig. 6. Back view of the recorder section showing the tape rolls.

into operation. With such operation, one loading of tape will last well beyond the 24-hour period. The machine will shut down a few seconds after signals cease and will not restart until the input circuit receives another impulse. For this type of operation, the time element of starting is a fraction of a syllable and the stopping time is adjustable up to seven seconds. The threshold level control can be set to prevent random operations from line noises or background sounds picked up by the microphone. The voice-operated relay section is located on the amplifier chassis. The first v.o.r. stage V_{1A} (see Fig. 3) taps its signal from the v.o.r. sensitivity control R_1. This stage renders the v.o.r. circuit essentially responsive to low frequency components because of C_1 (.005 μfd.) shunting the output of V_{1A}. On negative peaks of the signal voltage, V_{2A} conducts in series with V_{2B} and charges C_2. This biases V_{1B} negatively and cuts off plate current. If the signal is absent, C_2 discharges through a variable resistor R_2 and brings V_{1B} back to the conducting state. This "off-on" action of V_{1B} is reversed to "on-off" in V_3 by means of R_3, across which a voltage switches from 0 to a relatively large negative value with respect to the cathode of V_3. Hence, with signal, relay RL_1 contacts close and permit the motor to run. Without signal, the contacts open, stopping the motor.

R_2 is a preset control through which C_2 discharges, thus determining the time delay between signal stoppage and conduction of V_{1B}. R_4 sets a threshold value for conduction through V_{2A}, and is adjusted so that noise does not cause operation of the relay in the absence of signal.

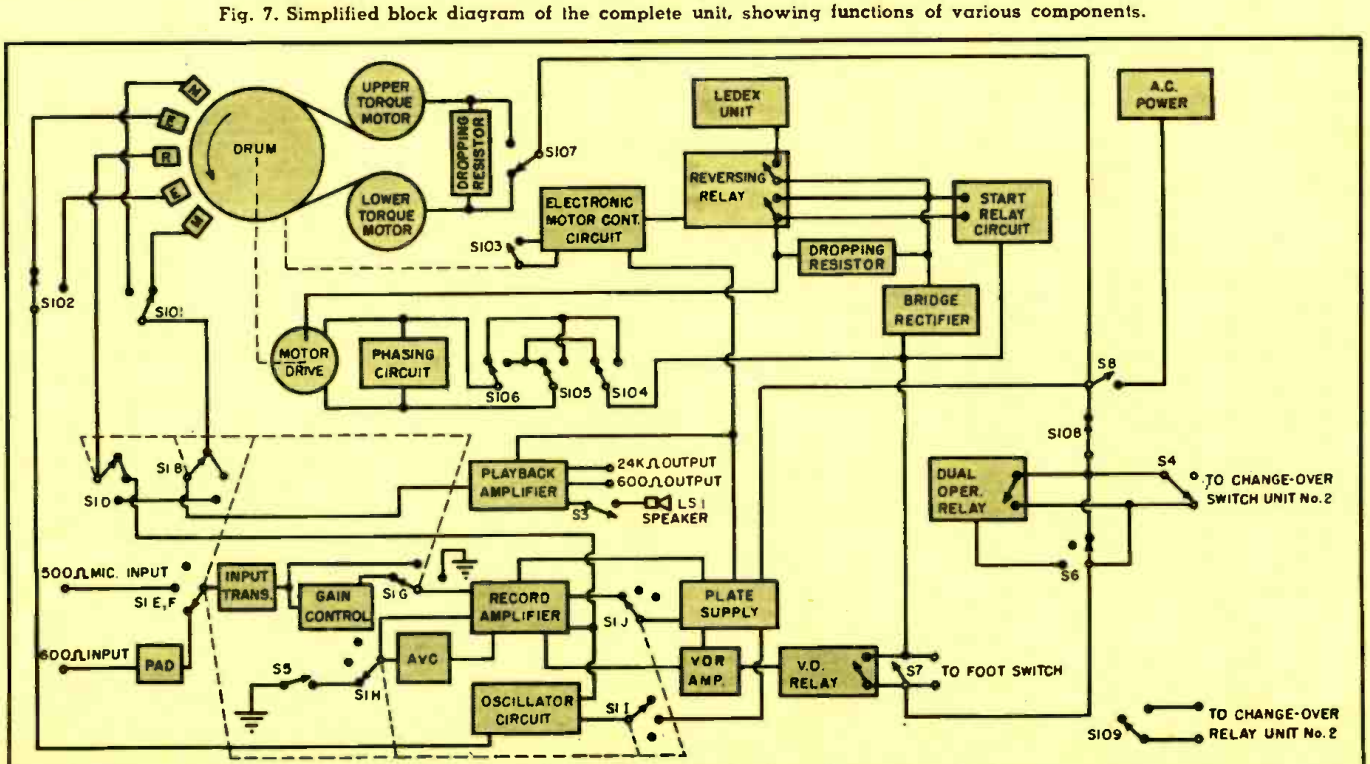
The 30-kc. erase bias voltage is generated by a conventional Hartley oscillator. This voltage is mixed with the signal before recording. The output of the oscillator is fed to the record head and also to an amplifier stage, where it is amplified and fed to the erase head.

Bias voltage is required for much the same reason as in biasing an electronic tube, i.e., in order to operate in as linear a manner as possible. In this case, linear operation pertains to the magnetization curve of the oxide-coated sheet. Erasing is accomplished by feeding a high frequency voltage to the erase head in order to create a high intensity field across its gap. In moving through this field, a magnetic substance experiences quick changes of state which are represented by a series of rapidly diminishing hysteresis loops, approaching and realizing practically a demagnetized condition. During playback, S_1 (Fig. 7) cuts off plate voltage from the oscillator and its amplifier, thus removing the bias and erase signals from the circuit.

The record amplifier consists of three amplification stages. This section is operative when S_1 is in positions 1 or 2. In position 1, the 600-ohm balanced input signal is fed through an attenuator pad to the input of the transformer. The output is fed through the record gain control to the first amplifier stage. In position 2, the 500-ohm balanced input microphone signal is fed directly to the input transformer, bypassing the attenuator pad. The output of the second stage is supplied through a level control to a separate amplifier stage in order to provide signal for the operation of the db meter, the v.o.r. and a.v.c. circuits. One half of a dual triode rectifies the output of this separate amplifier stage, developing a negative voltage across the diode load. This voltage is filtered, providing a negative bias to the first stage. The a.v.c. switch can be used to ground this circuit when S_1 is in position 1.

After the signal to be recorded goes through the second stage, it is fed to a frequency compensating network. In

Fig. 7. Simplified block diagram of the complete unit, showing functions of various components.



position 1 of S_2, corresponding in normal operation to a speed setting of four inches a second, the high frequency cutoff point of the amplifier response curve occurs higher in the frequency spectrum. In position 3, corresponding normally to a speed of 12 inches per second, the high frequency portion of the response curve is deemphasized. Following frequency compensation, the signal is fed to a pentode power amplifier stage and finally to the record head.

To extend the recording time of the RRP-24 further, a second recorder may be connected to it by a simple patch cord. Both units must have the motor control switch set to "dual." The first unit can then be set in operation at the start of recording by pressing the momentary switch to "start." When the first unit is on the last vertical scan, the second unit will automatically take up the recording function, thus giving an overlap.

A remote indicating device such as a ringing bell or flashing light may be used to attract the attention of the operator when a machine that is recording has but ten minutes of recording time left.

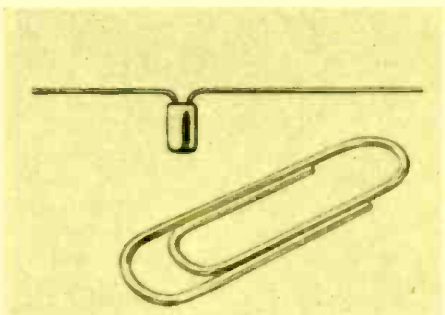
The RRP-24 has been used to advantage for diversified applications, and it is a literal fact that new uses are being uncovered daily for this versatile instrument. Some of the general uses to which the RRP-24 has been adapted are: airport control tower and airline communications center master recorder, press and commercial communications monitoring and transmission, broadcast program monitoring, information storage in computer systems, unattended monitoring for detective and police work, programming control of industrial equipment such as the production of patterns on textiles, automatic telephone answering centers, etc.

Some of the newer uses for the RRP-24 include unattended broadcast of music for restaurants and business offices from a central control point. The multiple-speed selection feature allows recording at slow speed and retransmission at an accelerated rate, cutting down wire service and telephone line charges. A similar recording rate is required at the receiving end, which is in turn played back at normal speed for transcription purposes. Distribution of confidential messages on a national basis and international transmission of facsimile data can be greatly speeded up with an attendant cost reduction by the above process. A special version of the RRP-24 will simultaneously record 24 channels, making it a valuable asset to industrial and government laboratories concerned with analysis of multiple phenomena.

NEW TUBES

SELENIUM DIODES

Two selenium diodes, Types 1S1 and 5U1, have been developed by *International Rectifier Corporation*, 1521 East Grand Avenue, El Segundo, Calif. Type 1S1 is rated for a maximum input of 26



volts r.m.s. at 100-microamperes output, while Type 5U1 is rated for 130 volts maximum at 1.5 ma.

These new diodes augment the line of eight subminiature types currently being produced by *International Rectifier Corporation* for operation in an ambient temperature range of 50 to 100°C. Extremely small in size for ease in wiring into a crowded chassis, the units are completely encapsulated within a thermosetting plastic to protect them against adverse environmental conditions.

RADIAL-BEAM POWER TETRODE

The Eimac 4X150D, a radial-beam power tetrode, has been developed by *Eitel-McCullough, Inc.* Well suited for use in 28-volt electrical systems, this tube has a heater rating of 26.5 volts at 0.57 amperes. It was designed for

use in commercial and military aircraft and other vehicular operation.

Identical in size and shape to the Eimac 4X150A, the 4X150D power tetrode can be used with the 4X150A air-system socket. Like the 4X150A, it is operated as an oscillator, amplifier, or frequency multiplier, and has a plate dissipation rating of 150 watts in Class C telegraphy or FM telephony service.

Further information on the 4X150D can be obtained by writing to the Application Engineering Department, *Eitel-McCullough, Inc.*, San Bruno, Calif.

27" TV PICTURE TUBE

Development of a 27" rectangular television picture tube has been announced by the Tube Department of *General Electric Company*. The largest picture tube made by *G-E*, it is a mag-

netic-focus, magnetic-deflection, all-glass tube. It features an aluminized backing on the screen which reflects light emitted from the back surface, thereby providing a picture which is up to 100 per cent brighter than a non-aluminized 27" tube at the same voltage, and consequently having greatly increased black and white contrast.

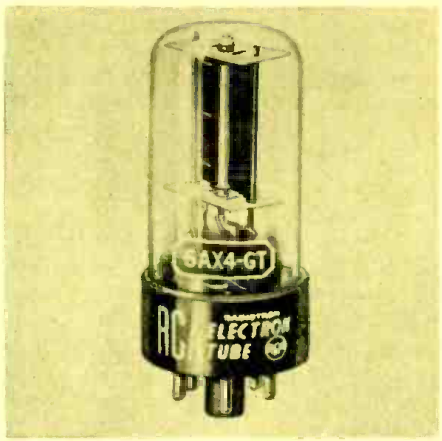
Type 27EP4 provides a 24" x 18½" picture. The length of the tube, from front to back, is less than 23 inches. Recommended operating conditions are: anode voltage, 16,000 volts; grid No. 2 voltage, 300 volts; grid No. 1 voltage, —33 to —77 volts; ion trap intensity, 38 gausses. Full details may be obtained from the *General Electric Tube Dept.*, 1 River Road, Schenectady 5, N.Y.

RCA TUBES

Half-Wave Vacuum Rectifier

Recently announced by the *RCA Tube Department*, Harrison, N. J., is the 6AX4-GT, a half-wave vacuum rectifier of the heater-cathode type. It is intended primarily for use as a damper tube in horizontal deflection circuits of television receivers.

Designed to withstand negative peak pulses between heater and cathode of



as much as 4000 volts with a d.c. component up to 900 volts, the 6AX4-GT provides flexibility in choice of deflection circuits. Heater rating for unipotential cathode is 6.3 volts at 1.2 amperes. Direct interelectrode capacitance (with no external shield) is 7.5 $\mu\mu$fd.

Twin Diode—Medium-Mu Triode

The 12BF6 just introduced by the *RCA Tube Department* is a multi-unit miniature tube of the heater-cathode type containing two diodes and a medium-mu triode in one envelope. It is intended for use as a combined detector, amplifier, and a.v.c. tube in automobile radio receivers operating from a 12-volt storage battery.

The characteristics of the triode unit are such that it can be impedance-coupled or transformer-coupled to the

output stage. In either case, the triode unit can supply more than ample output with low distortion to drive a pair of 12V6-GT's operating at maximum plate voltage in the output stage of automobile receivers.

MEDIUM-MU TRIODE

The Los Gatos brand Type 254 medium-mu triode may be operated as a

Class B a.f. power amplifier, and as a Class C r.f. power amplifier—either plate modulated or unmodulated. The 5.0-volt filament is of the thoriated tungsten type and operates at 7.5 amp.

Type 254 has a maximum average plate current of 255 ma., a maximum plate voltage of 4000 volts, and an average amplification constant of 25. A data sheet is available from *Lewis and Kaufman, Inc.*, 76 El Rancho Avenue, Los Gatos, Calif., which illustrates the tube and provides operating curves for average static characteristics.

SUBMINIATURE TRIODE

Raytheon Manufacturing Company announces a low microphonic subminiature triode designated as CK6247 (formerly known as CK628). When this tube is subjected to vibrational acceler-

ation of 15*G* at 40 cps, it has a maximum noise output of 2.5-millivolts a.c. across 10,000 ohms in the plate circuit. The normal amplification factor rating is 60, and the mutual conductance rating is 2500 micromhos with a maximum allowable plate voltage of 275 volts.

Technical data and further information may be obtained from *Raytheon Manufacturing Company*, Technical Information Service, Special Tube Section, 55 Chapel Street, Newton 58, Mass.

CATHODE-RAY TUBES

Development of a line of cathode-ray tubes employing electrostatic focus and magnetic deflection has been announced by the Cathode-ray Tube Division of *Allen B. Du Mont Laboratories, Inc.* Designed primarily for radar installations, the new tubes are: B1036P—, B1038P—, B1039P—, B1040P—, and B1056P—. They replace Types 5FP—, 10KP—, 12SP—, 12DP-A, and 7MP—, respectively.

In these tubes an electron lens obviates the necessity of a focus coil and requires only a low potential source of low power for focusing. This lens produces a more uniform spot size across the face of the tube, and thus resolution is improved considerably. Reduced power requirements mean fewer components.

Du Mont states that it is now possible to substitute electrostatically focused tubes for most magnetically focused types upon request. Further information may be obtained by writing to the Technical Sales Department, *Allen B. Du Mont Laboratories, Inc.*, 1500 Main Avenue, Clifton, N. J.

NEWS BRIEFS

CAPACITOR TESTING

In this photograph, an operator at the Vergennes, Vermont, plant of *Simmonds Aerocessories, Inc.*, is testing small capacitor units for accuracy before they are used in assembling Pacitron fuel gages, test equipment and other devices

for aircraft applications. Exacting requirements in the production of equipment of this kind make it essential to check even the smallest components to make sure that they comply with rigid specifications.

TV'S FUTURE IN INDUSTRY

In a technical paper presented at the Fall General Meeting of the AIEE at New Orleans, La., G. Holmes Wilson of *Diamond Power Specialty Corp.*, Lancaster, Pa., predicted that the future use of television in industry probably has a greater potential than that of commercial (entertainment) television. With the Utiliscope, industry's counterpart of the commercial television apparatus, already being used in some 200 different industrial applications, he pointed out that "the surface has hardly been scratched."

Mr. Wilson said that television can help perform the following basic functions in industry: (1) reduce accidents, (2) reduce operating costs, (3) reduce capital investment, and (4) under certain conditions provide greater intelligence than can be gained by direct observation.

1953 IRE PRESIDENT

Dr. James W. McRae, vice president of *Bell Telephone Laboratories*, has been elected president of the Institute of Radio Engineers for 1953. He succeeds Dr. Donald B. Sinclair, chief engineer of the *General Radio Company*, as head of this international society of over 30,000 radio engineers and scientists.

Dr. McRae first joined the staff of *Bell Telephone Laboratories* in 1937 to do research work on transoceanic radio transmitters. During World War II he served for three years in the U.S. Army Signal Corps, where he attained the rank of colonel and received the Legion of Merit for his services. He then returned to *Bell Telephone Laboratories* and in 1951 was appointed vice president in charge of the systems development organization.

TRANSISTOR TELEPHONE UNITS

A trial installation of transistor units is being made at Englewood, N. J., as a part of the customer long distance dialing service introduced there by the *Bell System* in 1951. The transistors will be used in oscillators to generate the electrical signals by which the numbers of a called telephone are sent from one central office to another.

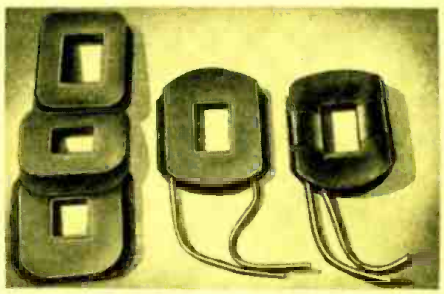
Shown in the photograph are F. E. Blount (left), who helped develop the oscillator, and Dr. William Shockley (right), who directed *Bell Telephone*

Laboratories' transistor research project. Mr. Blount holds one of the transistors, six of which are used in each oscillator.

With this new transistor equipment—much smaller and less expensive than the vacuum tube units previously employed—the signalling equipment, instead of being centrally located, can be placed exactly at the points where it is needed.

FLEXIBLE COIL FORMS

Now available from the *Precision Paper Tube Company* are coil forms with special flexible flanges—a new advancement in coil form construction—



which completely eliminate taping operations on motor field coils. Known as "Flexiform" bobbins, they cut both production time and labor requirements in coil installation — a highly important factor in speeding up assembly lines, especially where mass production techniques are desirable.

"Flexiform" bobbins can be readily supplied in shapes and sizes as specified. Flanges are of flexible rope paper while dielectric kraft paper is used for the core. For further information, write to the *Precision Paper Tube Company*, 2035 W. Charleston Street, Chicago 47, Ill.

LARGER QUARTERS

Consolidated Engineering Corporation has opened new and larger offices for its subsidiary company, *CEC Instruments, Inc.*, at 285 Madison Avenue, New York, N. Y. Walter J. Beagan, New York and Northeastern U. S. manager, will be in charge.

These offices will handle sales and services for *Consolidated Engineering's* line of analytical instruments for science and industry, including the company's newly announced electronic computer and automatic data handling equipment.

"DRAG DISTORTION"

According to a study made by Jacob Rabinow and Ernest Codier of the National Bureau of Standards, if a phonograph needle can move longitudinally (tangentially) with respect to the groove of an ordinary laterally recorded disc, the needle will not follow perfectly the lateral excursions of the groove, and "drag distortion" will result. In the playing back of recorded music, this distortion may apparently result in spurious tones of greater amplitude than the tones originally present.

It was not practical to measure electrically the amount of distortion caused by this longitudinal motion because of

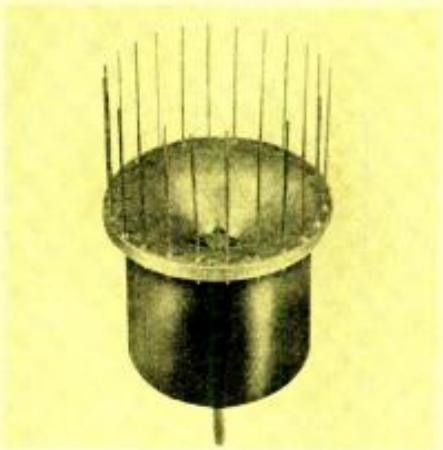
the simultaneous presence of other forms of distortion. It was possible, however, to determine the magnitude of the longitudinal motion, and by computation to arrive at the character and amount of distortion attributable to this motion.

This work has been reported in detail, with mathematical analysis, in the Journal of the Acoustical Society of America, Volume 24, No. 2 (March, 1952).

WEATHER SENSING EQUIPMENT

Motorola, Inc., 4545 W. Augusta Blvd., Chicago 51, Ill., has announced the development of a new weather sensing unit known as the "Snow Detector." Designed primarily for the de-icing of microwave antennas, this unit may be used wherever severe icing conditions and snowfall impair the operation of moving parts. An integral heater melts the snow and ice collected in the "bowl."

Fully automatic, the detector will turn on the heating elements whenever



icing conditions exist. Up to 30 amperes at 117 volts a.c. can be switched without external relays. The heating elements will then remain on until the icing hazard is past. No power is consumed at higher temperatures.

CAR RADIO SYSTEM

One of *Motorola, Inc.'s* 450—460 mc. two-way radio systems for automobile emergency radio service has been installed by the District of Columbia Division of the American Automobile Association in Washington, D. C., and was recently given its initial test. The test car was first driven over the areas of northwest Washington and part of Maryland; two-way communication was maintained over the entire area. The car was also driven along the banks of the Potomac River and across the Chain Bridge to Virginia, with no dead spots noted in the Virginia area.

The base station transmitter is installed atop a 100-foot building in northwest Washington. It has a power output of 20 watts with an antenna power gain of 8 db. The mobile unit also has a power output of 20 watts into a rooftop quarter-wave antenna.

RAYTHEON LABORATORY

Under construction at Bedford, Mass., is an electronics laboratory that is expected to be one of the most advanced laboratories ever built for the development of electronics equipment used in conjunction with aircraft. Operation of the laboratory, which is being built by *Raytheon Manufacturing Company*, will be concerned almost exclusively with research and development work for the U.S. Navy. To cost nearly $2,000,000 and to have 100,000 square feet of floor space on two floors, the new plant will be situated on about 15 acres of land at the north end of Hanscom Airfield.

HIGH SPEED CALCULATOR

By March, 1953, the Armour Research Foundation expects to have installed and in operation a "card-programmed calculator" which will be available to serve business and industry in the Chicago area.

The new calculator, now on order from *International Business Machines Corporation*, is a digital computer. The information necessary for the machine to operate is fed into it on punched cards that provide the operator with a large number of possible operations. After the operator sets up the machine for a problem and specifies the operations he wants it to perform, the machine will not only carry out the operations but also make all the necessary decisions as to the sequence in which they should be performed.

CONSOLIDATED APPOINTMENTS

Two appointments have been announced at *Consolidated Engineering Corporation*—that of Dr. Wilson S. Brubaker as senior research physicist and that of Dr. Paul Brock as engineering mathematician. Dr. Brubaker will work mainly in the field of mass spectroscopy, while Dr. Brock has been assigned to the company's computer group.

Dr. Brubaker was at various times a member of the faculties at Miami University, Cal Tech, and Ohio State University. Before joining *Consolidated*, he served for nine years as section manager for the physics department of *Westinghouse Electric Corporation* in East Pittsburgh.

Dr. Brock formerly did computation work with the *Kellex Corporation* and served as senior mathematician for the *Reeves Instrument Corporation*.

LOOKING at TUBES

By WILFRID B. WHALLEY

Adjunct Professor of Electrical Engineering
Brooklyn Polytechnic Institute

Brief history of the orthicon television pickup tube.

LAST month the design and operating characteristics of the remarkable tube development—the *iconoscope*—were discussed. This first practical television pickup device is still in active use, particularly for present-day moving picture film reproduction. While it has good resolution and is relatively simple in design, its bad qualities of "shading" and low sensitivity have led to intensive research and development. From this research have come various types of pickup tubes having very high sensitivity and quite uniform brightness level.

The iconoscope showed that high velocity electron beams gave copious secondary electron emission from the mosaic which reduced the sensitivity and also superimposed false signals. Two basic approaches were made to solve these problems. The first was to employ an auxiliary photocathode which led to the *image iconoscope* (known in Europe as the *super emiscope*); the second approach was to employ a beam of low velocity electrons for scanning, which prevented secondary electrons from being produced. After intensive development, this latter method led to the *orthicon* and later to the *image orthicon*.

Low Velocity Scanning

Low velocity electron beam pickup tubes have become so satisfactory and are now used so extensively that it is of real interest to review the prior research work.

The first problem encountered with low velocity electron operation concerned the beam diameter. With the usual type of electrostatically focused gun, the diameter was so large that the resolution was unsatisfactory. Hence, new guns and methods of using them had to be designed.

In addition to the problem of keeping a low voltage electron beam in focus, it was found that the electron must arrive at the mosaic as nearly perpendicular to the surface as possible. If arrival were at an oblique angle (which could readily occur under simple operating conditions due to small electric fields at the surface of the mosaic), then the oblique beam would simultaneously influence several elementary areas of the mosaic and produce a radical drop in resolution. So that there would be some possibility of the electron beam arriving perpendicular to the surface, a new photoelectron emitter had to be developed whereby the image of the scene could be focused on one surface and the scanning by the electron beam could take place on the opposite surface. This differs from the *iconoscope*, where both the image of the scene and the scanning take place on the same surface, requiring the high velocity electron beam to scan obliquely.

Several new types of mosaics and photoelectron emitting surfaces were devised. One type, which can be called the translucent target mosaic, was constructed in the following manner. The caesium silver particles were produced on one surface of a thin glass or mica sheet, while the signal plate (which in the iconoscope mosaic is opaque) was made transparent. Condensation of metallic vapor was controlled to a density which would still allow a large percentage of light to pass through.

Other types included "two-sided mosaics" and translucent photocathodes. By suitably combining these various photocathodes and mosaics in evacuated envelopes, it was then possible to determine the operating characteristics of low velocity electron beam scanning, without the need of an electron gun.

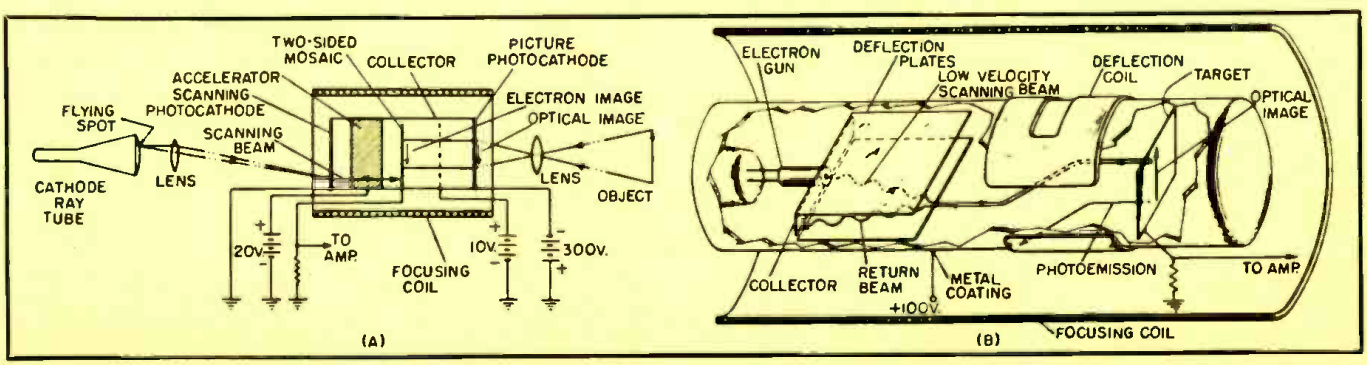
Experimental Methods

Figure 2 shows the arrangement of one of these experimental tubes. This tube contained a standard mosaic (similar to that used in the iconoscope), shown with the lead going to the video amplifier, and a photocathode having a conducting photosensitive surface. This photocathode was placed perpendicular to the surface of the mosaic, and both were immersed in the d.c. field of an electromagnet. The two pole pieces of the electromagnet were at right angles so that the flux paths fell, as accurately as possible, on sectors of circles of increasing radius.

A novel arrangement was the use of an external cathode-ray tube to provide the means for electron scanning in the pickup tube. The scanning raster on the face of the cathode-ray tube was optically focused onto the photocathode, which then emitted low velocity photoelectrons. Since the flying spot scanner operated at high voltage, the focused light beam diameter was reasonably small; and the groups of photoelectrons, emitted line by line during the scanning, were of correspondingly small diameter. The gun of the cathode-ray tube was supplied with blanking pulses so that the light beam was cut off during the retrace time, thereby avoiding another source of spurious signals.

The d.c. magnetic field was essential both to keep the emitted electrons in focus as they moved toward the mosaic, and to cause them to arrive perpendicular to the mosaic surface. As the electrons entered on a path parallel to the magnetic field, they were constrained to follow the magnetic lines.

Fig. 1. (A) Pickup tube using secondary emission amplification. (B) Schematic diagram of an orthicon.



Since these electrons were of low velocity (characteristic of photoelectron emission), no secondary electrons were produced at the mosaic surface. The device provided a picture signal with a steady background and a resolution determined chiefly by the diameter of the light beam from the auxiliary cathode-ray tube.

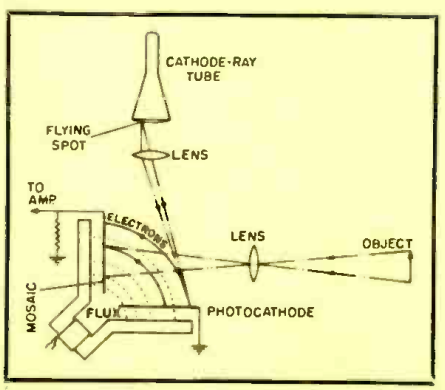
On each portion of the mosaic where the incident light was zero (dark area of the scene), the silver particles would move to an equilibrium potential such that arriving electrons from the scanning photocathode would be turned back and no signal current would flow to the amplifier. Conversely, on each portion that was illuminated by the scene, the potential would shift during the frame period to a more positive potential, due to the loss of photoelectrons. This small positive potential was then neutralized by the scanning photoelectrons, and it produced an output signal proportional to the light intensity.

Figure 1A shows another experimental low velocity scanning tube. This also employed an auxiliary flying spot light beam, but the internal structure was more complex. It made use of a translucent photocathode at the right, on which the image of the scene was focused, a two-sided mosaic near the center which was connected to the video preamplifier, and another translucent photocathode at the left.

The whole structure was placed inside a long "focusing" coil which produced a d.c. magnetic field parallel to the axis of the tube, as compared to the curved field of Fig. 2. The light beam caused photoelectrons to enter the accelerator field moving toward the mosaic. Photoelectrons proportional to the light intensity were also emitted from the picture photocathode, and these were accelerated toward the other side of the mosaic. The secondary electron emission multiplication produced by the accelerated photoelectrons provided a larger signal from this device than that of Fig. 2.

These experimental devices showed the real advantages of low velocity scanning but, needless to say, due to the external cathode-ray tube, they were not practical studio devices.

Fig. 2. Pickup tube using photoelectrons.



The Orthicon

The axial magnetic field produced by the large focusing coil was essential to low velocity electron operation, yet the scanning field had to be produced at right angles to the axis. A study of electron paths through a combination axial and perpendicular magnetic field showed that the electrons only diverged from the axis while in the perpendicular field. Hence, the aperture of the scanning field had to be at least as large as the mosaic.

A tube incorporating these principles is shown in Fig. 1B. It will be seen that the whole tube structure from the electron gun to the target was enclosed by the focusing coil. As the electrons left the gun through a limiting aperture of small diameter, they entered a pair of deflection plates. In these combined axial magnetic and electric fields, the electrons followed a cycloidal path toward either the left or right, depending upon the time in the horizontal scan cycle. Leaving the deflection plates, the electrons again moved parallel to the axis until influenced by the perpendicular magnetic field of the vertical deflection coil. After leaving the deflection coil, they again moved parallel to the axis toward the mosaic, and were collected in proportion to the potential of each part of the surface (as determined by the degree of illumination). Electrons which were not collected at the target returned on a path to the deflection plates which was almost identical to their forward path, and then moved on toward the collector.

In practical use, the focusing coil was mounted so that it could be accurately adjusted for alignment with the axis of the gun. The tube was carefully shielded. Otherwise, even relatively weak external fields would have been able to cause motion of the d.c. axial field and distort or reduce the resolution of the picture signal. Blanking pulses were supplied to the electron gun to prevent retrace "smearing."

This pickup tube, which was named the *orthicon*, had the good operating characteristics of the earlier experimental devices of Fig. 1A and 2, but had a larger output signal as well, due to the greater scanning current obtainable from the electron gun. The designation "orthicon" was chosen because a plot of output signal current over a useful range of input light intensity is a straight line. ("Orth," in Greek, means straight). It produced output signals almost completely free from the "shading" present in an iconoscope, had higher efficiency and a resolution of better than 400 lines.

NEW PRODUCTS

U.H.F. GENERATOR

Having a frequency range of 300 to 1000 mc., the Model 84-TV standard signal generator is useful for determining the characteristics of television receivers for the u.h.f. band and other equipment operating within that range.

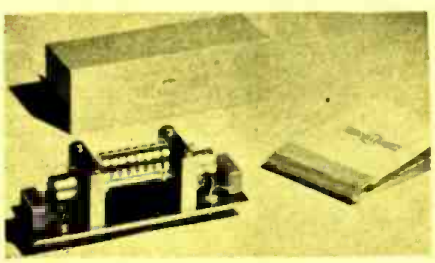
It was developed by the *Measurements Corporation*, Boonton, N. J.

The output voltage of the Model 84-TV is continuously variable from 0.1 microvolt to 1 volt across a 50-ohm load. Output impedance is 50 ohms and the VSWR is 1.3 to 1 or better. The filament of the oscillator tube is operated from an external d.c. supply in order to remove residual hum.

Modulation, continuously variable from 0 to 30%, may be obtained from an internal 400-cycle oscillator. Provision has also been made for applying external modulation within the range of 50 to 20,000 cycles. Percentage modulation is indicated by a panel meter.

MECHANICAL FILTER

Far more rigid control of transmitter sideband radiation as well as rejection of adjacent channel interference in receivers is claimed possible with the *Collins* mechanical filter. This unit is



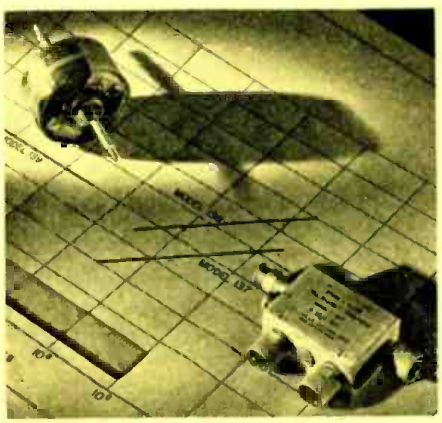
being offered to the electronics industry on a component basis and in addition is being incorporated by the *Collins Radio Company* in new transmitter and receiver designs.

The filter is a magnetostrictively driven unit for intermediate frequency application. Its unusual selectivity and its miniature size make it readily applicable to both military and commercial designs. The entire unit is housed in a hermetically sealed case smaller in size than a normal i.f. transformer.

More detailed information is available on request from the *Collins Radio Company*, Cedar Rapids, Iowa.

DIRECTIONAL COUPLERS

Wideband directional couplers, widely applicable tools for measuring numerous parameters relating to transmission lines, have been announced by *Sierra Electronic Corporation*, 813 Brittan Avenue, San Carlos, Calif. By the use of these couplers, with suitable addi-



tional instrumentation, reflection coefficient can be determined directly, thus permitting the simplification of several important transmission line measurements.

The *Sierra* couplers are available in three models, 137 and 138 for the frequency range of 30 to 1500 mc., and 139 for the frequency range of 10 kc. to 1 mc. Operating characteristics are shown in the accompanying illustration.

ACCELEROMETER

For measurement of high frequency shock and vibration, the *Endevco Corporation* has made available a "thimble-size" accelerometer of little weight and large output, designed in three models. The small size and weight permits testing of small components under actual or simulated shock and vibration conditions, while the small size and large output is well suited for missile, aircraft and vibration table measurements.

This instrument gives a self-generated output of 5 millivolts per G. Output is flat (±5%) over the range from 5 cps to 5000 cps, and is stable to within 5% over a temperature range of −20°C to +70°C. Model 2201 is a gen-

eral-purpose, stainless steel version with a weight of 0.5 ounces and an output of 5 millivolts per G; Model 2202 is a special, lightweight unit weighing 0.3 ounces; and Model 2203 is a large output unit generating 10 millivolts per G. Additional information may be obtained from *Endevco Corporation*, 180 E. California Street, Pasadena 1, Calif.

RANGE, RANGE-RATE CALIBRATOR

The Model 312 range, range-rate calibrator provides a simulated target for checking the range and range-rate of radar gun laying or ranging systems accurately and rapidly. Recently announced by *Missouri Research Laboratories, Inc.*, 2109 Locust Street, St. Louis, Mo., it may be used in the laboratory or on the production line.

Operating from an external or internal trigger, this instrument will check or calibrate range with an accuracy of .25% from 0 to 50,000 yards (in steps of 0—500, 0—5000, 0—50,000) and range-rate either in or out from 0 to 1500 knots with an accuracy of .5%. Although the Model 312 was designed for

60-cycle operation, 400-cycle models are available, and the company indicates that it can supply any combination of range and range-rate on request.

R.F. GENERATOR

Westinghouse Electric Corporation's new 25-kw. r.f. generator is available in both standard and de luxe models. The standard model is for use on relatively long production runs where readjust-

ment is infrequent; taps on the plate transformer provide power output control. The de luxe model uses saturable reactors to provide reliable stepless power control, thereby facilitating the quick setup changes required on short production runs of a variety of jobs. An electronic keying circuit is also included on the de luxe model to permit rapid and precise control of heat cycles.

The unit is rated at 25 kw. continuous at 450 kc. in accordance with NEMA standards, and the tank circuit has a high kva. rating. Both models have components arranged for easy access in inspection and maintenance. For further information, write *Westinghouse Electric Corporation*, Box 2099, Pittsburgh 30, Pa.

FREQUENCY CALIBRATOR

Measurement Engineering Limited, Arnprior, Ontario, has announced the availability of their Model CFR-1 frequency calibrator. A portable, self-contained secondary frequency standard, it provides accurate frequencies in the

range of 10 kc. to 500 mc., with a stability of 1 part per million.

Model CFR-1 is designed for laboratory or production checking and calibration of r.f. signal generators, receivers, wavemeters and frequency meters, in addition to many other applications requiring a source of accurate frequencies. Electrical features include: five fundamental frequencies with their associated harmonics, individual crystal controlled oscillators, an internal aperiodic detector, modulation level control, and an electronically regulated power supply. Output frequency may be modulated by an internal 400-cps signal.

TV CAMERA FOR INDUSTRY

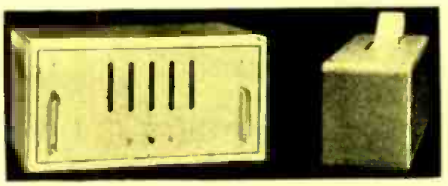
Production of a highly portable, self-contained TV camera, having all adjustments on the unit itself, has been announced by the *Dage Electronics Corporation*. Of "briefcase" size, the camera is tailored specifically to the visual requirements of business and industry.

The Dage unit features a simplified circuit that requires a minimum of attention and maintenance. It is no harder to focus than any home receiver. For remote viewing, any standard television receiver can be connected to it by means of a single inexpensive coaxial cable. A single camera can be hooked up with one or more TV receivers or, conversely, a number of cameras set at different locations can televise to one or more receivers.

For more information, write to the *Dage Electronics Corporation*, 69 North 2nd Street, Beech Grove, Indiana.

DIGITAL RECORDER

Now available from the *Berkeley Scientific Division* of *Beckman Instruments, Inc.*, is the Series 1550 digital recorder—a printed readout for high-

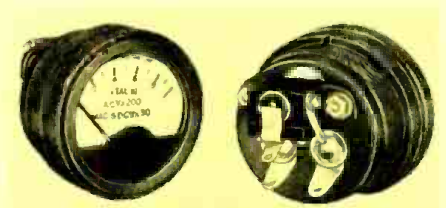


speed electronic counters. Composed of a readout unit and a printing recorder, the instrument provides a direct means of permanently recording sequential count information in Arabic numeral form on standard adding machine tape.

This digital recorder is designed to operate from electronic counters, time interval meters, events-per-unit-time meters, nuclear scalers, or other electronic totalizing devices at a maximum cycling rate of one printout every .8 second. Recording and indicating capacity is 3, 4, 5 or 6 decades. Most standard *Berkeley* instruments now in use can be readily adapted for operation with this unit.

ILLUMINATED PANEL METER

The difficult problem of illuminating miniature meters has been overcome by *International Instruments, Inc.*, in their new 1½" panel meter. A compact D'Arsonval movement permits light to go through a sealed "peep" window in the rear of the instrument case, pass over the movement and be diffused through a translucent plastic scale. The source of illumination is a miniature aircraft lamp, mounted in a specifically



designed housing attached to the back of the case.

Available in two styles — Model 150 (round case) and Model 153 (square case), the single unit assembly is said to make installation fast and easy. The

(*Continued on page* 31)

NEW LITERATURE

PREDETERMINED COUNTERS

Of special interest to production men are the new "SP" small, predetermined productimeters, designed for both stroke and rotary application, which can control production to the exact quantities required and eliminate losses due to overruns and underruns. Complete description, specifications, dimensional data, and switch capacities are contained in Bulletin No. 501, available on request from the *Durant Manufacturing Company*, 1919 North Buffum Street, Milwaukee 1, Wis.

COPPER-OXIDE RECTIFIERS

Basic characteristics and applications of copper-oxide rectifier stacks are described in an eight-page, two-color booklet which is being offered by the *General Electric Company*, Schenectady, 5, N. Y. Designated as GEA-5699A, the booklet is complete with charts, graphs, and tables illustrating the characteristics, manufacture, circuit design, and application of *G-E* copper-oxide rectifiers.

ELECTRICAL LAMINATIONS

T & S electrical laminations—and the special "OrthoSil" oriented steel used in their manufacture—are covered in Bulletin L-752, now being offered by *Thomas & Skinner Steel Products Company*. Materials, specifications, and test results are described, accompanied by actual size drawings of special and standard shapes, specification tables and graphs.

For your copy of Bulletin No. L-752, write to *Thomas & Skinner Steel Products Co.*, 1124 East 23rd Street, Indianapolis, Ind.

LACQUER AND CEMENT

Some of the important properties of "Q-Max" A-27 lacquer and "Q-Max" A-27 cement for radio and electronic service are discussed in detail in Bulletin 752, copies of which may be secured on request from *Communication Products Company, Inc.*, Marlboro, N. J. Tables on various test data are included, as well as diagrams giving power factor, loss factor and dielectric constant values.

DIRECT-WRITING RECORDERS

The advantages of using *Sanborn* equipment for the study and recording of a wide variety of electrical and mechanical phenomena are explained in a 16-page bulletin which has just been released. Entitled "7 Advantages of Sanborn Direct-Writing Recorders for Industrial Users," this bulletin may be obtained without obligation by writing to the *Sanborn Company*, 38 Osborne St., Cambridge, Mass.

RADIO TELEMETERING

A four-page brochure presenting airborne and ground station equipment and accessories for radio telemetering is now available. Copies may be had by writing to *Applied Science Corporation of Princeton*, P. O. Box 44, Princeton, N. J.

Charts show building block accessories in complete PW or PDM systems and custom-engineered ground station and laboratory equipment for the reception, recording, calibration, linearization, plotting and tabulation of data from airborne systems. The ASCOP fully automatic data treating device for reading and processing telemetering data is also covered.

CIRCUIT BREAKERS

"What You Should Know About Circuit Breakers" explains the operating principles of basic circuit breaker designs and provides engineering data on factors of application. This manual, which has just been published by the *Heinemann Electric Company*, also includes simplified diagrams showing the three basic types of circuit breakers in general use today with a brief description of each.

Copies of Manual 101 are available upon request from the *Heinemann Electric Co.*, 502 Plum Street, Trenton 2, N. J.

PRECISION RESISTANCE INSTRUMENTS

The complete line of precision electrical resistance instruments and electronic devices manufactured by *Tech Laboratories, Inc.*, is described in a 38-page catalog which has recently been released. Among the instruments covered are various attenuators and potentiometers, meter multipliers, matching networks, decade units, microhmmeters, tap switches, and many others.

Copies of this bulletin may be obtained by writing to *Tech Laboratories, Inc.*, 14E Edsall Boulevard, Palisades Park, N. J.

CHOPPERS

Catalog 280B, available from *Stevens-Arnold Inc.*, 22 Elkins Street, South Boston 27, Mass., describes the 1953 models of the *Stevens-Arnold* d.c.-a.c. choppers. These choppers are electromechanical precision vibrators, designed with emphasis on long life and low noise level. Having a frequency range of 10—500 cps, they are used as modulators or demodulators.

TECHNICAL BOOKS

"PRINCIPLES OF RADAR," Third Edition, edited by J. Francis Reintjes and Godfrey T. Coate. Published by *McGraw-Hill Book Company, Inc.*, 330 West 42nd Street, New York 36, N. Y. 985 pages. $7.75.

As before, the third edition of "Principles of Radar," compiled by members of the staff of the M.I.T. radar school, deals with the basic concepts and techniques of radar. It presents the engineering principles of the pulse circuits and the high frequency devices common to nearly all radar systems.

In this latest edition, the order of presentation has been completely reorganized, and virtually all of the material has been rewritten. The subject matter has been expanded by approximately 20 per cent, and more than half of the illustrations are new. A chapter on r.f. transmitting and receiving systems has been added.

The book begins with a description of the general features of radar systems and system components. This material is followed by detailed discussions of pulse circuits and their application to radar modulators, indicators, and receivers. The latter part of the book is devoted to the r.f. aspects of radar; it covers basic concepts pertaining to transmission lines, wave guides, cavity resonators, and antennas, together with the techniques of their use.

"FUNDAMENTALS OF ENGINEERING ELECTRONICS" by William G. Dow, Professor of Electrical Engineering, University of Michigan. Second Edition. Published by *John Wiley & Sons, Inc.*, 440 Fourth Avenue, New York 16, N. Y. 627 pages. $8.50.

The most important broad objective of this book is to make it relatively easy to achieve a reasonably complete and satisfactory understanding of the internal functioning of the electron devices that serve as the active elements in electronic circuits. Professor Dow has arranged and described the fundamentals of charged-particle behavior in such a way as to appeal to the engineer's analytical approach. Principles of particular importance to the engineer are selected for study; illustrations of these principles are drawn from engineering practice; and physical concepts are so treated as to permit ready determinations of magnitudes.

Among the changes which highlight the second edition are: the MKS system of units is employed throughout; the analysis of the behavior of space-charge-control tubes has been modernized by the introduction of equivalent electrostatic circuit and equivalent grid sheet potential concepts; basic new principles that must be employed in electron tubes designed for use in the u.h.f. and microwave frequency ranges are presented; and the basic aspects of semiconductor energy-level diagrams and their general relation to the behavior of transistors are discussed with reference to the Fermi distribution function and the Fermi energy-level.

TRANSMISSION LINE IMPEDANCE MEASUREMENT

By GERALD W. LEE

WHEN SETTING up a new broadcasting station, the radio engineer is always faced with the necessity of knowing accurately the characteristic impedances of the transmission lines. The following method of determining line impedance is comparatively recent and is not given in detail in any of the various textbooks on broadcast engineering.

The equipment needed is an r.f. signal generator, an r.f. bridge, a detector, and an accurate 0—1000 ohm decade resistance box or a variety of calibrated resistances of values near the theoretical impedance of the line. A decade box is more satisfactory as it is usually calibrated in steps of one-tenth ohm, and therefore the characteristic impedance can be measured to that accuracy.

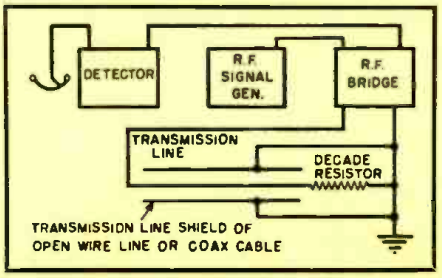
1. **Connect one end of the transmission line through the resistance box to ground. The ground connection may be made to the line ground; and the box should be set at the theoretical line impedance.**
2. **Set the r.f. signal generator for the frequency at which the station will operate, and to it connect the r.f. bridge and detector in the usual manner for measuring impedance, as shown in the block diagram.**
3. **"Look into" the line with the impedance measuring gear at the end opposite to that at which the decade resistance box is connected.**
4. **Vary the decade resistance box until the resistance measured by the r.f. bridge equals the resistance of the box. This resistance is then the characteristic impedance of the transmission line.**

A brief discussion of the theory involved in measuring by this method may be in order. Terman states: "In non-resonant lines the terminating impedance Z_L at the end to which the line delivers the power is made equal to the characteristic impedance. There is then only the incident wave train present and the power is transmitted at unity power factor. The power loss and peak voltage to which the line is subjected are then less than with any other mode of operation."

The above is essentially what has been done here, that is, the load impedance has been made equal to the characteristic impedance so that it is possible to look into the line and see its characteristic impedance.

In conclusion, it is the opinion of the author, which has been verified many times in the field, that the above procedure is easily the most accurate and time-saving method yet devised of measuring line impedance.

Block diagram of method employed.



Personals

WILLIAM W. DEAN is now the director of engineering of the *Langevin Manufacturing Corporation*, New York, N. Y. He was associated with *General Electric Company* for 11 years prior to joining the *Langevin* organization; since 1945 he has been audio facilities project engineer in *G-E*'s broadcast engineering section at Electronics Park. A senior member of the IRE, Mr. Dean is the author of a number of technical papers on broadcast audio facilities.

DONALD N. KIRKPATRICK has been appointed chief engineer of the *National Company, Inc.*, Malden and Melrose, Mass., in which position he will be responsible for all engineering activities including the development of new products. Mr. Kirkpatrick graduated from Lafayette College in 1932. Prior to his most recent employment as chief engineer of the *Boonton Radio Corporation*, he had already had 13 years of experience in the electronics industry.

JOHN K. McDONOUGH was promoted from general sales manager to general manager of the Radio & Television Division of *Sylvania Electric Products Inc.*, Buffalo, N. Y. Mr. McDonough joined *Colonial Radio Corporation*, predecessor company of the division, in 1943, and served as assistant to the vice president in charge of operations before becoming sales director in 1949. When *Colonial* became a division of *Sylvania*, he was appointed sales manager.

DR. CARL F. MOEN has joined the research and engineering team of *Electro-Voice, Inc.*, Buchanan, Mich., electroacoustic and electronic manufacturers, as senior engineer. Formerly a professor of physics at Pennsylvania State College, Dr. Moen received his Ph.D. degree in physics from the University of Toronto. During World War II, he conducted research on the theory of liquids and underwater sound for the Royal Canadian Navy.

DR. DAVID B. PARKINSON, who joined the *Brush Development Company*, Cleveland, Ohio, as department head of product engineering in 1948, has now been named production engineering manager. From 1938 to 1948, Dr. Parkinson served with *Bell Telephone Laboratories*, developing telephone equipment and systems, and anti-aircraft and other gun directors. For his work on the latter, he was awarded the Presidential "Medal for Merit" in 1947.

EDWIN J. RUDISUHLE, formerly with the Civil Aeronautics Administration as chief, electronics establishment branch, ninth region, has now joined the sales engineering department of *Lenkurt Electric Co.*, San Carlos, Calif. He will be concerned primarily with the application of carrier channelizing equipment to v.h.f. and microwave radio links. Mr. Rudisuhle's previous experience includes several years with the FCC as field and laboratory engineer.

D.C. Amplifier

(*Continued from page 9*)

be adjusted with a screwdriver until the meter reads zero. If the needle swings to the left, the meter leads should be reversed. The switch must then be returned to position 2 or zero position and a small source of potential inserted in the input circuit. A 1½-volt battery across a 10,000-ohm potentiometer will serve adequately. A d.p.d.t. switch across the output will be required to reverse the polarity. Starting at zero volts, the potentiometer setting should be advanced slightly so that the needle will deflect to about 0.8 ma. when the instrument switch is at position 3.

Then, the switch should be returned to position 2 and the polarity of the input voltage changed without changing its value. To accomplish this, the small d.p.d.t. switch is used in series with the low voltage from the battery circuit. The switch is now rotated clockwise to position 4 to check deflection on the reversed polarity. Deflection should be the same—0.8 ma. If it is not, the plate balance adjust R_4 must be rotated slightly and the new meter reading checked against that of position 3 after input polarity is reversed. When the needle is deflected to the same meter reading by the same input potential on position 3 and position 4 by reversing the polarity of the input voltage but not its value, the plate balance will be correctly adjusted.

When use of the instrument as a millivoltmeter is desired, a laboratory potentiometer is placed across the input and set for 250 mv. Then the switch is turned to "position 2 adjust." The "position 2 adjust" should be "zeroed" first. Finally, after the sensitivity control for meter R_5 is adjusted so that the needle will give full deflection for 250-mv. input, the meter is ready.

Recorders with 50-mv. full scale traverse require inputs with a reading of 0.20 ma. on this meter which corresponds to 50 mv. Improper polarity is indicated by the meter if the needle swings to the left, off scale. Thus, a total voltage of 0.500 volts can be achieved from ±0.250 volts. Much higher voltages can be measured through the use of input divider resistors.

For pH meter applications, the calibration is identical to that above through the plate balance operation. The glass electrode is inserted in the grid input lead and a calomel electrode is plugged into the pin jack. With the electrodes immersed in a buffer of pH 7, the meter is zeroed in position 2 as before. The switch should now be turned to position 3 and "position 3 adjust" adjusted until the meter reads zero; then the switch should be returned to position 2. Buffer pH 7 should be exchanged for buffer

pH 10.0 and the switch turned back to position 4. Meter sensitivity R_s should be adjusted until the meter reads 0.6 ma. The meter will then be ready for use.

With a glass electrode, the potential varies nearly linearly with the pH change referred to a reference-saturated calomel electrode. Thus, a practical glass electrode, such as a *Beckman*, with a reference pH = 7.00 will show no potential if placed in a solution whose pH is 7.00, but will show a potential if the solution in which the electrode is placed is other than 7.00. The greater the difference between the pH of the glass electrode and the solution in which it is immersed, the greater the voltage that is developed with reference to the calomel electrode. Since pH = 7.00 is accepted as a neutral condition, acid pH's read from 7.00 down, while basic pH's are read from 7.00 up, reversing polarity at 7.00.

The pH = 7.00 corresponds to a zero meter reading and each 0.20-ma. meter reading corresponds to 1 pH unit. So if the reference glass electrode is pH = 7.00, the acid scale will read pH = 7.00 to pH = 2.00 while the base scale will read pH = 7.00 to pH = 12.00. The range can be shifted by using glass electrodes with other reference pH's, and can be set for specific titrations in this manner if so desired. Also, the full 14 pH units can be scaled if proper meter sensitivity adjustment is made. However, a new scale would have to be constructed and the linearity of pH measurements with the glass electrode would tend to fall off at both ends of the scale. The range selected was decided upon as being most practical since it was not necessary to change or deface the scale in any way. The "pH adjust position" or position 3 is used to balance out the small asymmetry potential encountered with glass electrodes.

Conclusion

After initial calibration, the instrument should be aged by turning the switch to position 2 and allowing it to remain on overnight. In the morning, the calibration should be repeated and checked for variation.

For daily use, it is recommended that the instrument be left on all day in position 2. (It has heen left on for over 100 hours with no sign of ill effects.) When a reading is to be taken, the switch should be turned to position 3 or position 4, depending upon which polarity prevails, and the reading noted. After the reading is taken, the switch is returned to position 2 until the next reading is taken. The switch should not be returned to position 1 since this would turn off the power for the meter and a warming-up period would then be required before the next reading.

Temperature compensation was not found to be necessary and so was not included as a feature.

This instrument can be used as a sensitive electronic polarized relay by the insertion of a polarized relay in the circuit in place of the meter. Thus, a reversible motor could be actuated by very small out-of-balance voltages from a preset value at the input of the instrument. In this respect, it could serve as a rough servomechanism to regulate power supply voltages, temperatures, pressures, or pH's.

The applications of this versatile unit are many and the time spent on its construction should be repaid many times in good service.

INSTRUMENTATION FOR COLOR TELEVISION

PRACTICALLY all of the color television art in its present stage of development is encompassed in this giant "package" just completed by *Telechrome, Inc.*, Amityville, L. I., for a west coast client.

The equipment is capable of transmitting and receiving any of the commonly accepted types of color television (wideband simultaneous, NTSC, field sequential, line sequential encoding) as well as generating the necessary auxiliary synchronizing color subcarrier and color information. A programming system, test switching system, preview monitor, a monochrome system, flying-spot scanner for slides and roll-strip films, a color bar and dot synthesizer, necessary tri-color monitoring, transmitting at both r.f. and video, and receiving decoding equipment are also included. The unit is suitable for research or development as well as for on-the-air use. It consists of a compact seven-rack assembly with a built-in motor-driven quick-change arrangement for shifting from one system to another as well as for setting up the monochrome equivalent at both field sequential and RTMA rates.

Rack #1 provides the driving sources for all systems and contains the sync generators as well as the color subcarrier and the interlaced sampling divider.

Next in line is the encoding and matrixing rack which houses gamma amplifiers, keyed clamp and NTSC burst generators, NTSC keyers, and transmitting samplers.

Near the center of the assembly is the control rack, the hub of the setup. Emanating from a 60-button automatic switching panel are the "nerves" which reach to every unit in the assembly. Distribution and programming are done at this rack, permitting observation and study of practically every point in the over-all system. In this rack, too, are the waveform scope and the NTSC monochrome monitor.

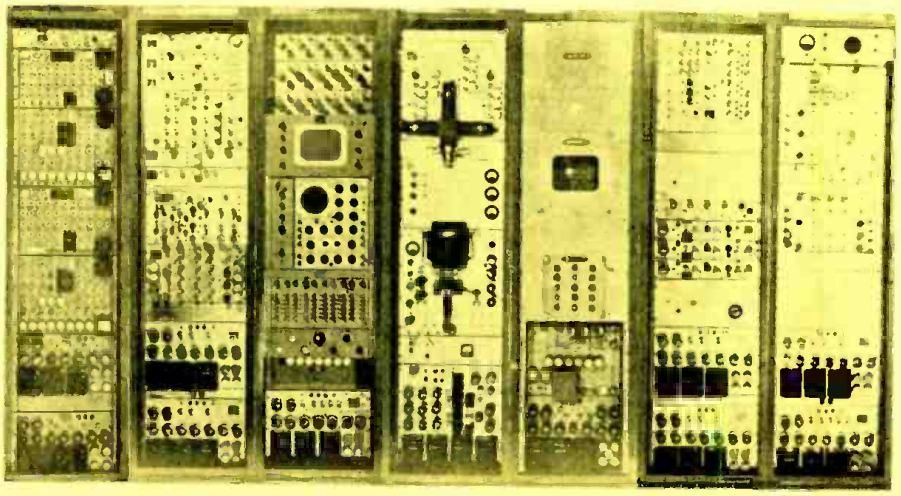
The center rack is for color pickup and scanning. The universal pickup here is equipped with crossed dichroic mirrors: red and blue reflecting, green transmitting; Wratten correcting filters are used in the red and blue channels; vignetting provided by a full scan of the seven-inch tube is held to a minimum. The universal color scanning generator is of the flying-spot type and produces three simultaneous red, green, and blue primary color signals. Resolution is better than 500 lines at standard RTMA rates and better than 400 lines at standard FCC rates.

The universal color monitor which displays the pictures produced at the scanner or bar generator is in rack #5; off-the-air signals are shown here too. The monitor uses three separate red, green, and blue reproducing kinescopes. Crossed dichroic mirrors are used for optical superimposition of the three color images so produced. The color range is superior to the best that can be obtained with present color photography, such as Kodachrome, die-transference or chemical processes. Extra rigid structural metal members maintain the dimensional stability and alignment of this unit.

Rack #6 contains the three color video amplifiers, the off-the-air receiver, and the color bar generator which produces fully saturated color bars for reception in scanning rack and display at the monitor.

The final rack performs several functions: decoding (both NTSC and field sequential), phase-equalization, and modulation-checking of the picture-and-sound transmitter.

Front view of the seven racks comprising the unit.



Electronic Defibrillator

(*Continued from page 7*)

is derived from a 250-va., 110-v., 60-cycle isolating transformer, and is fed to the electrodes through an adjustable current limiting resistor variable between 50 and 250 ohms. This restricts the maximum current to 2.5 amperes.

The output current is pulsed by a relay whose coil constitutes the plate load of a type 2050 thyratron tube. In the input grid circuit of this tube is a time delay network whose d.c. negative charging bias is supplied by a selenium rectifier power supply. When the "treat" button is pressed, the thyratron conducts, and the pulse relay actuates. Simultaneously, a negative charging voltage begins to build up on a condenser across the input grid. As soon as this negative voltage equals -2 volts, the thyratron is extinguished, and the pulse relay drops out. As long as the "treat" button is pressed down, the tube will be held nonconductive by this applied negative bias which slowly increases until it equals -10 volts. When the "treat" button is released, this accumulated charge is returned to set ground and the operation may be recycled at will. Proper selection of the values of charging bias voltage, condenser capacity, and charging resistance gives the desired time interval of pulse duration. Thus, timing of the current impulse length is rendered independent of human error, and is consistently reproducible within accuracy limits of ± 1/120 of a second.

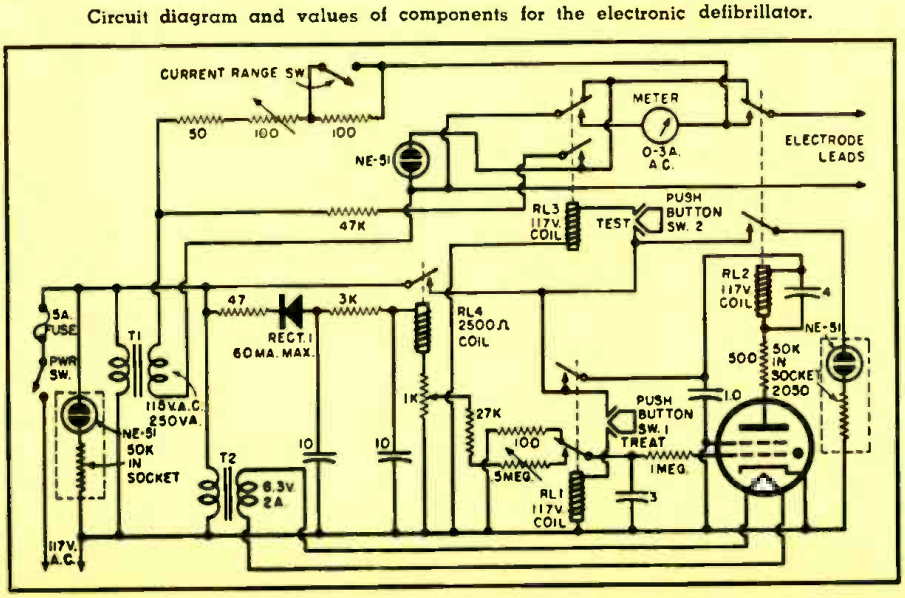
"Fail safe" operation of this instrument is considered of major importance, since a human life is always dependent upon its proper operation. While the likelihood of failure is very small, four preventive steps were taken to assure positive operation and to prohibit dangerous failure. Included in series with the d.c. bleeder network of the selenium rectifier power supply is the coil of a d.c. relay. This relay must actuate before the rest of the circuit will operate. In the event of bias supply failure, this relay will not operate, and the instrument becomes inoperative. The other relays in the circuit are so positioned physically that breakage of an armature spring or coil failure will prevent the function of this relay. The electrode leads at all times are internally shorted together except when the "treat" or "test" buttons are pressed. This prevents any insulation leakage from developing an electrical potential across the electrodes. The entire instrument is internally fused at 5 amperes.

Since the electrodes derive their current from the secondary winding of an isolation transformer, it is impossible for the surgeon to be shocked by coming into accidental contact with a grounded object such as a wet concrete floor, or a metal table frame. The electrodes are made of brass and copper, polish nickel plated, with white nylon insulating handles. They may be autoclaved or sterilized in the same manner as other tools.

Pressing the "test" button performs two operations simultaneously. It passes the output of the isolation transformer directly through the adjustable limiting resistor and the a.c. ammeter on the panel. By rotating the "current control" knob while the "test" button is depressed, the operator can set the delivered current to any previously selected value within the range of 0.5 to 2.5 amperes. Pressing the "test" button also turns on the "test" pilot light, and connects the electrode wires across this light. Touching the electrode plates together shorts out the light, proving that there is electrical continuity to the electrode plates. Since the NE-51 pilot light only draws 1/25 watts of power, no arc can be formed by touching the plates together. The voltage appearing at the plates during this test operation is small and harmless.

Operation of the instrument, because of the various safety circuits and automatic action, becomes feasible for the untrained operator. Since the defibrillator will warm up ready for use within 20 seconds, it is not necessary to leave the power on at all times during surgery, thus extending its operating life indefinitely.

Circuit diagram and values of components for the electronic defibrillator.



BIBLIOGRAPHY:

Stover, John H., "An Electric Defibrillator for Cardiac Resuscitation," Armed Forces Medical Journal, Vol. 2:57, 1951.

Birnbaum, George L., "Simple Cardiac Defibrillator," Journal of Thoracic Surgery, Vol. 23: 183, 1952.

Frequency Standard

(*Continued from page 11*)

driving oscillator may be compared to the time signals of the other five oscillators in the Washington laboratory and those at the WWV installation to differences as small as 20 millionths of a second.

The time differences or variations in each clock are reported each day to the U. S. Naval Observatory and are used in evaluating the mean solar time. The Observatory issues weekly corrections to the WWV signals with reference to mean solar time. Quarterly corrections for the slight deviations in absolute time and frequency as broadcast by WWV are also available from the National Bureau of Standards.

One of the principal uses of the WWV transmission of standard frequencies is that of calibrating precision oscillators. The system commonly employed is demonstrated by the manner in which the WWVH (Hawaii) transmissions are synchronized with those from WWV. Three oscillators are used to obtain accurate results. One oscillator unit is adjusted to one of the standard frequency transmissions from WWV. Each of the other two oscillators is compared to the first and the difference in frequency between them is measured. A better average of the deviation from the WWV transmissions is achieved by this method than would be possible if only one oscillator were involved.

One of the major continuing projects of the Bureau's frequency standard laboratory is the development of more precise quartz oscillators. Another is the investigation of the use of atomic and molecular resonance standards as a means for obtaining higher accuracies. Reference to such invariant standards would greatly simplify the maintenance of precise frequency and time standards.

New Products

(*Continued from page* 25)

lamp is supplied for 6, 14 and 28 volts. For complete details, write to *International Instruments, Inc.*, P. O. Box 2954, New Haven 15, Connecticut.

SCALER-PRINTER

A new scaler-printer, designed for radiation counting as applied in nuclear work, packaging and other applications, has been announced by the Research & Control Instruments Division of the *North American Philips Company, Inc.*, 750 South Fulton Avenue, Mount Vernon, N. Y.

This instrument indicates in printed numerals up to 999 and provides for multiplying this figure by 2, 4, 8, 16, 32 and 64. It will resolve pulses separated by 5 microseconds and will perform reliably for indefinite periods of time. An interval timer having a range up to 55 seconds allows count accumulation for a predetermined interval, reproducible to within 0.13 seconds.

An alternative indicator is available on the scaler chassis in the form of three rows of neon lamps in decimal arrangement. This works independently of the printer and can be relied upon separately.

SIX-CHANNEL AMPLIFIER UNIT

Model 201-A is a portable, self-contained system for the accurate measurement of such physical phenomena as strain, pressure, acceleration, vibratory displacement, and velocity. For detailed specifications and technical or application information, write to the *Yellow Springs Instrument Company, Inc.*, P. O. Box 106, Yellow Springs, Ohio.

This amplifier unit comprises: six individually excited, three-stage, single-channel amplifiers, with output metering and overload indicating circuits and with linear and integrated amplification employed to provide for the use of a wide variety of pickup devices; a separate electronically regulated power supply providing both a.c. and d.c. power to all channels; a shock mounted cabinet with power plugs for inserting the single-channel amplifier units and the necessary power and test cable assemblies.

RADIATION DETECTOR

Nuclear Instrument & Chemical Corporation, 229 West Erie Street, Chicago 10, Ill., announces the "Isotron"—a console-type instrument which permits clinical use of radioisotopes for both diagnosis and therapy. The Model 1617 Isotron incorporates a count rate indicating circuit, a special regulated high voltage supply, a gamma ray sensitive probe, an arm for positioning the probe, and a chart recorder to provide a continuous automatic record of the counting rates for a permanent record.

Housed in a compact cabinet, the Isotron operates on 120-volt, 60-cycle current. A simple set of controls is mounted on the slanting top panel, which provides for selection of counting ranges, choice of time constants to achieve desired counting accuracy, and variation of high voltage.

SELENIUM RECTIFIER CELL

For applications where size and weight are primary considerations, the *Federal Telephone and Radio Corporation*, Clifton, N. J., has designed a selenium rectifier cell rated at 36 volts (r.m.s.). Because the individual cell is so rated, a rectifier stack made up of these cells will not only withstand a higher reverse voltage, but will require fewer cells for the same voltage output. As a result, losses will be proportionately less, and the efficiency of the stack considerably increased.

The newly developed *Federal* rectifier unit is particularly well adapted for use in aircraft and in many types of military equipment. Its compactness and lighter weight also make it well suited for use in battery chargers and power supplies.

PRECISION RESISTORS

Featured in the Series "E" precision wire-wound resistors manufactured by the *Hycor Company, Inc.*, 11423 Vanowen Street, North Hollywood, Calif., are: noninductive windings on ceramic bobbins; a standard temperature coefficient of 0.000025 per degree C; varnish impregnation for moisture protection; and high resistance plus accuracy in small space.

Series "E" resistors are designed for use in applications requiring accuracy, stability and long life under conditions of extreme temperature variation plus moderately high humidity. They are wound with either Evanohm or Manganin wire, providing very low thermal emf against copper.

PHOTO CREDITS

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20, 21	RCA Review

Frequency Calibrator

(*Continued from page* 13)

was considered desirable to provide sufficient gain to drive a small loudspeaker directly, an output from the amplifier of 50 to 100 milliwatts was required. For such an output, a voltage gain of about 5000*X* is necessary. Although the 6X8 pentode-triode has a common cathode which complicates the bias problem, it was found suitable for this application. Bias was provided by means of a tapped cathode resistor system which was found to work quite well. This biasing system permitted the pentode section to be operated at a suitable bias level and the triode section to be biased so as to develop the desired power output. In this circuit, the audio response is peaked to minimize low frequency microphonics which develop when the small loudspeaker is mounted on the same chassis with the amplifier. The shunt capacitor across the output transformer attenuates the high frequency response in order to reduce the inherent noise which might be objectionable because of the high gain of the pentode section. Values of the coupling capacitors are small so as to reduce the low frequency response of the unit.

Figure 1 is a photograph of the calibrator constructed on a small breadboard-type experimental chassis. This particular unit produced a sensitivity to external signals of 50 millivolts for 100 milliwatts of audio output at 1000 cycles.

CALENDAR of Coming Events

JANUARY 26-30—IAS-IRE-RTCA-ION Symposium on Electronics in Aviation, New York, N. Y.

JANUARY 26-27 — Seventh Regional IRE Conference, University of New Mexico, Albuquerque, N. M.

FEBRUARY 4-6 — Western Computer Conference, Hotel Statler, Los Angeles, Calif.

FEBRUARY 5-7—IRE Southwestern Conference and Electronics Show, Plaza Hotel, San Antonio, Texas

MARCH 23-26—IRE National Convention, Waldorf-Astoria Hotel and Grand Central Palace, New York, N. Y.

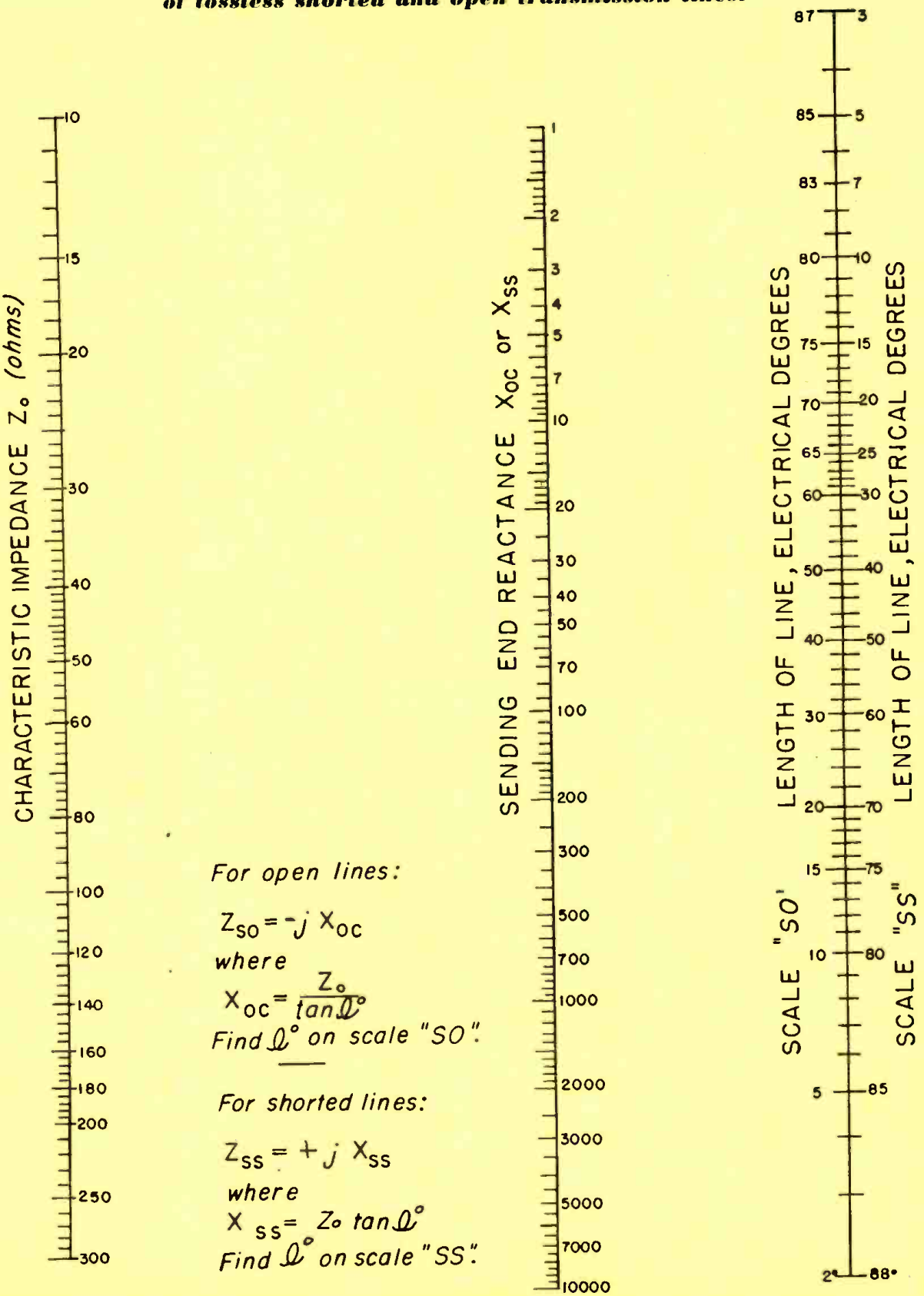
APRIL 11—New England Radio Engineering Meeting, University of Connecticut, Storrs, Conn.

APRIL 18—Spring Technical Conference of the Cincinnati Section, IRE, Engineering Societies Bldg., Cincinnati, Ohio

MAY 11-13—National Conference on Airborne Electronics, Hotel Biltmore, Dayton, Ohio

SENDING END IMPEDANCE OF UNIFORM LINE

This chart may be used to obtain input resistance of lossless shorted and open transmission lines.



For open lines:

$Z_{so} = -j\, X_{oc}$

where

$X_{oc} = \frac{Z_o}{\tan \ell^\circ}$

Find ℓ° *on scale "SO".*

For shorted lines:

$Z_{ss} = +j\, X_{ss}$

where

$X_{ss} = Z_o \tan \ell^\circ$

Find ℓ° *on scale "SS".*

Courtesy of Federal Telephone and Radio Corporation.

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- ☐ Industrial Instrumentation
- ☐ Machine Shop Inspection
- ☐ Reading Blueprints
- ☐ Toolmaking
- ☐ Gas–Electric Welding
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- ☐ Stationary Steam Engineering
- ☐ Stationary Fireman

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- ☐ Radio Operation
- ☐ Radio Servicing–FM
- ☐ Television
- ☐ Electronics
- ☐ Telephone Work

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- ☐ Diesel Locomotive
- ☐ Air Brakes ☐ Car Inspector
- ☐ Railroad Administration

TEXTILE
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TV ANTENNA

TRIO ZIG-ZAG TV ANTENNAS

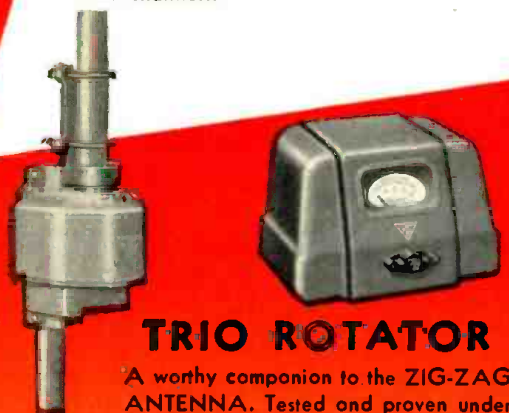
The sensational new TRIO ZIG-ZAG TV ANTENNA has already proven its superiority in the field. Thousands of installations have given a new high in TV reception, especially in ultra-fringe areas. Word of mouth has done the rest. TRIO'S plant capacity, taxed to the limit in an effort to supply the amazing demand for the ZIG-ZAG ANTENNA series, is being greatly expanded. Very soon now, your ZIG-ZAG ANTENNA will be supplied, and it's well worth waiting for.

ZIG-ZAG ANTENNAS have replaced every known type of installation and TRIO is proud to report that in EVERY instance the ZIG-ZAG ANTENNA has out-performed them all, even the tried and true TRIO dual-channel yagi.

TV listeners are finding that with a ZIG-ZAG ANTENNA they are no longer tied down to just one or two channels, but are getting excellent reception on channels never seen before. ZIG-ZAG ANTENNA is truly HOT on all VHF channels.

available in 8 different models, provide a new high in all-channel performance for any area, from metropolitan to ultra-fringe. Tremendous gain, sharp directivity, excellent match to 300 ohm line, sturdy vibration-proof construction and fast, easy installation tells the rest of the TRIO ZIG-ZAG ANTENNA story.

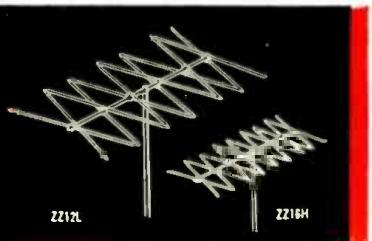
SEE THEM at your JOBBERS. WRITE for CATALOG.



TRIO ROTATOR

A worthy companion to the ZIG-ZAG ANTENNA. Tested and proven under every conceivable condition of load, weather, strain and stress. Two motors, one for each rotation direction. Positive electrical stops prevent damage of over-rotation. Positive brake action, no drift even when supporting heavy arrays in 80 MPH winds. Precision built of finest materials and UNCONDITIONALLY GUARANTEED by TRIO for TWO YEARS. SMARTLY STYLED DIRECTION INDICATOR has easy to read dial face and easy to use finger touch control. A beautiful instrument you'll be proud to own.

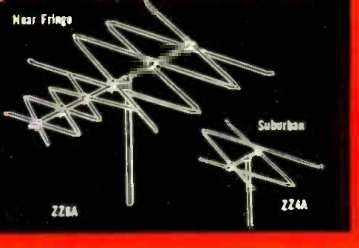
These ZIG-ZAG ANTENNAS provide the ultimate in extreme fringe area reception. ZZ12L provides 12-14 db. gain on Channels 2 thru 6. ZZ16H has a gain of 14 db. on Channels 7 thru 13. These antennas have very narrow forward lobe, high front to back ratio, provide high rejection in areas with co-channel interference.



Where maximum gain is not necessary these normal fringe model ZIG-ZAG ANTENNAS are ideal. Model ZZ8L has a gain of 9 db. average on Channels 2 thru 6. The ZZ8H provides an 11 db. gain on Channels 7 thru 13. Forward lobe patterns comparable to good multi-element single channel yagi.

For near fringe area reception these ZIG-ZAG ANTENNA models provide 8-9 db. gains on all Channels 2 thru 13. ZZ6L covers Channels 2 thru 6 and Model ZZ6H covers Channels 7 thru 13. Both models have patterns similar to those of cut to channel yagis.

These ZIG-ZAG ANTENNAS provide ALL CHANNEL reception with only ONE antenna bay. Model ZZ6A is designed for near fringe area reception of all Channels 2 thru 13, with an average gain of 9 db. Model ZZ4A is for use in suburban areas, providing an average gain of 6 db. on all Channels 2 thru 13.



TRIO

TRIO MANUFACTURING COMPANY • GRIGGSVILLE, ILLINOIS

DEALERS GETTING WESTINGHOUSE TUBES PROFIT FROM HEAVY LOCAL ADVERTISING AT NO COST

Service dealers are getting powerful local advertising support from new Westinghouse RELIATRON™ Tube Distributors. In cities now served by Westinghouse Distributors, dealers get local newspaper advertising, a complete kit of store display and imprinted mailing material.

All of it—local ads and kits—are designed to build TV-radio service business in the dealer's local area.

Best of all, none of it costs the dealer a penny!

You can get your store listed in two local newspaper ads at no charge, and get a kit to boot. If Westinghouse Tubes are now sold in your area, see your Westinghouse Distributor and take advantage of this $900-worth-of-advertising-at-no-cost offer.

NEWSPAPER ADS

COMING YOUR WAY

If Westinghouse Tubes are not yet distributed in your area, be patient. Distributors are being established in all market areas as fast as product availability and good service permit.

You'll soon have the chance to buy RELIATRON Tubes. Keep this tremendous opportunity in mind: you'll get newspaper advertising at no cost! Imprinted material for mailings! Imprinted signs for your window! All of it is local advertising which sells your service in your own area where it counts.

For the name of your Westinghouse Distributor, or the approximate date when Westinghouse Tubes will be available in your area, drop a postal card to Dept. G-201 or have your regular distributor contact Dept. G-201 for information on how he can better serve you.

RELIATRON™ TUBES

ELECTRONIC TUBE DIVISION

Westinghouse Electric Corporation
Box 284, Elmira, N. Y.

YOU CAN BE SURE...IF IT'S Westinghouse

ET-95013

Sweeping the Country!

BUY DIRECT AND SAVE

'PRE-FAB' **COLLINS** TUNERS *and* RECEIVERS

AUDIO PRODUCTS CO.

Collins Audio Products Co. is in no way affiliated with Collins Radio Co.

Two ALL NEW Complete Kits for Every High-Fidelity Need

FM Tuner Kit **$55**

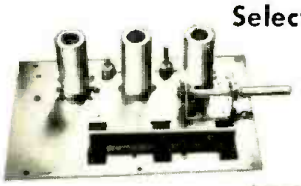
The FM-11 tuner is available in kit form with the IF Amplifier mounted in the chassis, wired and tested by us. You mount the completed RF Tuning Unit and power supply, then after some simple wiring, it's all set to operate. 11 tubes: 6J6 RF amp, 6AG5 converter, 6C4 oscillator, 6BA6 1st IF, (2) 6AU6 2nd and 3rd IF, (2) 6AU6 limiters, 6AL5 discriminator, 6AL7-GT double tuning eye, 5Y3-GT rectifier. Sensitivity 6 to 10 microvolts, less than ½ of 1% distortion, 20 to 20,000 cycle response with 2DB variation. Chassis dimensions: 12½" wide, 8" deep, 7" high. Illustrated manual supplied. Shipping weight 14 lbs.

Each Collins Tuner Kit is complete with punched chassis, tubes, power transformer, power supply components, hardware, dial assembly, tuning eye, knobs, wire, etc., as well as the **completed** sub-assemblies: FM tuning units, AM tuning units, IF amplifiers, etc., where applicable. Since all these sub-assemblies are wired, tested and aligned at the factory, Collins Pre-Fab Kits are easily assembled even without technical knowledge. The end result is a fine, high quality, high fidelity instrument at often less than half the cost — because you helped make it and bought it direct from the factory. Bring your present reproducing system up to date with a new Collins Tuner.

FM/AM Tuner Kit **$77.50**

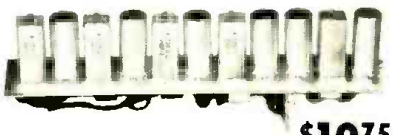
The original 15 tube deluxe FM/AM pre-fab kit redesigned on a smaller chassis. The tuner now measures 14" wide by 12" deep by 7½" high. This attractive new front and dial assembly opens up new applications where space is at a premium. Kit includes everything necessary to put it into operation—punched chassis, tubes, wired and aligned components, power supply, hardware, etc. Kit comprises FMF-3 tuning unit, IF-6 amplifier, AM-4 AM tuning unit, magic eye assembly and complete instructions. All tubes included. Shipping weight 19 lbs.

Selected Basic Components For Special Applications



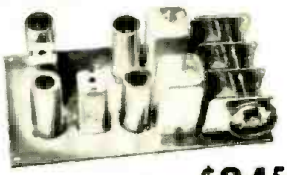
FMF-3 Tuning Unit **$15.25**

The best for FM. The most sensitive and most selective type of "front end" on the market. 6 to 10 microvolts sensitivity. Image ratio 500 to 1. 6J6 tuned RF stage, 6AG5 converter, 6C4 oscillator. Permeability tuned, stable and drift-free. Chassis plate measures 6½"x4½". In combination with the IF-6 amplifier, the highest order of sensitivity on FM can be attained. Tubes included as well as schematic and instructions. Draws 30 ma. Shipping weight FMF-3: 2½ lbs. Dial available @ $3.85



IF-6 Amplifier **$19.75**

A remorkable value! 6 tubes are used in the IF amplifier: 6BA6 1st IF, (2) 6AU6 2nd and 3rd IF's, (2) 6AU6 limiters and 6AL5 discriminator. High gain, wide-band response (200 KC) for highest fidelity. 20 to 20,000 cycles. Distortion less than ½ of 1%. Draws 40 ma @ 220 volts. Chassis plate dimensions: 11-5/16"x2½" Shipping weight: 3 lbs.



AM-4 Tuning Unit **$24.50**

Tops in AM superhet performance! A 3-gang tuning condenser gives 3 tuned stages with high sensitivity and selectivity. Assembly is completely wired, tested and aligned ready for immediate use. Frequency coverage 540 KC to 1650 KC at a sensitivity of 5 microvolts. Tubes 6BA6 RF amplifier; 6BE6 converter; 6BA6 IF amplifier and 6AT6 detector. Draws 30 ma @ 220 volts. Mounts on a chassis plate meosuring 4"x7⅜". Shipping weight 2½ lbs. Dial available at $3.85.

RD-1C Tuner & Dial **$28.50**

The COLLINS RD-1C FM tuner chassis is unique in the field. A whole, compact FM tuner and dial that fits in the palm of your hand. Convert AM sets to FM/AM receivers for only a few dollars! Unlimited applications where space is at a premium. Use in conjunction with your phonograph amplifier. Full frequency response to 20,000 cycles. Sensitivity 20 microvolts, permeability tuned. Tuning unit and IF amplifier on the same chassis plate. Draws 40 ma @ 100 volts. Tubes: 6AG5 converter, 6C4 oscillator, (2) 6AU6 IF amplifiers, 6AL5 in new ratio detector circuit Shipping weight tuner and dial 5 lbs.

MAIL COUPON TODAY

To: Collins Audio Products Co. Inc.
P.O. Box 368, Westfield, N. J.
Tel. WEstfield 2-4390

☐ FM Tuner Kit ☐ FM/AM Tuner Kit ☐ Slide Rule Dial Assembly
☐ FMF-3 Tuning Unit ☐ IF-6 Amplifier ☐ RD-IC Tuner and Dial
☐ AM-4 Tuning Unit

NAME.....

ADDRESS.....

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

Amount for Kit $..... See weights, add shipping cost $.....

Total amount enclosed $..... Check ☐ Money Order ☐

WHEN YOU THINK OF TUNERS, THINK OF COLLINS AUDIO PRODUCTS

SYLVANIA PICTURE TUBES

Lasted Longer than others tested!

"IT'S A TRUE BLUE-RIBBON TUBE"

BEST IN OVER-ALL POINT QUALITY!

SYLVANIA OUTLASTED ALL TUBES TESTED

Only Sylvania tubes showed NO FAILURES after 1400 hours . . . *at accelerated voltages*

Exhaustive tests conducted under the supervision of an outside impartial laboratory, the United States Testing Company, showed Sylvania Picture Tubes lasted longer than any others tested.

These tests included the picture tubes of nine leading manufacturers. All tubes were placed in identical test racks and tested under identical accelerated voltages. At the end of 1400 hours, only the Sylvania Picture Tubes showed *no failures.*

These tests definitely establish the outstanding dependability of Sylvania Picture Tubes. They prove that these tubes will best uphold your reputation for fine performance in the sets you manufacture, sell or service. Send today for complete details about Sylvania Picture Tubes. Sylvania Electric Products Inc., Dept. 3R-2101, 1740 Broadway, New York 19, New York.

TESTS CONDUCTED BY U.S. TESTING COMPANY

SYLVANIA

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

Within the INDUSTRY

A.I.E.E. will hold its 1953 Winter General Meeting January 19-23 at the Hotel Statler in New York. Some 4000 of the nation's leading engineers, scientists, and research men and women are expected to attend.

L. F. Hickernell, chief engineer at *Anaconda Wire & Cable Co.*, has been appointed chairman of the technical program committee. This committee will supervise sixteen daily technical sessions. They will be held simultaneously and, during the five day period, will cover every field of electrical engineering and related sciences.

* * *

GORDON C. KNIGHT has been named assistant to the president of *International Telephone and Telegraph Corporation.*

Active in management and industrial relations since 1941, Mr. Knight joins *IT&T* from its subsidiary, the *Capehart - Farnsworth Corporation,* where he served successively as assistant to the president, division manager of research and development, and operations manager of the commercial products division.

He served four years with the U.S. Navy Amphibious Forces during World War II and held the rank of lieutenant at the time of his discharge.

* * *

ADMIRAL CORPORATION has announced construction of a new 46,000 square foot addition to its television plant in Bloomington, Illinois. The new plant contains television installation lines, storage for cabinets, tubes and other components, and warehouse space for finished products . . . **HALLMARK ELECTRONIC CORPORATION,** Newark distributing firm, has moved to new and larger quarters at 85 Monticello Avenue in Newark. The new facility provides over 7000 square feet of sales and storage space . . . **JAVEX,** manufacturer of meters and electronic devices, has moved to Redlands, California from Garland, Texas. The company is occupying a new plant on its recently-purchased 25-acre site in Redlands . . . **SYLVANIA ELECTRIC PRODUCTS INC.** has dedicated its new electronics division headquarters in Woburn, Massachusetts. The new 50,000 square foot plant employs approximately 850 persons and will serve as the headquarters for the administrative, sales, engineering, and manufacturing staffs of the electronics division as well as serve as the site of the principal manufacturing operations . . . **SPIRLING PRODUCTS INC.** has moved its manufacturing facilities from 62 Grand Street in New York to a new, modern plant on Henrietta Street at Duffy Avenue in Oyster Bay, Long Island . . . Television production is now underway at Plant No. 5 of the **RAYTHEON TELEVISION AND RADIO CORPORATION.** The new facility, located at 51st Street and Cottage Grove Avenue in Chicago, will be devoted exclusively to the production of TV receivers.

* * *

CRESTWOOD RECORDER CORPORATION of Chicago has been purchased by **DAYSTROM ELECTRIC CORPORATION,** subsidiary of **DAYSTROM, INCORPORATED,** Elizabeth, N. J. firm. H. H. Hanlon, president of *Crestwood,* will continue as sales manager of the new subsidiary and will direct national distribution . . . **MAGNETIC RESEARCH CORP.,** El Segundo, California, is a newly-formed company specializing in the research, development, and production of magnetic devices. Hugo Woerdemann heads the new firm which has offices at 318 Kansas Street in El Segundo . . . Edward T. Clegg has resigned his post as chief engineer of **KUTHE LABORATORIES** to form a new company, **CLEGG LABORATORIES, INC.** The new firm will develop and build instruments and equipment for the radar pulse generation field and will later enter the u.h.f. component and equipment market, catering to the ham. The company's main office is at 410 John Street, East Newark, N. J. . . . A new firm for the manufacture of electrical, electronic, and nuclear products has been formed under the name **PLASTIC CAPACITORS, INC.** Stephen Meskan heads the new organization which is located at 2511 W. Moffat Street, Chicago 47.

* * *

JAMES A. COMSTOCK has been named president of *Acme Electric Corporation,* Cuba, N. Y., while Charles H. Bunch has been elevated to the post of chairman of the board.

Mr. Comstock joined the company in 1930 as chief engineer. He has served as purchasing agent, manager of specialty transformer and radio transformer sales, general manager of the Clyde, N. Y. plant of the company, and, since 1946, as executive vice-president.

* * *

FRANK W. MANSFIELD of *Sylvania Electric Products Inc.* has been reappointed chairman of the Industry Statistics Committee of the Radio-Television Manufacturers Association.

Leonard C. Lane, B.S., M.A.
President of Radio-Television Training Association. Exec. Dir. of Pierce School of Radio and Television.

I GIVE YOU MORE EQUIPMENT TO TRAIN YOU BETTER

Set up your own home laboratory with the 15 BIG TV-Radio kits we send you. You build AND KEEP your own complete BIG SCREEN TV RECEIVER, Super-Het Radio Receiver, R.F. Signal Generator, Combination Voltmeter-Ammeter-Ohmmeter, C-W Telephone Receiver, AC-DC Power Supply. Everything is furnished complete, including all tubes, plus big TV picture tube.

GET MORE!

LEARN MORE!

EARN MORE!

THOUSANDS OF NEW JOBS IN TELEVISION

I PREPARE YOU AT HOME IN YOUR SPARE TIME

MORE TRAINING TO FIT YOU FOR THE BETTER PAY JOBS

Thousands of new jobs will open up right in your own state, now that the government has lifted restrictions on new TV stations. My simple, successful methods have helped hundreds of men — most of them with NO PREVIOUS TRAINING — find places in America's booming TELEVISION and Electronics industries. You too can get the success and happiness you always wanted out of life within months . . . studying at home . . . as I train you to become a full-fledged TV TECHNICIAN. Many of my students make as much as $25.00 a week repairing Radio-TV sets in their spare time while learning . . . pay their entire training almost from the very beginning from spare time earnings . . . start their own profitable service business.

But I don't stop after I qualify you as a TV Technician . . . although right there you can choose from among dozens of fascinating careers! I continue to train you — AT NO EXTRA COST — to qualify for even better pay in the BETTER JOBS that demand FCC licenses, with my . . .

MORE VALUE!

YOU GET A ROUND TRIP TO NEW YORK CITY AT NO EXTRA COST

FROM ANYWHERE IN THE U.S. OR CANADA — I pay your way to New York and return, PLUS 2 FREE weeks, 50 hours of advanced instruction and shop training at the PIERCE SCHOOL OF RADIO & TELEVISION. You use modern electronics equipment, including student-operated TV and Radio stations. You go behind the scenes of New York's big Radio-TV centers, to study first hand. And I give you all this AT NO EXTRA COST! (Applies to complete Radio-TV course only.)

Only RTTA makes this amazing offer.

I GET MY GRADUATES GOOD PAYING JOBS

"Thanks to your training, I qualified for a good job as a Receiver Tester at Federal Telephone and Radio."
— Paul Frank Seier

"I'm making good money in my own business, repairing and installing radio and TV sets — thanks to your training."
— Irwin Polansky

"Your excellent instruction helped me get my present job as an airport radio mechanic for American Airlines. — Eugene E. Basko

"I'll always be grateful to your training which helped me get my present fine position as Assistant Parts Manager."
— Norman Weston

Many others working at NBC, RCA, CBS, DuMont, Philco, Emerson, Admiral and other leading firms.

FREE FCC COACHING COURSE

PREPARES YOU AT HOME FOR YOUR FCC LICENSE.
THE BEST JOBS IN TV AND RADIO REQUIRE AN FCC LICENSE.
Given at NO EXTRA COST after TV Theory and Practice is completed.

NOW! ADVANCED FM-TV TRAINING

If you have previous Armed Forces or civilian radio experience—my ADVANCED COURSE can save you months of training. Full theory and practical training . . . complete with kits, including BIG SCREEN TV RECEIVER and FREE FCC License Coaching Course.

FREE EMPLOYMENT ASSISTANCE

My vocational adviser will help you obtain a good-paying job in the locality of your choice.

VETERANS!

MY SCHOOLS FULLY APPROVED TO TRAIN VETERANS UNDER *NEW* G.I. BILL! If discharged after June 27, 1950 — CHECK COUPON BELOW!

Also approved for RESIDENT TRAINING in New York City . . . qualifies you for full subsistence allowance up to $160 per month.

MAIL COUPON TODAY!

BOTH FREE! New Illustrated Book and Sample Lesson. Learn How My Simple Methods Make Success Easy!

NO SALESMAN WILL CALL!

Mr. Leonard C. Lane, President
RADIO-TELEVISION TRAINING ASSOCIATION
1629 Broadway, Radio City Station
New York 19, N. Y. Dept. T-1

Dear Mr. Lane: Mail me your NEW FREE BOOK and SAMPLE LESSON that will show me how I can make BIG MONEY in TELEVISION. I understand I am under no obligation and no salesman will call.

(PLEASE PRINT PLAINLY)

Name _____ Age _____

Address _____

City _____ Zone _____ State _____

I am interested in: ☐ Radio-TV ☐ Advanced FM-TV.
VETERANS: If qualified under new G.I. Bill, check your choice: ☐ Home Study ☐ Resident Study.

RADIO-TELEVISION TRAINING ASSOCIATION

1629 Broadway, Radio City Station, New York City 19, N. Y.
LICENSED BY THE STATE OF NEW YORK

The 21-man committee, under Chairman Mansfield, directs the Association's activities in collecting and compiling statistical information for the radio-television industry. During the last fiscal year, this committee supervised the establishment of a statistical department within RTMA headquarters and broadened the Association's activities in this field.

* * *

HOWARD BRIGGS, formerly assistant vice-president in charge of the *Hoffman* government contract office in Washington, D. C., has been appointed assistant to the president of *Hoffman Laboratories, Inc.* of Los Angeles.

Prior to joining the company in 1950, Mr. Briggs was vice-president in charge of sales for the *Howard Radio Co.* in Chicago, a position he held for 15 years.

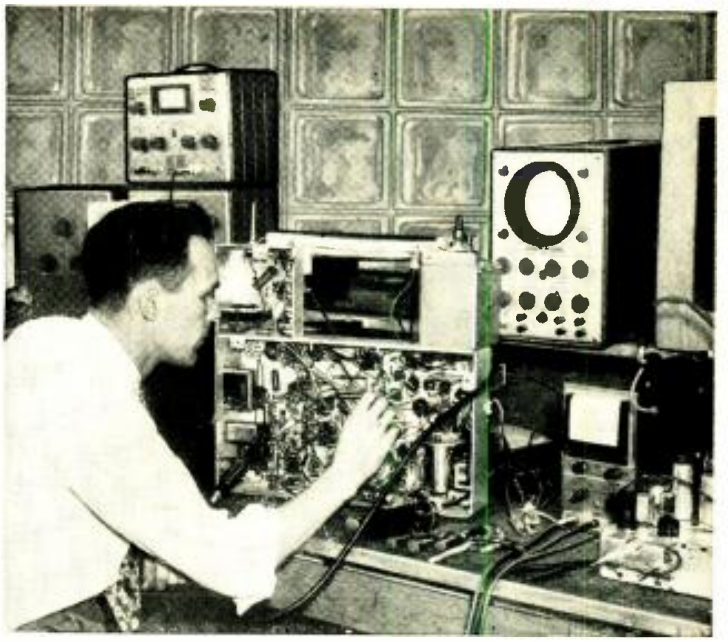
In his new post, he will manage the military production phase of the corporation and will coordinate procurement, sales, manufacturing, and other related departments of the company.

* * *

A. E. ABEL has been appointed assistant director of engineering and research for *Bendix Radio Div.* . . . *The Brush Development Co.* has named **ALBERT J. W. NOVAK** to the post of assistant general sales manager . . . **HERBERT RIEGELMAN,** until recently a vice-president of *Montgomery Ward,* has been appointed manager of marketing for the receiver department of *General Electric* . . . **DR. E. F. W. ALEXANDERSON,** noted engineer and inventor, has joined *RCA* as a consultant. This new association returns him to the company he served as chief engineer from 1920 to 1924 . . . **VICTOR WELGE** has joined *P. R. Mallory & Co., Inc.* as associate director of engineering . . . **HENRY GOLDSMITH** has been appointed manager of the "Sonora" brand sales division of *Sonora Radio & Television Corp.* . . . **WILLIS E. CLEAVES** has joined *Bendix Radio Div.* as staff assistant to the general manager of the division. He was formerly with *Collins Radio Company* . . . **ANTON C. FISHER** is the new sales and advertising manager for *Fretco Inc.,* manufacturers of TV antennas and antenna accessories . . . **ABRAHAM HYMAN,** formerly supervisory electronic engineer for the CAA in New York, has joined the *JFD Mfg. Co.* as an electronic consultant . . . **DONALD L. HERR** has been elected president of *American Electronic Mfg., Inc.,* a newly-established Los Angeles firm . . . **R. CARROLL MANINGER** has been made acting director of the physical research and development department and **ARTHUR R. SOFFEL** named director of the instrument assembly and design department for *Vitro Corporation of America* . . . **GARDNER P. WILSON** has joined *Consolidated Engineering Corp.* as senior development engineer . . .

(*Continued on page* 101)

Here's your Opportunity



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

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

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

The Big New Industry with a Great Future

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

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

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

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

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

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. *Write for free catalog on resident courses.*

Send for FREE BOOKLET

Mail the coupon—today. Get complete information on the RCA INSTITUTES Home Study Course in Television Servicing. Booklet gives you a general outline of the course by units. See how this practical home study course trains you quickly, easily. Mail coupon in envelope or paste on postal card.

MAIL COUPON NOW!

RCA INSTITUTES, INC., Home Study Department RN-153
350 West Fourth Street, New York 14, N. Y.

Without obligation on my part, please send me copy of booklet "RCA INSTITUTES Home Study Course in TELEVISION SERVICING." (No salesman will call.)

Name_____
(please print)

Address_____

City_____ Zone_____ State_____

RCA INSTITUTES, INC.
A SERVICE OF RADIO CORPORATION of AMERICA
350 WEST FOURTH STREET, NEW YORK 14, N.Y.

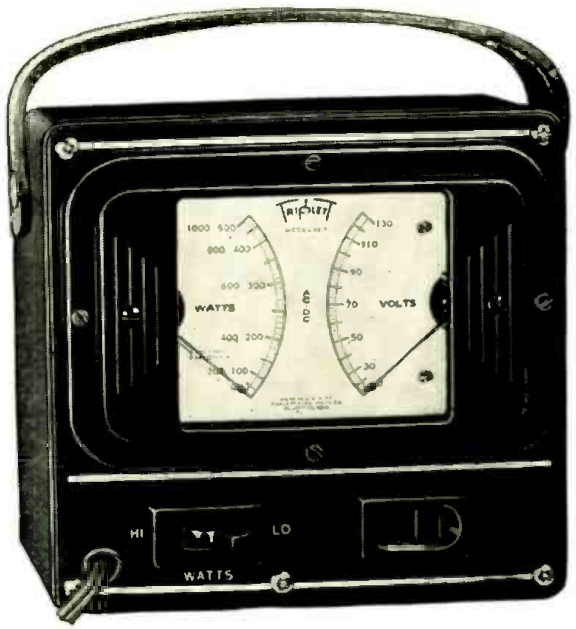
Bill Clemens says—

Midget Radio Service (a 3-Man Shop)
129 S. Elizabeth St.,Lima, Ohio

"TRIPLETT 660 saves us 50 to 100 man hours per month."

1. ISOLATING THE TROUBLE—Plug the power cord of the chassis into LOADCHEK and note the reading. With your eye on the large meter remove the rectifier tube and you can tell immediately which side of the tube the trouble is on. You have already eliminated 50% of your probing time.

2. LOCATING THE SHORT—With Loadchek you can quickly check the shorted side, part by part, without laying down tools or picking up test leads. Here, the trouble was a short in the transformer, spotted without having to warm up set. Overloads are found the same way.



Locates trouble in a hurry

The above pictures illustrate but one of the many time-saving uses of Triplett 660 Loadchek. This versatile instrument accurately measures power consumption, enables you to see instantly any deviation from normal load, without disconnecting a single part . . . finds trouble in a hurry.

For Radio and TV servicing—for almost any kind of electrical trouble-shooting—LOADCHEK saves hours of painstaking work every day. At its moderate cost no service technician can afford to be without it. Try one today—and see! Write for free booklet.

TRIPLETT ELECTRICAL INSTRUMENT CO., BLUFFTON, OHIO, U.S.A.

Suggested U. S. A. DEALER NET $29.50

Price subject to change without notice.

TRIPLETT

Triplett

TRAIN *FASTER* — TRAIN *BETTER* — TRAIN *EASIER*
IN 10 MONTHS — OR LESS — FOR
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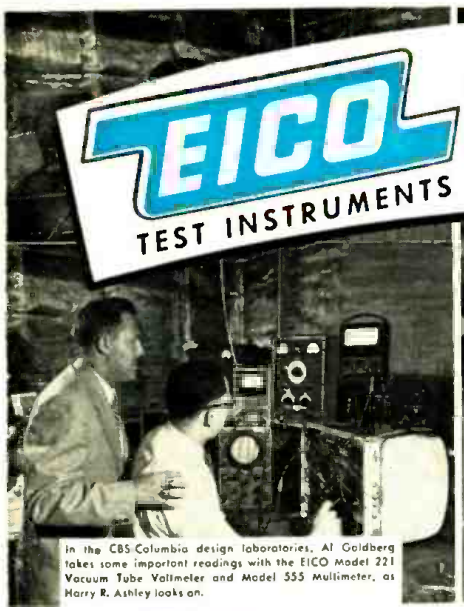
EICO GUARDS CBS Columbia HIGH STANDARDS OF TELEVISION PRODUCTION QUALITY

TEST INSTRUMENTS



In the CBS-Columbia design laboratories, Al Goldberg takes some important readings with the EICO Model 221 Vacuum Tube Voltmeter and Model 555 Multimeter, as Harry R. Ashley looks on.

Mr. Al Goldberg, Assistant Chief Engineer of CBS-Columbia and Harry R. Ashley, President of EICO, inspecting the use of the EICO Model 221 Vacuum Tube Voltmeter and Model HVP-1 High Voltage Probe at the Sweep Frequency Troubleshooting Position on the CBS-Columbia Television production lines.

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OSCILLOSCOPES

THE ELECTRONIC EYE OF THE SERVICE TECHNICIAN

By **MILTON S. KIVER**
Pres., Television Communications Institute

A survey of the various service-type oscilloscopes currently available and details on how instrument is used in radio and television repair operations.

The Triplett Model 3441 5" service-type oscilloscope.

THE introduction of television wrought many changes in the working habits of the radio technician. It caused him to develop a broader understanding of electronic circuits and a greater appreciation of what they can do. It introduced him to many new components and to many different types of circuits. And, above all, it brought into his daily life test instruments which he may have heard of, but which he seldom had occasion to use.

The most important of the new instruments, from the standpoint of utility, is the oscilloscope. For servicing, the technician can employ the oscilloscope to view directly the shapes of the waves present at various points in the television receiver. He can tell by inspection whether they possess the proper shape and he can determine by measurement whether they are attaining the desired amplitude.

For alignment, the oscilloscope is a natural companion to the sweep generator, depicting graphically the response curve of the circuit into which the sweep signal is fed. This not only provides an instantaneous picture of circuit conditions as they exist, but any changes caused by adjusting coil cores and/or trimmer condensers become immediately apparent. The technician is thus kept fully informed at all times of the condition of the circuit being worked on.

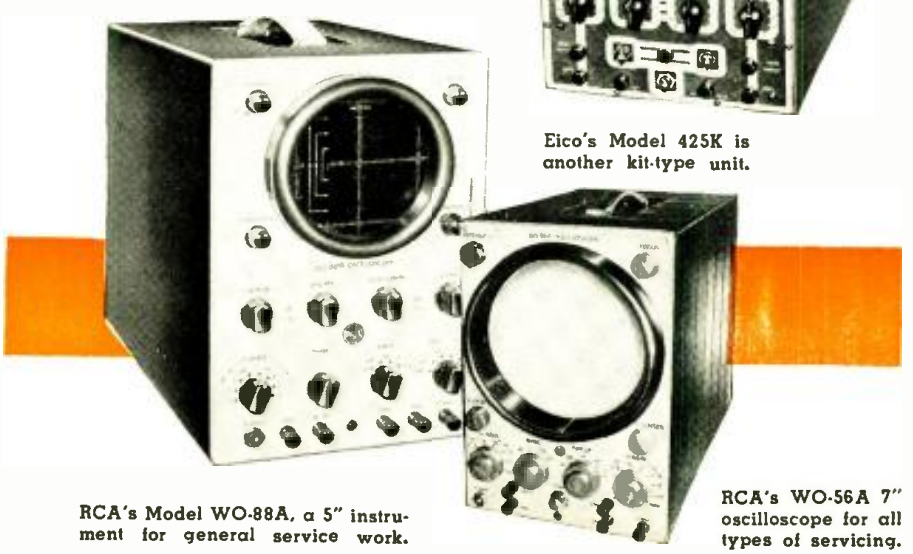
There is a considerable amount of similarity between some of the operating controls on an oscilloscope and the operating controls of a television receiver. This is because an oscilloscope and the deflection circuits in a television receiver operate on the same basic principles. Thus, the "Intensity" control on the scope does exactly the same thing as the "Brightness" control on the television receiver. The same is true of "Focus" controls and of "Vertical" and "Horizontal" centering controls.

The oscilloscope is an impressive looking instrument with a seemingly endless array of controls. At least that is the impression the uninitiated get. To dispel this illusion and to fit these controls into a logical pattern, let us examine the basic diagram of an oscil-

Heath Company offers this Model O-8 scope in kit form.

Eico's Model 425K is another kit-type unit.

Radio City Products Company's Model 533M "Midgetscope" unit.



RCA's Model WO-88A, a 5" instrument for general service work.

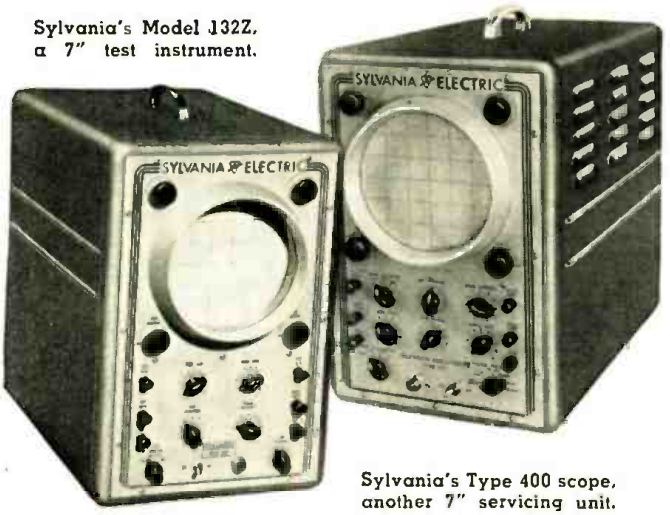
RCA's WO-56A 7" oscilloscope for all types of servicing.

TABLE 1

Make & Model	Tube Size	Vertical Sensitivity	Bandpass (+0 −3 db.)	Phasing Control	Blanking Control	Intensity Mod.	Self Measurement of Peak-to-Peak	List Price	Remarks
COSSER Model 1039 B	3"	2.27 v. r.m.s./in. 13 v. r.m.s./in.	25 cps to 150 kc. 25 cps to 3.5 mc.	No	No	No	No	$167.00	Designed for portable use. Weight 9¼ lbs. Size 11½" x 5½" x 4½"
DU MONT Model 292	3"	.4 v. r.m.s./in.	5 cps to 100 kc.	No	See Note 2	No	See Note 1	135.00	
GENERAL ELECTRIC Model YNA-4	3"	A.C.—.18 v. r.m.s./in. D.C.—.5 v. d.c./in.	0-30 kc. +0, −15% 0-30 kc. +0, −15%	No	No	No	Yes	189.50	Vertical and horizontal amplifiers d.c. coupled. Designed primarily for industrial applications.
HICKOK Model 380	3"	75 mv. r.m.s./in.	0-2 mc.	No	Yes	No	No	215.00	Designed for portable use. Weight 14 lbs. Size 13½" x 9" x 6"
RADIO CITY PRODUCTS Model 533M	3"	20 mv. r.m.s./in.	20 cps to 180 kc. (within ± 2 db)	No	No	No	No	99.50	Designed for portable use. Wt. 9 lbs. Size 11¾" x 7¾" x 5⅛"
SUPREME Model 650	3"	.5 v. r.m.s./in.	20 cps to 100 kc.	No	No	No	No	99.95	
DU MONT Model 274-A	5"	.2 v. r.m.s./in.	5 cps to 110 kc.	No	See Note 2	Yes	See Note 1	135.00	
DU MONT Model 304A	5"	9 mv. r.m.s./in.	0 to 250 kc.	No	See Note 2	Yes	Yes	333.00	Flat face tube.
EICO Model 425K	5"	.1 v. r.m.s./in.	5 cps to 400 kc.	No	No	Yes	See Note 1	44.95 (in kit form)	Has detailed step-by-step instructions for construction.
EICO Model 430K	5"	20 mv. r.m.s./in.	10 cps to 1 mc. ± 2db	No	No	Yes	See Note 1	(in kit form)	New model.
ELECTRONIC MEASUREMENTS Model 600	5"	.02 v. r.m.s./in.	15 cps to 500 kc.	No	No	Yes	No	99.50	
EL-TRONICS Model WBO-50	5"	20 mv. r.m.s./in.	20 cps to 5 mc.	No	See Note 2	Yes	Yes	279.50	Sweep oscillator variable from 10 cycles to 150 kc. in 6 steps.
GENERAL ELECTRIC Model ST-2A	5"	A.C.—15 mv. r.m.s./in. D.C.—2 v. d.c./in.	20 cps to 500 kc. +0, −20% 0-500 kc. +0, −20%	No	No	Yes	Yes	327.50	Has special low capacity probe input terminal on front panel. Probe extra.
GENERAL ELECTRIC Model ST-2B	5"	A.C.—10 mv. r.m.s./in. D.C.—27 mv. d.c./in.	10 cps to 400 kc. +0, −20% 0-400 kc. +0, −20%	No	Yes	Yes	Yes	495.00	Available with short or long persistence CR tubes. Has special terminal for low capacity probe. Probe extra.
GENERAL ELECTRIC Model ST-2C	5"	.075 v. r.m.s./in.	20 cps to 3 mc.	No	No	Yes	Yes	374.25	Has special terminal for low capacity probe. Probe extra. Scope response not more than 50% down at 5 mc.
HEATH Model O-8	5"	25 mv. r.m.s./in.	10 cps to 800 kc.	No	No	Yes	See Note 1	43.50 (in kit form)	Has detailed step-by-step instructions for construction.
HICKOK Model 640	5"	15 mv. r.m.s./in. (1 mc.) 35 mv. r.m.s./in. (4.5 mc.)	0-4.5 mc.	Yes	No	Yes	Yes	355.00	Synchronization of pattern on either positive or negative peaks. Self contained beam blanking amplifier eliminates return trace when using sawtooth sweep. Sync. line or 2X line freq. available.
HICKOK Model 670	5"	10 mv. r.m.s./in.	0-650 kc.	Yes	See Note 4	Yes	No	229.00	Same as Model 640.
JACKSON Model CRO-2	5"	18 mv. r.m.s./in. 25 mv. r.m.s./in.	20 cps to 100 kc. 20 cps to 4.5 mc.	No	Yes	Yes	Yes	197.50	User has choice of wide bandwidth and reduced sensitivity or reduced bandwidth and increased sensitivity.
PRECISION Model ES-500A	5"	20 mv. r.m.s./in.	0-1 mc.	Yes	Yes	Yes	Yes	173.70	Has vertical phase reversing switch, also many extras.
RCA Model WO-88A	5"	25 mv. r.m.s./in.	0-500 kc.	Yes	No	No	Yes	159.50	
SIMPSON Model 476	5"	18 mv. r.m.s./in.	20 cps to 300 kc.	No	No	Yes	See Note 1	197.00	
SUPREME Model 655	5"	.3 v. r.m.s./in.	20 cps to 100 kc.	No	No	No	No	126.50	
SUPREME Model 660	5"	.1 v. r.m.s./in.	5 cps to 5 mc. (within ±2 db)	No	Yes	Yes	No	287.60	
TRIPLETT Model 3441	5"	10 mv. r.m.s./in. (See Note 6)	0-2 mc. (See Note 6)	Yes	Yes	Yes	Yes	199.50	70 v. (0 to 60,000 cycles) is made available from the internal saw-tooth osc. It can be used as an audio oscillator, or when checking to drive high-voltage unit of TV receiver.
PRECISE DEVELOPMENT Model 300	7"	10 mv. r.m.s./in.	0 to 5 mc.	Yes	Yes	Yes	Yes	79.95 (in kit form)	Has detailed step-by-step instructions for construction.
RCA Model WO-56A	7"	10.6 mv. r.m.s./in.	0-500 kc. (+0, −2 db)	Yes	No	No	Yes	217.50	Normal sweep trace can be expanded horizontally three times. Good for checking portions of waveforms.
SYLVANIA Model 132Z	7"	.1 v. r.m.s./in.	7 cps to 70 kc.	No	No	Yes	See Note 1	149.50	
SYLVANIA Model 400	7"	10 mv. r.m.s./in.	10 cps to 2 mc.	Yes	No	Yes	See Note 5	249.50	

See opposite page for applicable notes.

Sylvania's Model 132Z, a 7" test instrument.



Sylvania's Type 400 scope, another 7" servicing unit.

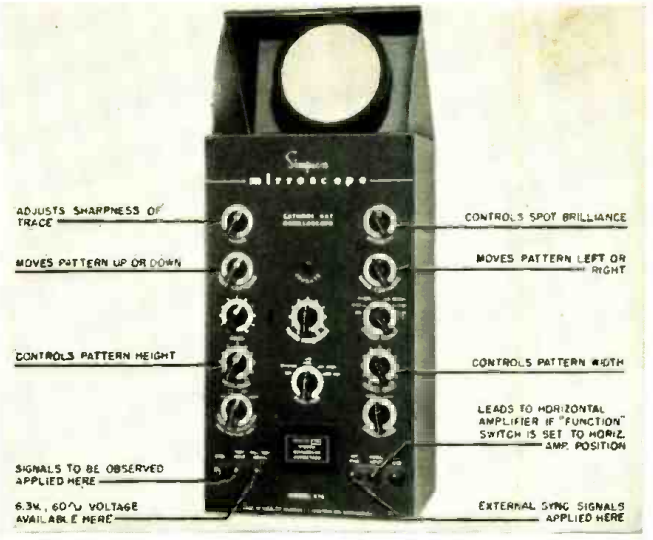


Fig. 1. Control functions on a representative scope. See text.

NOTES:

1. A 60-cycle voltage having an r.m.s. value of 6.3 volts is available at a front panel terminal. While not specifically designed for peak-to-peak voltage measurement, it can be adapted to this purpose.
2. There is no blanking control, but there is an internal retrace blanking circuit.
3. A 60-cycle test voltage of approximately .5 volt r.m.s. is available at a front panel terminal. This can be used for small peak-to-peak voltage measurements.
4. There is provision for blanking out return trace when a 60-cycle sinusoidal sweep is used.
5. A 60-cycle test voltage of approximately 25 volts is available at a rear panel terminal.
6. When scope rear switch is in 2 mc. position, sensitivity is 10 mv. r.m.s. per inch. When in 4 mc. position, sensitivity is 20 mv. r.m.s. per inch.

Notes applying to certain of the oscilloscopes covered in Table 1 appearing on page 32 (opposite).

loscope. This is shown in Fig. 2 (page 34). The heart of the instrument is the cathode-ray tube because it is on the screen of this tube that the incoming waves are traced out.

To produce the waveshape of applied signals, two sets of voltages must be applied to the cathode-ray tube. One of these voltages is the horizontal deflection voltage and this serves to move the beam slowly across the screen from left to right and then rapidly on retrace from right to left. If left by itself, all this voltage would do is produce a straight line horizontally across the screen. It is a sawtooth voltage which is internally generated in the oscilloscope and then applied to the horizontal deflection plates via the horizontal amplifiers.

Positioned at right angles to the horizontal deflection plates is another set of two plates. These are the vertical deflection plates. Here are applied the waves we wish to reproduce on the screen. Thus, as the beam is moved along (by the horizontal deflection voltage), it is also moved up or down by the incoming voltage. When the voltage applied to the vertical plates increases (say), the beam moves up; when it decreases, the beam moves down. (The reverse action may occur. Of importance only is the fact that positive voltages swing the beam in one vertical direction and negative voltages swing it in the opposite direction.) In this way the shape of any wave applied to the vertical deflection plates is traced out.

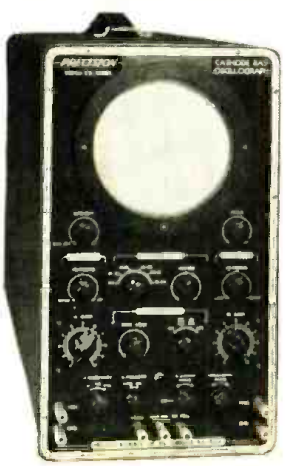
It is perfectly possible to apply voltages directly to the deflection plates themselves and this is sometimes done. However, in order to obtain any sizable deflection of the beam, either straight across or up and down, a considerable amount of voltage is required. A much more flexible arrangement is achieved by inserting amplifiers between the deflection plates and the applied voltages. Now, sizable beam deflection can be obtained with input voltages on the order of millivolts.

In brief, then, the oscilloscope contains suitable amplifiers for the vertical and horizontal deflection voltages, a cathode-ray tube, a saw-tooth voltage generator, and a power supply. This is the basic circuit.

Oscilloscope Controls

The oscilloscope shown in Fig. 1 contains what might be termed an

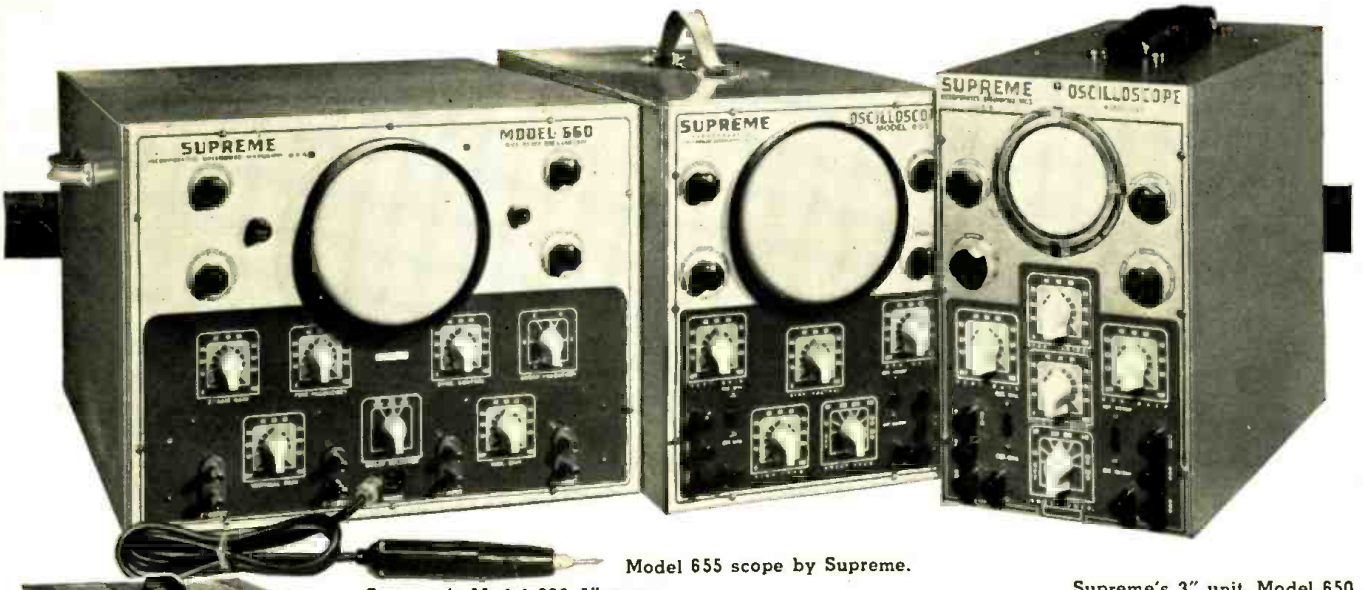
Precision Apparatus Company's Model ES-500-A.



DuMont's Model 274-A 5" oscilloscope unit.

The Model 304-A, a 5" scope made by DuMont.

DuMont's Model 292—a 3" instrument for servicing.



Model 655 scope by Supreme.

Supreme's Model 660 5" scope.

Supreme's 3" unit, Model 650.

El-Tronic's Model WBO-50 5" scope.

Jackson's 5" unit, the Model CRO-2.

Hickok's Model 670, a 5" unit.

The Model 640, also by Hickok.

average number of controls. The functions of the "Focus," "Intensity," and two centering controls are clearly indicated. In Fig. 1 they are the four top controls. They adjust easily and seldom cause trouble.

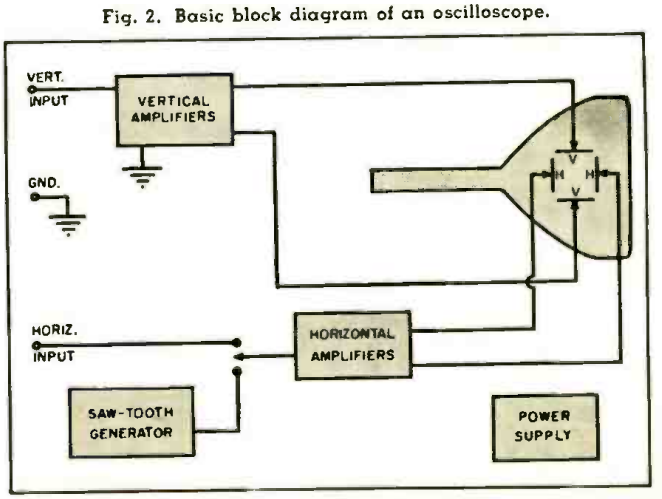
The next three controls, "Sync," "Range Frequency," and "Sweep Range," are all associated with the saw-tooth generator contained in this instrument. The simplest of these three controls, and actually the one to be set first, is the "Sweep Range" control. In the "Off" position, this control turns the saw-tooth generator off and the beam appears as a pin point of light at the center of the screen. The beam should not be permitted to remain stationary at one point or it will burn the screen, with the result that in future use this spot may become insensitive and not produce any light at all as the beam passes over it.

Beyond the "Off" position, the "Sweep Range" switch selects the frequency range for the horizontal saw-tooth (or linear) sweep. The first position beyond "Off" is labeled "15 to 75" cycles which means that the frequency of the saw-tooth deflection voltage produced will lie within this range. (The frequency of the saw-tooth wave tells you how many times a second the beam sweeps across the screen from left to right and how many times it retraces. For example, a 60-cycle saw-tooth wave will move the beam 60 times per second from left to right and 60 times from right to left on retrace.) The exact frequency generated within this range will be determined by the position of the "Range Frequency" control. This control is a potentiometer and at the low end of its range the saw-tooth frequency is at its lowest point for any position of the "Sweep Range" switch; at the other end (extreme clockwise position) of the "Range Frequency" control, the saw-tooth sweeping range is at the upper limit of its range. In the case of the 15 to 75 cycle position, this would be 75 cycles (approximately).

Sweeping ranges of this particular instrument (of Fig. 1) extend from 15 cycles to 60,000 cycles, which is about average for most oscilloscopes. The upper frequency limit varies from 30,000 cycles (30 kc.) in some instruments to a high of 100,000 or 150,000 in others. The top figure of most

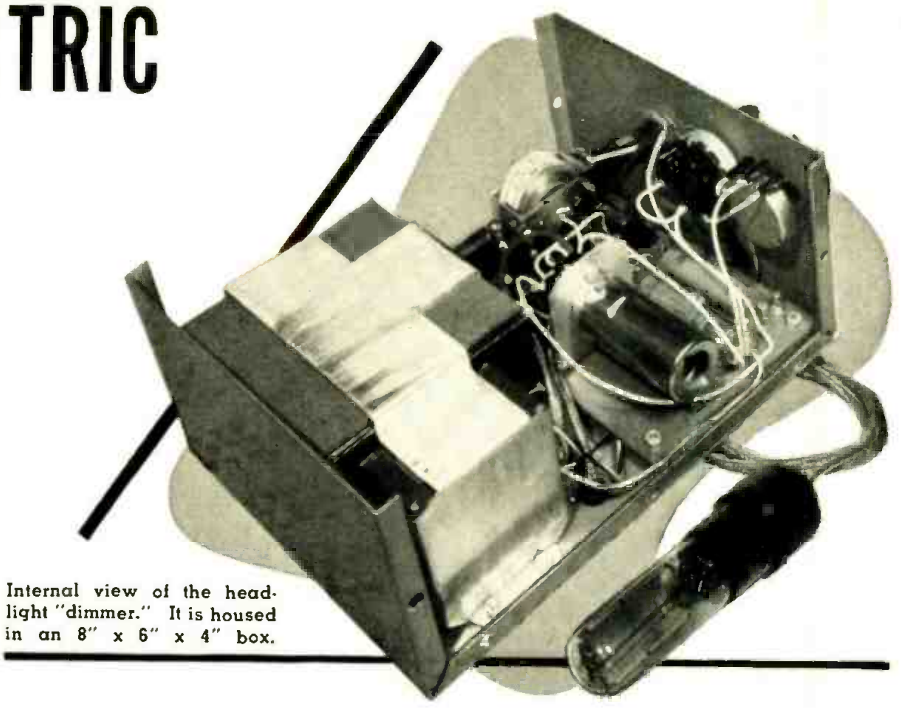
(*Continued on page 87*)

Fig. 2. Basic block diagram of an oscilloscope.



A PHOTOELECTRIC HEADLIGHT DIMMER

By
PETER J. VOGELGESANG
Engineering Research Associates, Inc.



Internal view of the headlight "dimmer." It is housed in an 8" x 6" x 4" box.

Construction details on a battery-operated headlight dimmer which is activated by single Type 868 phototube.

PHOTOTUBES and photocells find almost limitless applications. They are used for everything from reproducing the sound track on motion picture film to controlling smoke in large industrial plants. Almost every month one sees some new and ingenious device designed around the singular properties of the phototube.

The application of the phototube as a headlight dimmer, while probably not very new and certainly not ingenious, is novel and the possessor of such a device will have something to appeal to his mechanical sensibilities.

The operation of this photoelectric headlight dimmer is very simple. Light from the headlights of an oncoming automobile strikes a phototube. The voltage change within the phototube is amplified by a two-stage, direct-current amplifier and the output of the amplifier actuates a sensitive relay. The sensitive relay, in turn, causes the headlights of one's own automobile to switch to the "low" position.

At first thought, the practicability of such a device seems doubtful because the circuit may be affected not only by light from oncoming autos but also by light from street lights, building lights, and even the full moon. It would seem that the headlights of one's auto would be popping up and down like a jack-in-the-box. A number of characteristics of the circuit prevent this from happening.

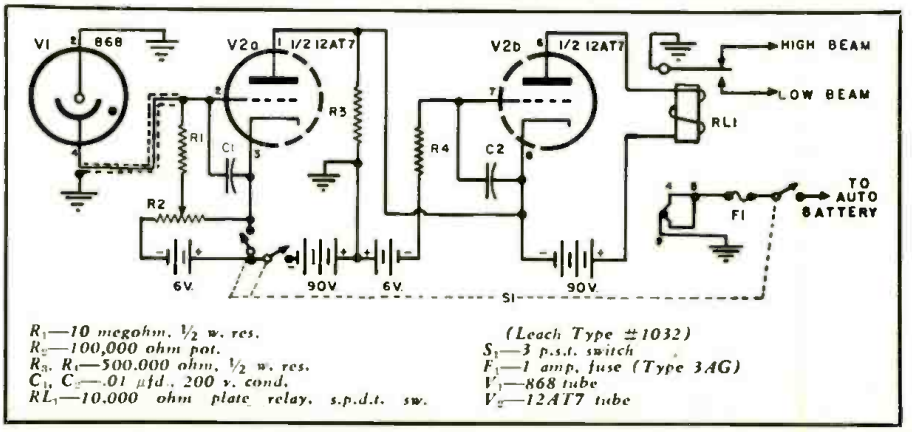
First, of course, the phototube is shielded to prevent incidental light from striking it. Only the light from in front of the auto will affect the device. The combination of resistance and capacitance in the input of the amplifier causes the circuit to respond slowly to sudden changes of light intensity either from light to dark or dark to light. This eliminates the possibility of the circuit "fluttering" or being actuated by passing autos and anything that might temporarily interrupt the light source. The bias on the first stage of the amplifier is controlled by a potentiometer. This "threshold" control can be adjusted to compensate for any extraneous or residual light source such as a full moon or the light from one's own headlights reflected off a snow-covered highway. It also provides a means of adjusting the range or distance at which the headlights of oncoming autos will actuate the circuit. Like any armature relay, more current is required to close the sensitive relay than is required to keep it closed. In the circuit, once the headlights have been dimmed by a given intensity of light, much less light is needed to keep them dimmed. This eliminates the possibility of one's headlights reverting to the "high" position when the driver of an oncoming auto dims his lights.

The entire operation of this device is based upon the idea that if there is enough light to actuate the circuit, there is enough light to see the road without the help of the "high" lights.

The circuit of the device is simplicity itself. An 868 gas phototube supplies the light sensitive element and a twin-triode 12AT7 vacuum tube is used as the two-stage, direct-current amplifier. The anode voltage for the phototube and the plate voltage for the triodes is supplied by two 90 volt "B" batteries. The grid bias for each triode is supplied by two separate 6 volt "C" batteries each made of four little penlight cells connected in series. The heater voltage is taken from the auto battery and is used as a safety precaution. A triple-pole, single-throw switch opens the heater circuit and the plate and bias circuits of the first stage of the amplifier when the unit is not in use. It is not necessary to open the plate circuit of the

(*Continued on page* 110)

Complete schematic diagram and parts list covering the phototube headlight dimmer.



R_1—10 megohm, ½ w. res.
R_2—100,000 ohm pot.
R_3, R_4—500,000 ohm, ½ w. res.
C_1, C_2—.01 μfd., 200 v. cond.
RL_1—10,000 ohm plate relay, s.p.d.t. sw. (Leach Type #1032)
S_1—3 p.s.t. switch
F_1—1 amp. fuse (Type 3AG)
V_1—868 tube
V_2—12AT7 tube

U.H.F. ANTENNAS

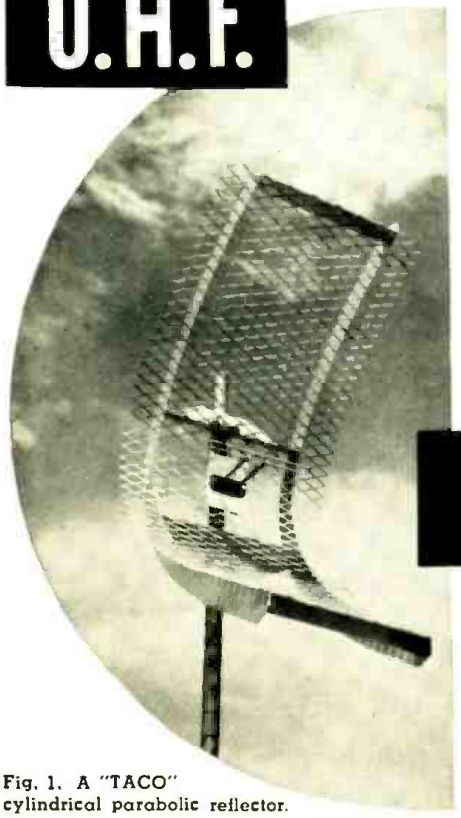
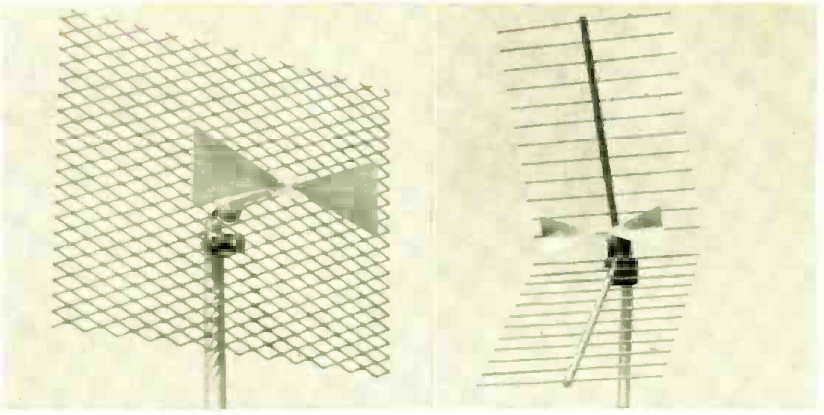


Fig. 1. A "TACO" cylindrical parabolic reflector.



Walsco's "Reflecto-Fan" (left) and "Corner Reflector" (right) antennas for u.h.f. reception. They were recently field-tested in Portland, Oregon.

By **MILTON S. KIVER**
Pres., Television Communications Institute

Part 2. An analysis of u.h.f. antennas using reflectors. Several arrays of unconventional shapes are also covered.

IN THE preceding article we examined in detail such u.h.f. antennas as fan dipoles, stacked "V's," rhombics, yagis, plus other arrays which at present find application at v.h.f. but which can also be employed at u.h.f. with suitable size modifications.

Continuing our study of u.h.f. arrays, let us consider those antennas which owe their sharp directivity and high gain to their reflectors.

The addition of a reflector to an antenna serves several purposes. First, it reduces or substantially eliminates reception of any signals approaching the array from the reflector side. This converts a bi-directional antenna into one which can receive signals from essentially one direction only. Secondly, it increases the gain of the array in the remaining direction.

In v.h.f. applications, there is usually only one reflector employed and this is frequently a single rod, or, at most, two or three rods, positioned about .15 to .25 wavelength behind the receiving element. While these rods do serve to reduce signal reception from the rear, they are far from being totally effective. A more efficient reflector would be one constructed of a solid metallic sheet (or a wire mesh of similar size) placed behind the antenna. At v.h.f. frequencies, antenna dimensions are such that use of a sheet reflector would cause the array to become bulky and frequently difficult to erect. However, at u.h.f. frequencies, the dimensions are sufficiently reduced so that sheet reflectors are entirely feasible. Mesh screens serve as well as solid metallic sheets. The fact that there are openings in the screen does not materially affect its performance as a reflector as long as the openings are on the order of .2 of a wavelength or less. Dimensions of the reflector are not critical but the edges should extend for a short distance beyond the dipole elements.

In common use, too, are parallel bars as reflectors in place of a mesh. The same considerations of small spacing apply here, also.

Two stacked dipoles with a sheet reflector made of a series of rods are shown in Fig. 6. The dipoles in this instance are broader than conventional rods and this is done purposely to extend the bandpass of the array and to keep the input impedance more uniform over the range of frequencies to be received. The antenna shown was designed for v.h.f. use and within this region the reflector screen is 8 feet across. The same array, dimensioned for the u.h.f. band, could be reduced considerably.

Parabolic Reflectors. Parabolic reflectors are not at all new. For many years, before anyone thought of using them for the concentration of radio waves, they were employed for light beams. Their concentrating action is due to the shape of the reflecting surface and the fact that, for reflection, the incident and the reflected rays make equal angles with any line that is drawn perpendicular to the surface at the point of reflection. To understand this, refer to Fig. 3A. Here we have the ray AB hitting the parabolic surface at point A. Let the line NA be perpendicular to the parabola at Point A. Then, for reflection, angle α must equal angle ϕ. It will be found that the reflected ray AC will pass through the focal point F. Furthermore, it can be shown that all rays parallel to the main axis reaching the parabolic surface will likewise meet at point F. Going the other way, rays starting from F will strike the parabolic surface and travel outward in parallel lines, as in Fig. 3B. Spherical surfaces do not possess this property. The parabolic reflector may be used either to concentrate a set of rays coming toward it or to produce a group of parallel rays for transmission. In ultra-high frequency communication, both are desirable.

It should be noted that the concentrating action or focusing occurs only when the rays arrive at the reflector along lines parallel to its main axis. For all other angles of incidence, the rays do not pass through the focal point F. The reader might think this would impose a limitation on the unit, but experience has shown that radio waves coming from points as close as 3 or 4 miles away arrive essentially as parallel rays. At greater distances the effect is even more positive.

For reception or transmission, the antenna is placed at the focal point, F. In order to achieve the proper focusing action, the antenna must be kept as small as possible. For this reason, only simple antennas are used.

The radiation beam of a parabolic reflector (known also as a rotational parabola or a paraboloid) is circular. See Fig. 5. This means that the height of the beam in the vertical plane is the same as the width of the beam in the horizontal plane. It does not mean, however, that the energy is being radiated to all points about the parabolic reflector. The energy is concentrated into a beam, like the light from a flashlight, and projected in the di-

rection that the reflector is facing.

The ability of a parabolic reflector to concentrate energy into a narrow beam is due to its ability to take the spherical waves which are radiated by a dipole placed at its focus, and convert this energy into a plane wave. (For the purposes of explanation, it is easier to consider many of these antennas from the standpoint of transmission rather than reception. However, whatever is stated for one use is just as true for the other.) Now, energy radiated into space will travel in a direction perpendicular to its wave front. If we have a plane wave, such as shown in Fig. 2A, then the energy will travel forward in a straight line, because this is the only direction which is perpendicular to the wave front. The energy will have no tendency to spread out because all sections of the wave front, being in the same plane, will move forward in the same direction. When the wave front is spherical all sections of the wave front will move in a direction perpendicular to the wave front, similar to the plane wave. However, since the wave front surface is curved, perpendiculars drawn to various points of the wave will not all be parallel to each other. See Fig. 2B. As a result, this energy will spread out as it travels producing a radiation pattern which is not as sharp or directive as that obtained with a parabolic reflector.

As a general rule, then, the directivity of any radiating system depends upon its ability to convert whatever energy it receives into a plane wave.

In order for a parabolic reflector to produce a plane wave, its shape must be truly parabolic in all directions, the antenna must be placed precisely at the focal point, and the dimensions of the antenna made small in comparison to the dimensions of the parabolic "dish." If any of these conditions are not adhered to, the radiation pattern does not remain circular and the radiated wave front begins to curve. This causes the beam width to increase and energy is radiated off to the sides through the establishment of minor lobes. Parabolic reflectors, when carefully constructed, are capable of providing appreciable gains over that obtainable from a simple dipole alone.

It is possible to use sections of a parabolic reflector instead of an entire paraboloid. The cylindrical parabolic reflector shown in Fig. 1 can provide a gain of 8 db over a resonant dipole. The vertical directivity is sharp but the horizontal directivity is somewhat broad. Where high gain is desired and the ghost problem is not serious, this array will produce excellent results. Also, the reduction in size from a full paraboloid permits the unit to be built more economically.

The Corner Reflector. Instead of using curved surfaces as reflectors, it is possible to use two flat surfaces which are so placed as to intersect each other at some angle, forming a corner. This type of reflector, shown in Fig. 4, is known as a "corner reflector" antenna. The driven element, usually a dipole antenna, is placed at the center of this corner angle and at some distance from the vertex of the angle. Fig. 4 shows the antenna as it is used for the reception of horizontally polarized waves. By turning the system on its side, vertically polarized waves could be received as well. The two reflecting sides may form any angle up to the limiting value of 180°, in which position they become a flat surface.

The response pattern of this array depends not only on the corner angle but also on the distance between the antenna and the vertex of the reflector corner. When this distance is relatively large (large compared to the wavelength used) a pattern containing more than one main lobe is obtained as shown in Fig. 7. Moving the antenna in too close will affect the vertical response of the array and make it more susceptible to ground reflected signals. Since neither of the foregoing conditions is desirable, the exact positioning of the dipole must be carefully controlled.

The corner angle in the commercial array of Fig. 4 is 90° and a similar bend is placed in the dipole. The reflector bar spacing is .2 of a wavelength or less at the highest frequency at which the array is to be used. Gain over the entire u.h.f.-TV band is high, ranging from about 7 db at 500 mc. to 13 db at 900 mc. The wide bandwidth and good gain of this array make it very attractive for weak signal areas.

Horn Antennas. With the shift of commercial television broadcasting to the ultra-high frequencies, we approach the region where horn antennas, which are so widely employed in radar, become feasible for TV. Here, again, size is the only restricting factor and only in the u.h.f. region do

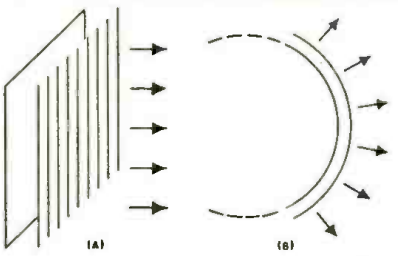


Fig. 2. A plane wave (A) tends to travel in a straight line, maintaining a close concentration of energy. A spherical wave (B) tends to spread out.

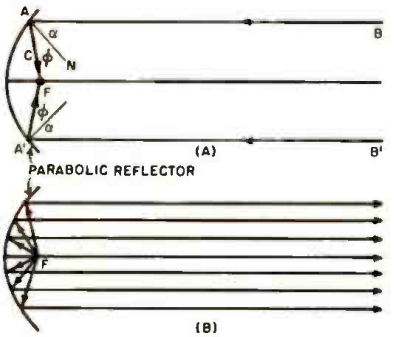
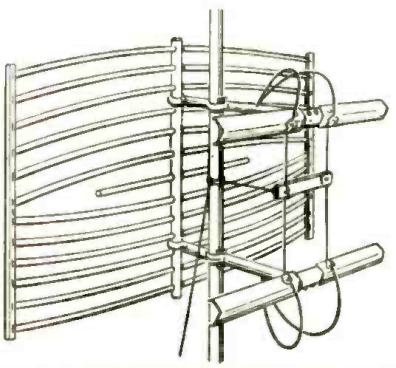


Fig. 3. (A) Action of a parabolic reflector in concentrating all parallel rays at its focus, F. (B) Rays originating at the focal point, F, leave the parabolic surface in parallel rays.

Fig. 6. A v.h.f. array using a reflector screen. Such reflectors are more common in u.h.f. region than v.h.f. band.



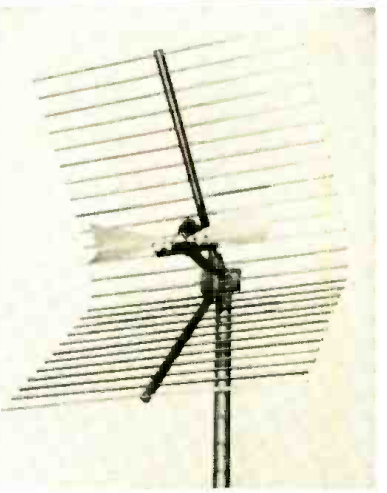


Fig. 4. An RCA corner reflector using a fan dipole. See text for description.

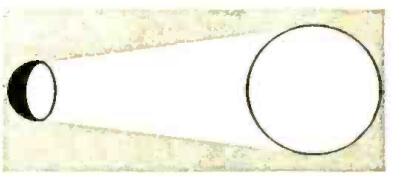
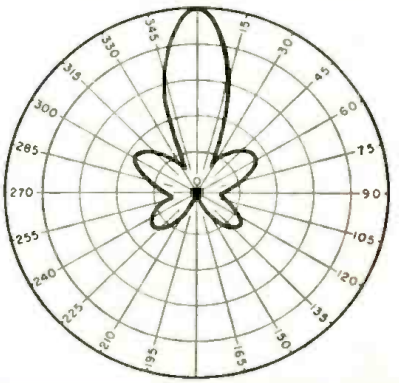


Fig. 5. The radiation beam of a parabolic reflector is circular as shown.

Fig. 7. When distance between the dipole and corner reflector is too large, more than one lobe will appear.



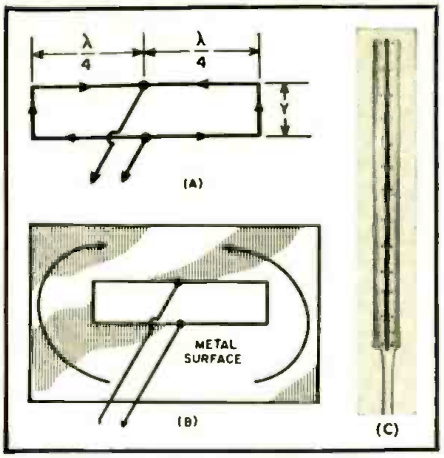


Fig. 8. (A) Two parallel-connected quarter-wave stubs. (B) A simple slot antenna. (C) A commercial slot antenna for u.h.f. TV.

these units become small enough to assume reasonable proportions.

A horn antenna can be considered as an outgrowth of a wave guide. Wave guides are very efficient hollow transmission lines which are extensively employed in ultra-high-frequency circuits to conduct energy from one point to another. If it is desired to transmit this energy into free space, the ends of the wave guide are flared out. See Fig. 10.

By flaring the ends, the energy traveling along the guide will gradually move from the guide to open space with a minimum of reflection back into the wave guide. In a sense, then, the flaring serves as an impedance match between the guide and the surrounding space into which the energy is transmitted. By the same token, any energy which is received is gradually conducted through the narrowing horn until it reaches the wave guide.

Horns and wave guides may either be rectangular or circular in shape. Of immediate interest is the rectangular horn. With several modifications, this can be made into an effective TV antenna. Rectangular horns contain four sides, but since horizontally polarized waves are used in TV transmission, both top and bottom sides of the horn can be removed. Secondly, since transmission lines rather than wave guides are used to conduct the energy from the antenna to the receiver, we can remove the wave guide and substitute the conventional 300-ohm twin-lead. See Fig. 9. Now, all we need do to transform this into a practical device is to use a fine mesh wire screen in place of the two remaining solid metal sides.

From the difference in shape of the modified horn antenna, the reader may suspect that the method of computing its dimensions will also differ from other antennas. For the horn shown in Fig. 9, the height and width (or vertical side separation distance) dimensions are given by the formula:

$$H_c = W_c = \tfrac{1}{2}\,\lambda_c$$

and $B_c = \tfrac{1}{2}\,\lambda_c$ (when $\theta = 60°$)

where λ_c is the lowest wavelength which it is desired to receive with this horn. Thus, if the lowest signal to be received is taken as 61 megacycles, $\tfrac{1}{2}\,\lambda_c$ is found equal to 8 feet, using the wavelength formula:

$$\lambda = \frac{984}{f(mc.)}$$

$$\lambda = \frac{984}{61}$$

$$\lambda = 16\ ft.\ approx.$$

and: $\lambda/2 = 8\ ft.$

Now, of course, 8 feet represents a considerable height and width across the mouth of the horn in spite of the fact that the two sides taper down to a narrow opening at the transmission line end. However, 61 mc. is a fairly low frequency for which to be using a horn antenna. In the u.h.f. band the dimensions would be reduced considerably, for at 500 mc. they become about 1 foot by 1 foot across the mouth of the horn.

In one 8-foot model[1], the power gain of this horn over a half-wave dipole at 61 mc. was slightly more than 2 db. See Fig. 11. Note, however, how the db figure rises with frequency and at 216 mc. it is greater than 14 db. The gain thus is seen to be considerable and it also possesses the desirable characteristic of rising with frequency. In addition, this array possesses a fairly sharp directive pattern as shown in Fig. 12. Reception of signals from the rear of the structure is on the order of 1 per-cent.

Examination of the gain curve in Fig. 11 reveals how rapidly the gain decreases as the cut-off frequency is approached. This type of behavior is typical of horn type structures and it means that if appreciable gain is desired at a certain frequency and beyond, that the cut-off frequency be chosen well below this point.

The gain of a horn is also dependent upon the flare angle of the horn. This is the angle θ (in Fig. 9) which the horn sides make with each other as they approach the apex where the transmission line is located. Flare angles between 40° and 60° are most common. For each length of a side there is one angle which will give best results. In general, as the length increases, the optimum angle needed becomes smaller. In the 8-foot horn discussed, a 60 degree flare angle was employed. This is a good compromise for the $\tfrac{1}{2}\,\lambda$ dimensions given in the formulas.

[1] Morgan, D. O.: "Horn Antennas for Television," Electronics, October, 1951.
[2] Kraus, John D.: "Antennas." Published by the McGraw-Hill Book Company, New York.

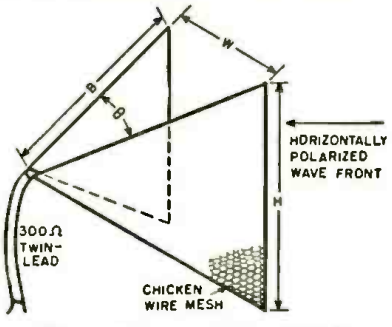


Fig. 9. A horn antenna which is suitable for television reception.

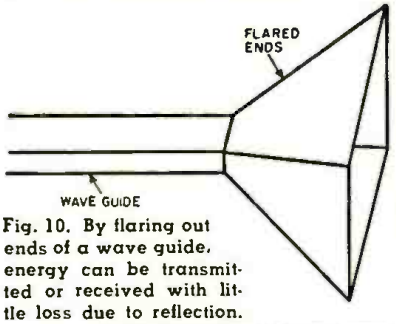


Fig. 10. By flaring out ends of a wave guide, energy can be transmitted or received with little loss due to reflection.

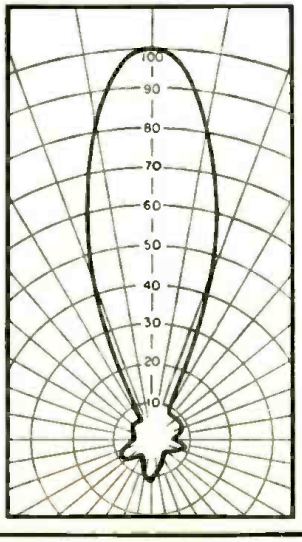
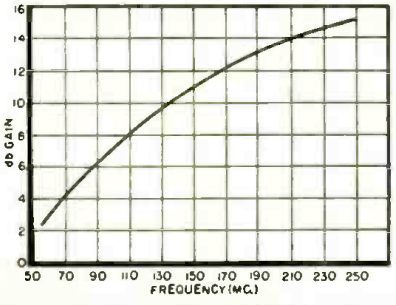


Fig. 12. Response pattern of horn antenna. Note how small back lobes are.

Fig. 11. Gain curve of a horn antenna.



Other Antennas

It would be difficult to attempt to describe all of the queer shapes and configurations which u.h.f. antennas can take. Already covered are those which will probably be most popular. However, before we leave this subject, it may be of interest to examine briefly several additional antennas which have been used for u.h.f. reception.

A. Slot Antenna.[2] When two resonant quarter-wave stubs are con-

(*Continued on page* 127)

THE "TWO-METER MASTER"

By **ROB WAGNER, W6WGD**
R.F. Lab, Dalmo-Victor Co.

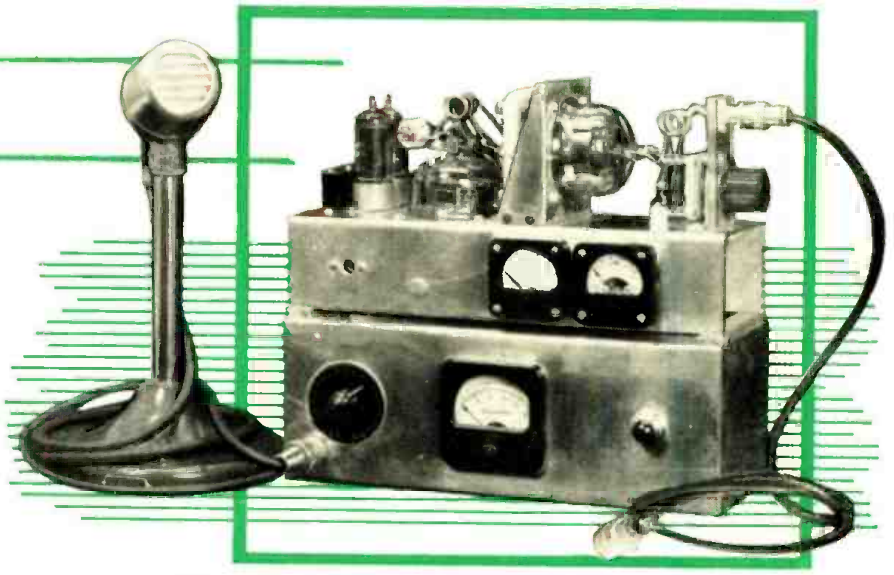


Fig. 1. Over-all view of the compact two meter transmitter.

Good efficiency, hi-fi audio, and compact size are features of this low-power 144 mc. transmitter for ham and CD use.

WORKING two-meter DX with low power seems to be dependent upon several factors: one, a good location; two, an efficient antenna; and three, well designed equipment. Before describing a miniature eight-tube transmitter of broadcast quality which inexpensively fulfills the third requirement, let's compare two hypothetical two-meter stations and their DX logs:

At station Number One, we find its operator chatting away with Far Acres, which location measures two hundred and sixteen airline miles from the operating table. The signal report, umpteen db above S9, is due, in part, to six feet of rack and panel, sufficient in size to house a full gallon on one of the lower bands, running some portion of a kilowatt input on two meters. By comparison with station Number Two, the cost of this electronic machinery is phenomenal.

Operator Number Two has a much smaller version of the foregoing installation; the pleasures of "high" power are denied him, for *THIS* fellow has to buy bread, beans, and baby shoes. His interest lies in obtaining the most power output from the least dollar input, applying thereto audio sidebands of sufficient magnitude to be heard in DX-land with good readability. His signal report at Far Acres sounds less than umpteen db over S9, but his QSO "Enjoyability Quotient" seems just as high as that of station Number One, while his saving in beans and baby shoes is considerable. The higher input may result in more consistent DX averages, but Two maintains a fairly good score considering the difference in light bills.

For those who fall into the "Number Two" category, the following transmitter should be of interest.

The r.f. section uses an 8 mc. crystal, a pair of 5763's and an 832A to arrive at 144 mc.; a second 832A functions as the class C final, operating at 18 to 21 watts input. A single 12AU7 delivering class B modulation, 12AT7 cathode-follower driver, 12AT7 amplifier, and a 12AX7 cascaded for two stages of speech amplification comprise the miniature modulator. Designed for use with a crystal mike, the quantity and quality of available audio will elicit bouquets from those claiming a hi-fi ear!

During the course of this article, emphasis has been placed upon grid-drive, that elusive quantity so often found lacking in two-meter transmitters. Without adequate drive, modulation linearity is non-existent, anodes tend to become illuminated, while efficiency drops to the point of no return.

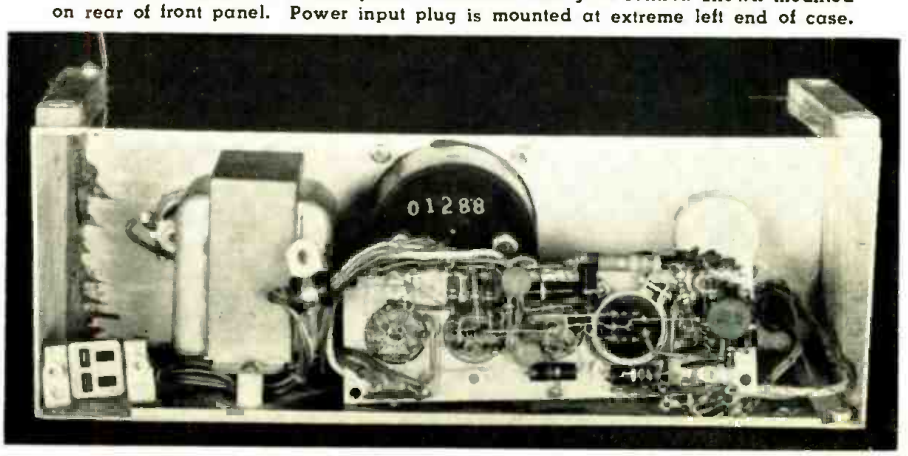
After several types of circuits were tried, the "Two-Meter Master" evolved into its present design, one which has shown its merit by delivering maximum miles per dollar input.

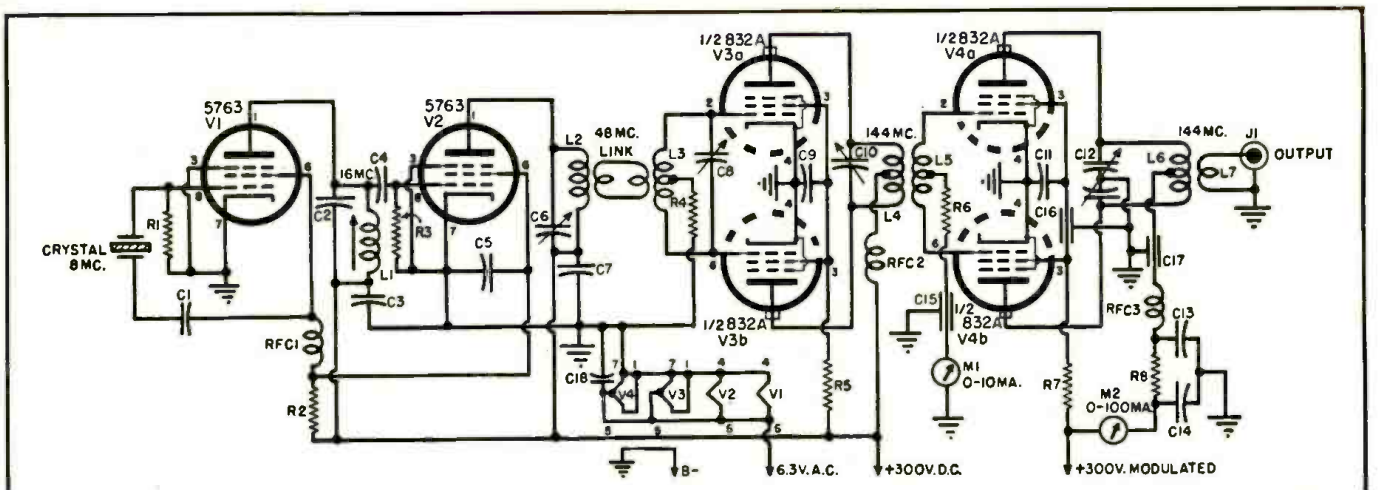
The r.f. section begins with an electron-coupled crystal oscillator using a 5763 pentode with output at 16 mc. A dual-triode overtone oscillator was tried and rejected, as its 24 and 72 mc. frequencies proved incompatible with certain TV receivers. (Secondly, its power output was found to be too little to provide the "more than just enough" grid drive required in all stages of the transmitter.)

The schematic diagram, Fig. 3, shows an 8 mc. crystal in a modified Pierce circuit, employing the screen grid of the 5763 as the anode of a triode oscillator. The electron-coupled plate circuit tunes to the crystal's second harmonic by means of L_1, a miniature iron-slug tuned coil, through which flows 300 volts of d.c. plate potential.

A 5763 pentode operating as the first tripler to 48 mc. receives approximately three milliamperes of grid drive by means of its capacity coupling

Fig. 2. Bottom view of unit showing modulator wiring. Tube sockets and driver transformer mount on the aluminum breadboard, inverted to show wiring technique. Breadboard connections are made through flexible cable of sufficient length to allow removal of unit for easy maintenance. Note the shielded wires running from speech input terminals to microphone connector and gain control, shown mounted on rear of front panel. Power input plug is mounted at extreme left end of case.





R_1—56,000 ohm, ½ w. res.
R_2—12,500 ohm, 15 w. wirewound res.
R_3—100,000 ohm, 1 w. res.
R_4—22,500 ohm, 1 w. res.
R_5, R_7—25,000 ohm, 25 w. wirewound res.
R_6—33,000 ohm, 1 w. res.
R_8—250 ohm, 1 w. res.
C_1, C_3, C_5, C_7, C_9, C_{11}, C_{13}, C_{14}, C_{18}—.001 μfd. disc cond. (Centralab "Hi-Kap")
C_2—10 μμfd. ceramic cond. (Erie)
C_4—100 μμfd. ceramic cond. (Erie)
C_6—APC air trimmer (remove all but 3 plates)
C_8—3-30 μμfd. postage-stamp trimmer
C_{10}—5.5 μμfd. midget var. 8-plate cond. (E. F. Johnson Co.)
C_{12}—3-plate butterfly cond. (see text)
C_{15}, C_{16}, C_{17}—.001 μfd. feedthrough cond. (Centralab FT-1000)
RFC_1—2.5 μhy. r.f. choke
RFC_2, RFC_3—24 t. #28 en. on ¼" dia. form
L_1—17 t. #28 en. on ⅜" dia. iron-slug form (Cambridge Thermionic)
L_2, L_3—8 t. #16 en., ½" i.d. (B & W "Miniductor")
L_4, L_5—6 t. #14 en., ⅜" i.d. (see text)
L_6—6 t. #18 solid hookup wire (see text)
L_7—See text
Link—1 t. each end #18 solid hookup wire
M_1—0-10 ma. d.c. meter
M_2—0-100 ma. d.c. meter
Crystal—8 mc. crystal
V_1, V_2—5763 tube
V_3, V_4—832A tube

Fig. 3. Schematic diagram of the r.f. section of the 144 mc. transmitter. See Fig. 7 for the modulator schematic.

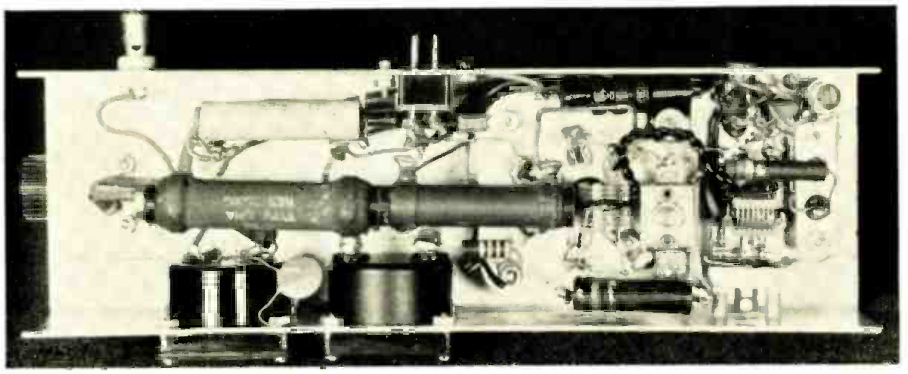
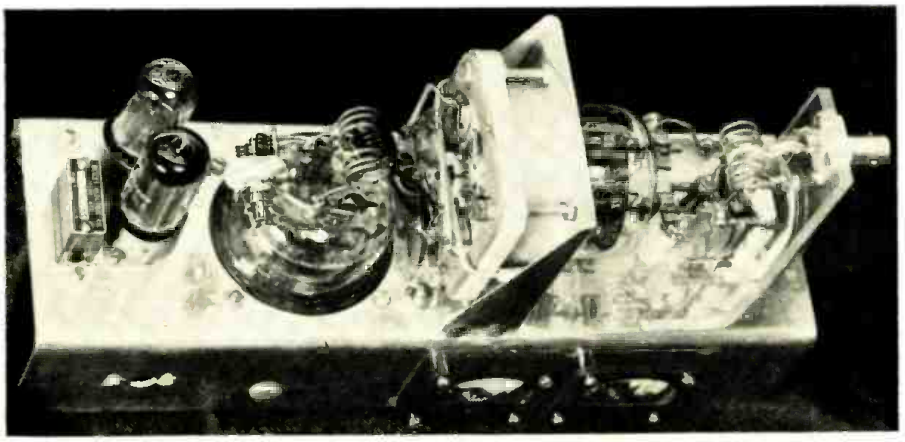


Fig. 4. Bottom view of r.f. unit. The crystal socket, with oscillator plate coil L_1 above, is at the extreme right. C_6, the APC air padder with L_2 mounted across its terminals, appears at bottom right. C_5 and L_3 are shown mounted on tube socket, which also supports the oscillator r.f. choke, RFC_1. Screen resistors R_5 and R_7 are bolted together, supported by connections to the power plug and tube socket. R_2 mounts with a bracket adjacent to the power plug. Note home-made meter shunts.

Fig. 5. Top view of the r.f. unit. The 5763 oscillator tube appears top left, with the 5763 first tripler following the crystal. C_{10} and L_4, the plug-in tank circuit, is shown coupled to L_5, the final amplifier grid coil. The amplifier's neutralizing wires are visible across the back of tube socket. The final amplifier plate circuit, shown with antenna link fully coupled, is clearly shown, including the method of connection to the 832A plate terminals. Oscillator output is tuned with the slug screw, visible above the crystal at the extreme top left. Screwdriver setting of C_{16}, the 48 mc. plate condenser, is made through small hole on left front panel.



(C_4) to the oscillator plate coil. The tripler plate circuit tunes with C_6, an APC air trimmer cut down to three plates, and L_2, an eight-turn *B & W* "Miniductor" soldered directly to C_6.

Mounting of components is shown in Fig. 4. R_2 provides grid bias, and 250 volts of screen potential comes from the junction of RFC_1 and R_2 at the oscillator screen supply point. The 48 mc. 5763, operating at a plate potential of 300-325 volts, supplies 2.5 ma. of grid drive to the following stage.

5763's were chosen for the first two stages because of their excellent frequency-multiplying characteristics and power handling capabilities; the second tripler utilizes an 832A for several other reasons. The tube, one of the few available which makes an effective push-pull tripler to the v.h.f. spectrum, operates efficiently with a minimum of grid drive, providing sufficient output without running to incandescence of both anodes and pocketbook. Use of the 832A, operating well under its maximum ratings (rather than smaller tubes dissipating their maximum power), has proved its worth during many long rag-chews. Remember—a locomotive can't be pulled by a team of white mice, even though the driver uses a big whip!

The second tripler link-couples to its driver stage to afford selectivity against harmonics (watch that TVI!) and optimum coupling, resulting in a better power transfer than was forthcoming from capacity coupling. (*NOT* recommended!) Unity coupling could not be used at this stage due to physical placement of components. To conserve space, the 832A grid circuit resonates with C_8, a "garden-variety" postage stamp trimmer, and a *B & W* "Miniductor" (L_3) of eight turns soldered directly to the socket's grid

pins. A twisted length of solid insulated hookup wire provides link coupling between both triplers. A one turn link to the plate circuit of the first tripler fits snugly inside the "cold" end of L_2, while the link's opposite end forms a single turn around the outside center of the 832A grid coil, L_3. Details are shown in Fig. 4.

Connected between the center of L_3 and ground, R_4 provides grid bias for the 832A; the use of an alternate circuit requiring separate bias resistors to avoid center tapping the coil proved unnecessary. Voltage dropping resistor R_5 from the 300 volt plate supply delivers screen potential to the tube, which measures approximately 250 volts d.c.

The second tripler's tank circuit appears somewhat unusual. A small inductance (L_4) and tuning condenser (C_{10}), soldered to a pair of miniature *Fahnestock* clips, serve to "plug on" the tank circuit atop the tube at its plate connectors. This not only conserves space, but results in the shortest leads at this point. In addition, it places the tripler plate tank immediately adjacent to the final amplifier's grid connections at the tube socket. Note the tank condenser, C_{10}, is a midget air padder having eight plates (approximately 5.5 $\mu\mu$fd. capacity). An air condenser is recommended rather than postage-stamp or rotary ceramic trimmers, since the 832A attains a high operating temperature at its top, resulting in frequency drift if a temperature-sensitive condenser is used.

The 832A final amplifier receives its drive from the second tripler plate coil by means of unity coupling. Capacity and link coupling were tried but were discarded in favor of this method, as unity coupling offers an optimum impedance match between circuits and provides maximum grid drive to the final. Unity coupling requires no retuning when changing frequency, being broadly resonant by virtue of its relatively high impedance at 144 mc. This coupling must be carefully adjusted during tuneup; maximum coupling does *not* mean maximum drive! L_{5b}, six turns of insulated solid hookup wire, solders directly to the grid pins of the final amplifier's tube socket. The grid coil interlaces about half way into the turns of L_5, and a point of mutual inductance will be found where maximum drive occurs. Approximately four milliamperes of drive appears at the final grid meter, more than is required for the 832A operating under these conditions. However, in this case subtraction is preferable to addition, thus reduction of drive to its proper value of 2.4 ma. may be accomplished by slight decoupling of L_5.

The final amplifier plate circuit differs from the preceding stages, being tuned with a balanced split-stator condenser, C_{13}. For maximum efficiency, long lines should have been used, but space would not allow. The amount of plate efficiency sacrificed by employing a tank circuit appears to be negligible in view of the satisfactory amounts of DX worked, in addition to having utilized a minimum of space in construction.

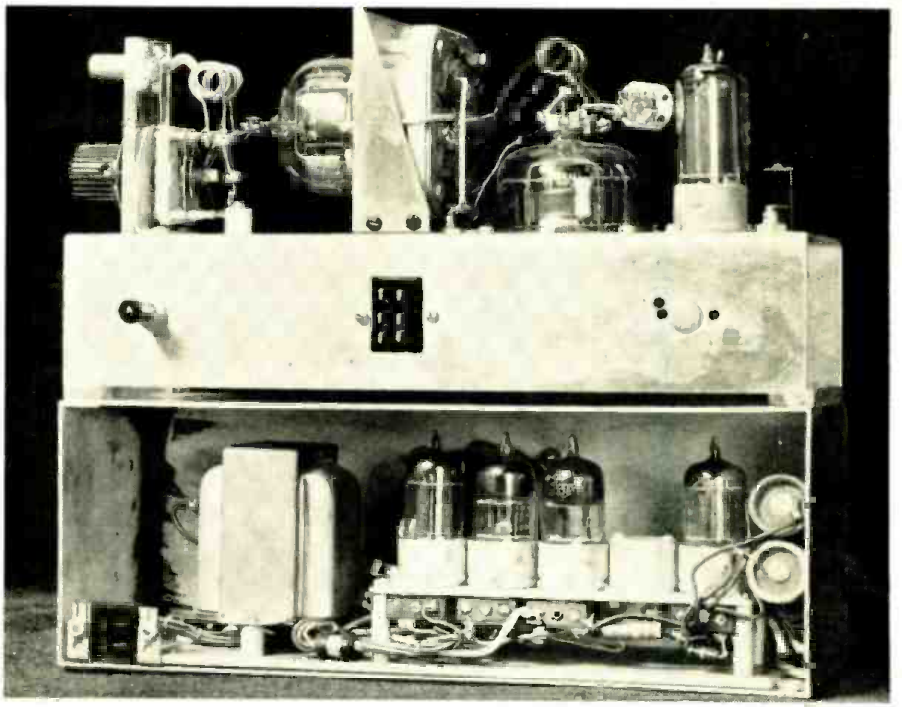
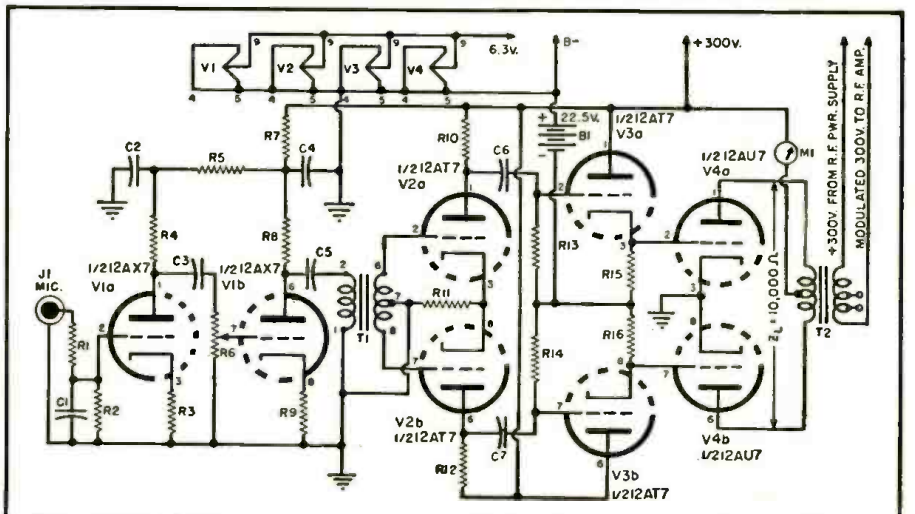


Fig. 6. Rear view showing modulator construction. The 12AX7 speech amplifier tube, with C_2 and C_1 decoupling condensers, appears at the far right. From the "Ouncer" transformer straight left to the 10-watt modulation transformer, assembly follows schematic layout. The binding post terminal "A" provides separate power input from the modulator to final amplifier. Power cables, etc., are omitted to insure clarity.

The final tank condenser, C_{12}, evolved from a junk-box (SCR-522) butterfly condenser with all but two rotors and one stator plate removed to lower the capacity to approximately 15 $\mu\mu$fd. Both L_1 and L_6 are wound with 6 turns of #14 wire upon the shank of a ⅜" drill, leaving a ¼" space at each coil's center. This construction facilitates center-tapping, also allowing insertion of the single-turn antenna link at the coil's center. C_{12} provides mounting for a rectangular piece of polystyrene which supports a miniature coax connector. A single-turn antenna link fastens to the connector, providing r.f. output to a coaxially-linked antenna coupler. (*Continued on page* 143)

Fig. 7. Complete schematic of the modulator unit. See Fig. 3 for r.f. section.



R_1—120,000 ohm, ½ w. res.
R_2—2.2 megohm, ½ w. res.
R_3, R_9, R_{11}—2200 ohm, ½ w. res.
R_4, R_8—220,000 ohm, ½ w. res.
R_5—1 megohm, ½ w. res.
R_6—.5 megohm pot. ("Gain Control")
R_7, R_{13}, R_{14}—470,000 ohm, ½ w. res.
R_{10}, R_{12}—100,000 ohm, ½ w. res.
R_{15}, R_{16}—10,000 ohm, ½ w. res.
C_1—100 $\mu\mu$fd. ceramic cond. (Erie)
C_2, C_4—4 μfd., 450 v. elec. cond.
C_3, C_5—.01 μfd. disc cond. (Centralab "Hi-Kap")
C_6, C_7—.001 μfd. disc cond. (Centralab "Hi-Kap")
T_1—Driver trans., single plate to push-pull grids (UTC "Ouncer" O-6)
T_2—Mod. trans., 10,000 ohm pri. to 4500 ohm sec., 10 w. (Thordarson #T21M52 was used)
M_1—0-75 ma. d.c. meter
V_1—12AX7 tube ("Speech Amplifier")
V_2—12AT7 tube ("Power Amplifier")
V_3—12AT7 tube ("Cathode Follower Driver")
V_4—12AU7 tube ("Class B Modulator")

DEMAGNETIZER

By

MATTHEW MANDL

Author, "Mandl's Television Servicing"

Fig. 1. Plastic reels of recorded tape can be demagnetized in a single operation by using unit described in this article.

Details on a handy service tool which can be built from junk parts and used for various demagnetizing procedures.

A HANDY device around the service shop is a unit which can produce an a.c. magnetic field. This is useful on those occasions when it is necessary to demagnetize metal-sided picture tubes, tape recorder heads, and for other applications involving either a magnetizing or demagnetizing process.

One of the simplest means for constructing such a unit is to utilize an old power transformer, as this eliminates the necessity for coil winding. All the laminations are first removed as shown in Fig. 3. Make sure the power transformer has no internal shorts by checking with an ohmmeter. If some of the low voltage secondary windings are damaged, these can be unwound after lamination removal. The flat long sections are discarded, while the E-shaped sections are reinserted in the core in one direction as shown in Fig. 4A. The transformer cannot be used in that form, however, because the loose laminations will buzz and vibrate severely upon the application of a.c. to the primary of the transformer. (If long leads extend from the secondary windings, they should be cut off flush with the core.)

The unit can be placed in a wooden box or tin can as shown in Fig. 2 so that the open end of the unit is flush with the top of the wooden or tin container. A hole can be drilled in the closed end to accommodate the a.c. leads. Sealing wax can then be melted over a slow heat and poured over the transformer. Pour the sealing wax until it rises to the level of the transformer core top. Excess can be trimmed off with a hot knife. The unit should then be set aside to cool.

A wooden section or a disc cut from a plastic sheet can be mounted on the closed end with stand-off tubular supports. A push-button is used so the current to the primary winding can be turned on and off at will. (See Fig. 1.)

The container can be painted any color to suit, and a section of felt should be cemented to the exposed sealing wax using *Miracle* cement or other similar adhesive. The felt is necessary to prevent chatter which is set up by the magnetic field when the unit is brought near the object.

Fig. 2. Over-all view of the demagnetizer. It is constructed from junk box parts.

After the switch has been wired to one of the leads of the transformer primary, a line cord is attached for six feet or more, depending on how far away from the a.c. plug the unit is to be used. Fig. 4B shows the schematic of the completed unit.

Typical Uses

Demagnetizing Metal Picture Tubes: If the metal side of a picture tube has been brought into contact with a permanent magnet, a portion of the metal will retain magnetism and influence the picture beam. As the picture beam travels through the tube it is bent out of its true path by the field produced by the magnetized portion. Thus, during the sweep of the beam its linearity will be affected each time it comes into the area of the magnetic field. Thus, one corner or portion of the picture can become severely distorted by the presence of the magnetized portion of the picture tube as shown in Fig. 5. This distortion will be present at all times and cannot be eliminated by adjustments of the linearity or other controls. (This is different from the corner shadow effect produced when the electron beam strikes the neck of the picture tube internally. In such an instance a portion of the picture is blotted out, while with a magnetized cone the entire picture is present but bent out of shape in one section.)

The demagnetizer can be used to remove the magnetism lodged in one section of the picture tube by use of the magnetic field produced. Inasmuch as the a.c. field generated is very strong, however, several precautions must be observed. Do not, for instance, depress the button and then bring the demagnetizer near the metal side. The force of the magnetic pull will be so strong that the demagnetizer will be drawn abruptly to the side of the picture tube with a severe jar. Instead, place the unit over the portion of the picture tube which is magnetized and depress the button while the felt end of the demagnetizer is resting against the tube side as illustrated in Fig. 4C. With the button depressed, the demagnetizer is moved in a rotary fashion around the suspected area and then removed *while the switch is still closed.*

As with the precautions mentioned later for demagnetizing recording heads, care must be taken not to release the switch while the magnetic

field is influencing the metal side of the picture tube. If the switch is released, the collapsing field will severely magnetize the picture tube side instead of demagnetizing it. Make sure the switch is depressed and remove the unit beyond the point where its field influences the picture tube. Recheck by turning the receiver on to see if the distortion is present. Make sure that improperly adjusted linearity controls or corner shadows are not giving symptoms of magnetism.

If the area has not been freed of magnetism, the a.c. field can be reapplied and the entire unit moved all around the tube to make sure all areas are demagnetized. Keep the button depressed and remove the unit with the switch closed. If desired, a small pocket compass can be used initially to determine the exact whereabouts of the magnetized portion.

Erasing-Recording Heads: After a tape recorder has been used for a while the recording and erasing heads have a tendency to become magnetized. This decreases the efficiency of recording and introduces some element of distortion in the recorded sound. For this reason it is good practice to subject both the recording and erase heads to an a.c. field to obliterate the magnetism which they have accumulated. This, of course, does not apply to permanent magnet erase heads.

To do this, remove the tape reel from the machine because if the reel has recorded information, portions of it will be erased by the presence of the magnetic field of the demagnetizer. After the reel has been removed from the machine the demagnetizer is brought near the recording and erase heads and the button depressed. Bring the demagnetizer as close as possible to the recording and the erase heads. Leave the unit in position for a few seconds and remove *while the button is depressed.* If the button is released while the unit is close to the recording and erasing heads, it will magnetize rather than demagnetize them. For this reason it is essential that the a.c. magnetic field be maintained by keeping the button depressed while moving the demagnetizer a couple of feet away from the heads.

Erasing Magnetic Recording Tape: The erase heads of tape recorders are often unable to cleanly obliterate overmodulated recordings. On playback the old recording is then heard faintly through the new recording. To avoid this, the demagnetizer can be used to erase the entire reel of tape at one time. To do this the reel of tape is removed from the machine and placed on a wooden bench. The magnetizer unit is then placed on the reel and the button is pressed to generate the magnetic field. The demagnetizer unit is then moved in a circular fashion all around the reel. With the button depressed the reel is turned over and also treated on the reverse side. The reel is then ready for re-use with complete erasure. Because this is an a.c. field, the erasure is clean and does not leave a noise background such as is produced when using a magnet. To assure a.c. erasure the button should be kept depressed *while the unit is taken away from the reel.* Alternating current signal energy in the form of hum will not be induced into the reel because it is not applied while the tape is moving through a recording head. Instead, the a.c. field is applied over the entire surface area at one time for erasure purposes.

The button should not be kept in a depressed condition for more than several minutes, because the absence of the rectangular small lamination sections has decreased the core area of the transformer. This decreases permeability and has the same effect as reducing inductance. For this reason the inductive reactance (opposition to a.c. flow) has been reduced and greater currents flow than would normally be the case. For this reason the core and laminations will start to heat up after a few minutes and may remelt the sealing wax. However, as only a few seconds are required for erasure, there is no necessity for keeping the button depressed for extended periods.

The unit is effective on tape which is on a plastic reel. When tape is on a metal reel the metal ribs act as a shield for the magnetic field and partial erasure results. Also when the coil is brought into proximity to a metal reel, severe vibrations and chatter will be set up in the metal sides of the reel.

The reels should not be demagnetized while on the machine, because the metal panel will influence the erasure and clean erasure may not result.

Magnetizing Servicing Tools: Screwdrivers, pliers, scissors, or other tools can be magnetized by this unit. A strong magnetism is induced in such objects by the fields generated by this device. In order to magnetize a screwdriver or other object, hold it against the felt face of the unit as shown in Fig. 6. Depress the switch for a few seconds and release the switch *while the tool is held to the unit.* Inasmuch as the collapsing magnetic field which is produced when the button is released is of a single polarity, it will magnetize any metal tool capable of receiving magnetism.

Demagnetizing Tools: If the occasion should arise where a tool or other metal object is to be demagnetized it should be held to the face of the unit and the button depressed, and *removed while the switch is still in a depressed condition.* While the switch is closed, the field generated is a.c. in character. During this field, the object is removed from its influence and for this reason it will be rid of any residual magnetism which it contained. —30—

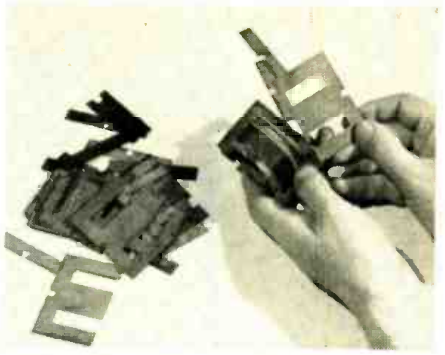


Fig. 3. Disassembling the transformer used with unit. The "E" sections are retained.

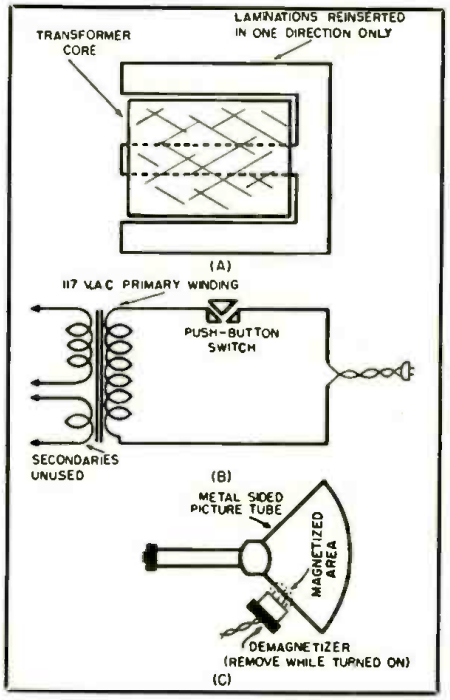
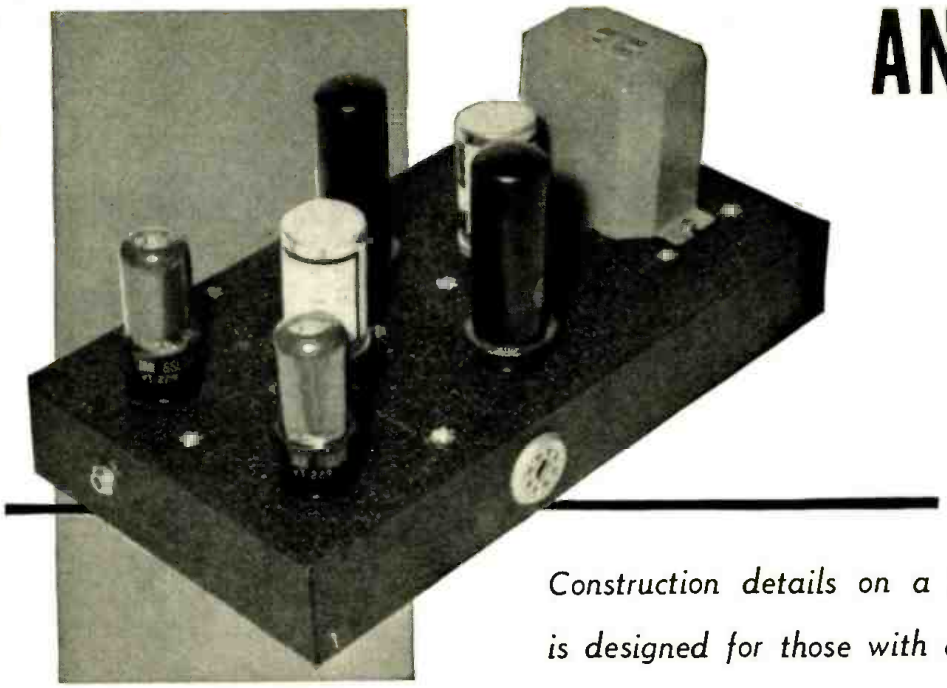


Fig. 4. (A) Correct method for re-assembling transformer. See text. (B) Complete circuit diagram for demagnetizer. (C) Method of using unit on metal-sided picture tube.

Fig. 5. Effect of magnetization on television pattern. Picture is distorted in the tube area which has been magnetized.

Fig. 6. How the demagnetizer can be used to magnetize service tools. A slight variation in operation permits this function.

AN AMPLIFIER FOR $20.



By ARNOLD J. GASSAN

Construction details on a quality amplifier unit which is designed for those with a good ear but a flat purse.

Fig. 1. Front view of the home-built amplifier. Parts required for its construction can be obtained for less than twenty dollars.

SEVERAL times friends have asked me to build them an amplifier that sounded "good." When asked why they didn't buy one of the commercially available models, they quoted prices from the numerous brochures they had examined, and their plight was clear. An amplifier purchased across the counter will cost from forty dollars up, and there will be no guarantee of anything more than that the thing will make sounds.

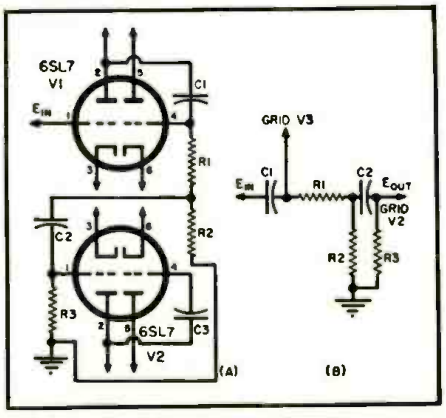
The "hi-fi" enthusiast apparently has to have either a well-lined pocketbook or a tin ear. Somewhere between these limits is a tolerable average of cost against fidelity; the amplifier described is one answer. Essentially, it is a compound of several amplifiers, all of which are excellent, but the commercial models have prices beyond the purses of the average music-lover with a yen for better sound than his conventional table radio-phono combination will produce.

The amplifier is one which sounds well. All graphs aside, that is the final criterion for an audio amplifier; it must reproduce music or speech with a certain fidelity, allowing the individual character of the sounds to be heard. The design of this circuit has been thoroughly checked with an audio oscillator, harmonic analyzer, and square-wave generator, and the results may be seen in Fig. 4 and Table 1. As in all electronics the final circuit is a compromise, in this case between cost and quality of reproduction. The response curve could easily have been extended to 100 kc., by quadrupling the price of the output transformer. Yet, when this amplifier was "auditioned" with three commercially-available amplifiers in the $50.00 to $100.00 range, its performance compared favorably. Essentially, the circuitry is similar to the well known Williamson amplifier.

The Inverter

Starting at the beginning of the circuit, the inverter is a direct-coupled, split-load type, otherwise known as the cathodyne phase inverter.[1] There are two principal advantages to this circuit: first, fidelity. In the general circuit shown in Fig. 2A, a portion of the voltage generated by V_1 is tapped off the voltage divider R_1, R_2 and applied to the grid of V_2. This circuit is a commonly used type of inverter. In theory, only enough of the signal from V_1 is fed to the grid of V_2 to produce *exactly the same signal amplitude at the plate of V_2 as exists at the plate of V_1*, and of course 180 degrees out-of-phase with the plate signal of V_1. Unfortunately, the balance of output signals from this type of inverter will change each time the tubes V_1 or V_2 are changed. Because of the possibility of the two tubes being changed in opposite directions, *i.e.*, V_1 being replaced with a tube of higher gain than the original, and V_2 with a lower gain tube, a difference in amplitude of several per-cent can occur.

Fig. 2. (A) Circuit of a feedback-type inverter. (B) The equivalent circuit of the voltage divider in the feedback path.



Just as important is that the RC circuit, C_1, $R_1 + R_2$, C_2, R_3, provides what is essentially a two-stage, high-pass RC filter, with the output of the first stage going to one-half of the push-pull circuit, and the output of the second stage to the other half of the push-pull circuit. The lower the frequencies involved, the more noticeable the phase shift distortion produced by the characteristic. If a feedback loop around the inverter is employed, then at some frequency the out-of-phase components add algebraically to produce more distortion than linearity and, in extreme cases, instability of the entire loop. The second advantage of the split-load inverter over the type just discussed is that it is cheaper. A quick look at Fig. 3 will show that several resistors and a condenser which are indispensable to the older circuit, are not needed.

In the inverter used in this amplifier (see Fig. 3) the effect of direct coupling appears: there are no RC circuits to introduce phase shift, and thus the response of the inverter itself is flat over a tremendous range. The advantages of the unbypassed cathode in the second half of the inverter are evident if one thinks of an unbypassed cathode load as a generator developing a degenerative signal and applying it to a control element of the tube. Thus, the split-load inverter may be looked upon as a conventional amplifier stage with large degeneration, and also as a cathode-follower amplifier. A mathematical analysis of the circuit indicates that the response of either output—the cathode load or plate load—is essentially linear within the limits of the tube itself, and flat well into the megacycles. There is only a small phase shift within the

inverter, approaching three or four degrees.

The cathode load was chosen in the output side of the inverter by inserting a variable resistor in the cathode circuit, and determining what actual resistance would develop an equal signal, when compared to the plate signal. The ratio of plate to cathode loads is dependent, it was found, on the value of the plate load of the first half of the inverter and the gain of the tube itself.

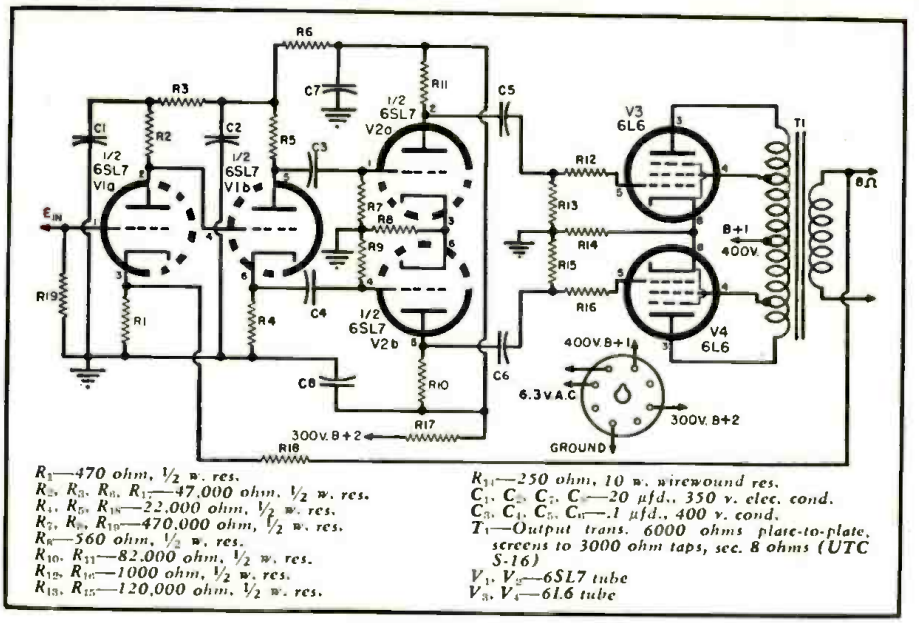
The second tube, V_2, is used to drive the 6L6's, and also for the normal purpose of voltage amplification, since the inverter has little gain, on the order of three or four, for both halves of the tube.

At this point note must be made of the decoupling of all stages. This is expensive, but if not done will cause oscillation; at worst, lack of sufficient decoupling will cause muddiness.

The Output Stage

In many ways the output stage is the most interesting, and certainly more nearly accounts for the sound of the system than any other individual stage. The 6L6 plates are connected normally to the 6000-ohm taps on the output transformer. Then, the screens are connected to the 3000-ohm winding. For d.c., the stage is essentially triode connected, push-pull. Yet, for a dynamic condition, with which we are really concerned, the circuit is a hybrid, with the advantages of both triode connection and tetrode operation, and few of the disadvantages of both.

The effect produced when the screens of a beam-power tetrode are tied to the plates through a closely-coupled tertiary winding of lower impedance than the plate circuit has been analyzed in another publication.[2] However, in essence, as the ratio of screen to plate impedance moves from zero toward one, the internal impedance of the generator, in this case the 6L6's, falls sharply, then gradually, until it approaches the low impedance of a triode. Under the same conditions the maximum power output available for a constant input power (in other words, the efficiency of the circuit) decreases gradually, along a gentle curve. Low-level distortion decreases rapidly at first, and then gradually; high level distortion increases asymptotically. When a ratio of screen to plate impedance of 18.5% is reached the optimum congruence of the curves results. All these figures and curves are for a closely-coupled third winding. Why won't they work as well for a theoretically perfectly coupled winding, *i.e.*, one coincident with the plate winding? They do, and the end result was that taps were simply placed *on* the plate winding to produce an impedance ratio that agreed with the computations. The result is that the tubes are operated essentially as triodes looking at the d.c. characteristics, but as tetrodes from an a.c. viewpoint.



R_1—470 ohm, ½ w. res.
R_2, R_3, R_8, R_{17}—47,000 ohm, ½ w. res.
R_4, R_5, R_{18}—22,000 ohm, ½ w. res.
R_7, R_9, R_{10}—470,000 ohm, ½ w. res.
R_6—560 ohm, ½ w. res.
R_{10}, R_{11}—82,000 ohm, ½ w. res.
R_{12}, R_{16}—1000 ohm, ½ w. res.
R_{13}, R_{15}—120,000 ohm, ½ w. res.
R_{14}—250 ohm, 10 w. wirewound res.
C_1, C_2, C_3, C_6—20 µfd., 350 v. elec. cond.
C_4, C_5, C_8—.1 µfd., 400 v. cond.
T_1—Output trans. 6000 ohms plate-to-plate, screens to 3000 ohm taps, sec. 8 ohms (UTC S-16)
V_1, V_2—6SL7 tube
V_3, V_4—6L6 tube

Fig. 3. Complete circuit diagram and parts list for the low-cost amplifier unit.

However, there were no transformers available with taps at 20% of the plate impedance. Experiments were made with ordinary, available, inexpensive transformers with several taps of varying impedance. The lowest impedance ratio available was ½, or 50%; little or no change in the sound was expected with this ratio, because the optimum conditions listed previously are found only in a narrow region of load ratios. Yet, on connecting the screen grids to the available primary taps, an immediate improvement in sound quality was noted. For example, the pitch and timber of tympani were more readily heard and stringed-instruments sounded *cleaner*. The end result is that the circuit has not been modified since being built and tested, which for an audio-electronics hobbyist is most unusual.

A note on the feedback loop: negative feedback is applied to the cathode load of the first stage from the output winding. The concepts behind the use of negative-feedback circuits have often been discussed in this magazine.

(*Continued on page* 104)

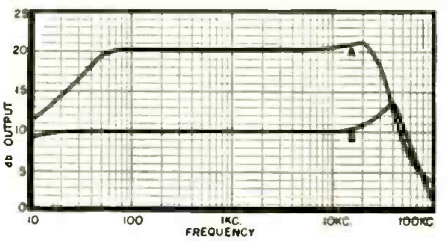
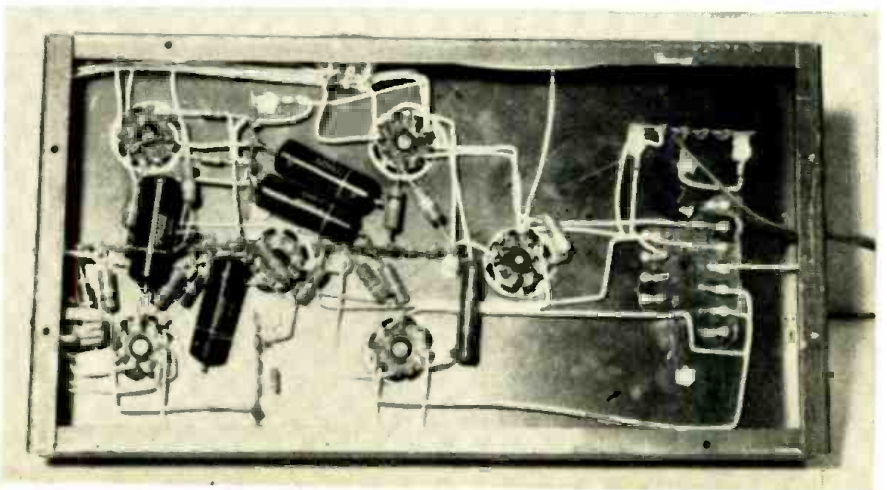


Fig. 4. Output power vs. frequency measured across 8-ohm resistive load. Curve A is .65 volt input, output power of 14.6 watts; Curve B is .20 volt input, output power of 1.25 watts. Db reference level is arbitrary.

Input Volts	Freq.	2nd Har.	3rd Har.	4th Har.
.2	500	.48%	.30%	.13%
.6	500	.84%	1.6%	.20%
.2	1000	.36%	.25%	—
.6	1000	.84%	1.5%	.20%
.2	5000	.37%	....	....
.6	5000	.90%	....	....

Table 1. Distortion vs. input power-frequency. Percentage of second, third, and fourth harmonics developed at two power levels and at 500, 1000, and 5000 cycles, measured across an 8-ohm resistive load. Signal generator used developed between .1% and .2% combined second and third harmonics.

Fig. 5. Under chassis view of the home-built amplifier showing layout of parts.



NEW DESIGNS for 1953

Fig. 1. The Emerson Model No. 721 which features recessed controls on side panel to reduce cabinet size.

By

WALTER H. BUCHSBAUM
Television Consultant
RADIO & TELEVISION NEWS

A preview of some circuit changes which technicians will encounter in the new television receiver models.

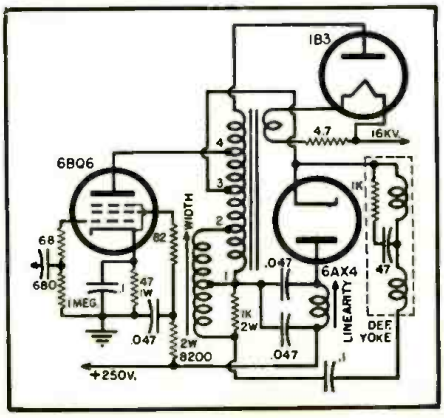
SURVEYING the designs of the new, 1953 crop of TV receivers we find few radically new features. Instead, manufacturers have concentrated on smoothing out previous design and production headaches. Improvements of existing circuits rather than entirely new designs seems to have been the order to the engineering staffs. Some mechanical improvements, especially in high voltage sections and picture tube mounting, as well as new tubes, comprise the bulk of the innovations. The major circuit changes can be lumped into five categories; two are the improved intercarrier sound system (RADIO & TELEVISION NEWS July, 1952) and the new type electrostatic focus for picture tubes (RADIO & TELEVISION NEWS March, 1952). The other three innovations are an autotransformer flyback circuit, a triode phase detector for horizontal a.f.c., and the use of 40 mc. i.f. systems. The scope of this article includes a discussion of these topics plus some unique designs and a list of new tubes and their application.

Autotransformer Flyback

A large majority of set manufacturers have apparently decided that the autotransformer type of flyback circuit is the most efficient and economical to date. This circuit is used with slight variation in the new *Admiral, Arvin, DuMont, Emerson, G-E, Hallicrafters, Motorola, Packard-Bell, Philco, RCA, Scott, Sentinel, Sylvania, Trav-Ler, Zenith* and many other receivers. A typical circuit is shown in Fig. 2, as taken from the new *Admiral* models. The major difference between this and previous high-efficiency flybacks is the autotransformer feature. This does away with the leakage reactance between primary and secondary, and therefore reduces losses and also permits a shorter retrace time. This latter was often the cause of horizontal foldover and with the new autotransformers foldover is rarely evident.

Since an autotransformer is used to couple the sweep signal to the deflection yoke, the pulse polarity will be the same as on the driver tube plate, *i.e.*, positive. This, in turn, requires reversing the connections to the horizontal deflection coils and also reversing the connections to the damping diode. Now the cathode rather than the plate receives the high pulses. Putting large positive pulses on the cathode poses two problems. The heater-to-cathode breakdown voltage is exceeded and the heater-to-cathode capacity is shunted across a portion of the flyback transformer. To overcome this, some receivers use a 6W4 damper with a separate heater winding on the power transformer. This winding has especially low capacity to ground and often one side of the heater is connected to a suitable tap on the flyback transformer. A simpler solution to this problem is the development of new damping tubes such as the 6AX4 shown in Fig. 2. This tube has a heater-to-cathode voltage rating of 4000 volts (cathode positive) and a very low capacity between heater and cathode so that the heaters of this tube can be part of the regular, grounded heater string. Other features of this circuit include a tapped width coil which is omitted in some versions, and surprisingly high boost voltage. As shown in Fig. 2, only 250 volts "B plus" is supplied to the plate of the damper tube, but the boost voltage available at terminal #1 of the transformer may be as high as 400 volts.

Fig. 2. Autotransformer flyback circuit. This one is used in the Admiral 19B1, etc.



Triode Phase Detector

Most readers will be familiar with the stabilized multivibrator circuit used in horizontal a.f.c. systems for the past few years. It includes a single coil and condenser tank circuit in combination with a cathode-coupled multivibrator, operating at 15,750 cps. The frequency control action is provided by a double diode, usually a 6AL5, which compares the incoming synchronizing pulses with a signal fed back from the flyback transformer. This is usually called the phase detector, because the error voltage developed depends on the phase between the synchronizing pulses and the local signal. The circuit shown in Fig. 5 represents the latest simplification of this phase detector. With minor variations this circuit is used in 1953 models of *Emerson, G-E, Motorola, Olympic, Scott, Sentinel, Trav-Ler,* and several others. The double triode at the right forms a conventional stabilized multivibrator using a resonant circuit L and C_5. Tuning L varies the frequency and in this particular example the slug-tuned coil acts as horizontal hold control. The ½ 6SN7 at the extreme left of the diagram is a phase splitter providing horizontal sync pulses of equal amplitude, but opposite polarity. These pulses are coupled to the phase detector through C_2 and C_1, just as in the case of a double-diode type detector. In Fig. 5,

however, the entire operation of phase detection and error voltage generation is accomplished by a single triode section of a 6SN7. Note first that this tube receives no "B plus" voltage. The plate is grounded through R_1 and the cathode through R_2. Incoming sync pulses are applied directly to the grid and cathode while a saw-tooth voltage from the flyback transformer is fed to the plate. Depending on the coincidence of the voltage at the plate, grid, and cathode, the tube will pass more or less current. All tube current must go through R_1 and R_2 and the voltage set up across these two resistors is the error voltage which corrects the frequency of the oscillator. To make sure that this is pure d.c., the filter consisting of R_3, C_3, and C_4 is used. An additional signal is fed back through C_6. This is a small portion of the output of the horizontal sweep oscillator and is connected to the grid of the phase detector. Its polarity is opposite to that of the sync pulse coming through C_2 and it effectively bucks out a portion of that pulse as long as the oscillator is at the correct frequency. When the oscillator drifts, the sync pulse alone becomes effective and helps set up the error voltage to correct the oscillator.

The main advantage of this circuit is its economy. Using one half of a 6SN7 permits the use of the other half in some other section and thus often results in a saving on the number of tubes. Performance of the triode phase detector is no better than its double-diode predecessor, but neither does it result in any disadvantages. It is safe to predict that in many future models the double-diode circuit will be replaced by the triode phase detector and understanding its operation is therefore important to every service technician.

40 mc. I.F.

Like the lifting of the TV station freeze, 40 mc. i.f. systems have been predicted and planned for years. Much has been written about the theoretical and practical advantages of using this frequency. Two valid reasons exist now for changing to a 40 mc. i.f. system. One is the fact that the FCC has now allotted a band at 21 mc. for amateur use, and the second is the appearance of u.h.f. television stations. Probably the most pressing reason is the amateur interference problem and the problem of image interference in some TV areas. Changing to 40 mc. prevents all image reception in any one TV band and naturally greatly reduces the chances for ham interference. As concerns u.h.f., the problems of r.f. bandwidth and a suitable system for tuning the r.f. stages make a 40 mc. i.f. imperative. It permits the u.h.f. tuner to have a 20 mc. passband without any danger of image interference.

The actual frequencies used in the new i.f. band vary slightly, but the standard appears to be 41.25 mc. for the accompanying sound carrier and 45.75 for the video carrier. A typical i.f. passband is shown in Fig. 4. Among the 1953 models featuring 40 mc. i.f.'s are *Arvin, Emerson, G-E, DuMont, Philco, Westinghouse,* and *Zenith* receivers. The tubes used are usually 6CB6's having a higher transconductance and less loading effect than the old 6AG5 at 40 mc. The loading resistors for stagger-tuned, single-coil systems are slightly higher than in 20 mc. i.f. systems because the tube input loading at 40 mc. naturally is greater than at 20 mc. Traps for the sound, adjacent sound, and picture carriers are mostly of the absorption type used in the older i.f. systems. From these factors it becomes apparent that alignment of the new, 40 mc. i.f. section will present no new or different problems.

Unique Designs

Although most manufacturers advertise some distinguishing feature, space permits us to describe only three of the most unique designs. One unusual design is the *Emerson* model 721, 17" table model featuring recessed controls at one side as shown in Fig. 1. By this mechanical arrangement it is possible to use a really compact design so that the entire receiver is only slightly larger than the picture tube. Because of the recess of the controls the channel selector uses a dial light so that the station number is clearly visible from a reasonable distance. Using a double-tuned 40 mc. i.f., improved intercarrier sound, cascode tuner, and autotransformer type flyback, this receiver is typical of the new 1953 models.

Another unique feature is used in the *Zenith* 1953 models and this consists of a 6BE6 in an unusual sync pulse clipper circuit. This pentagrid tube is the only sync tube in the set and furnishes horizontal and vertical pulses stripped from the video signal and properly clipped and limited. The actual circuit operation is somewhat involved but the principle of it is the use of two out-of-phase signals applied to the control and the converter grid

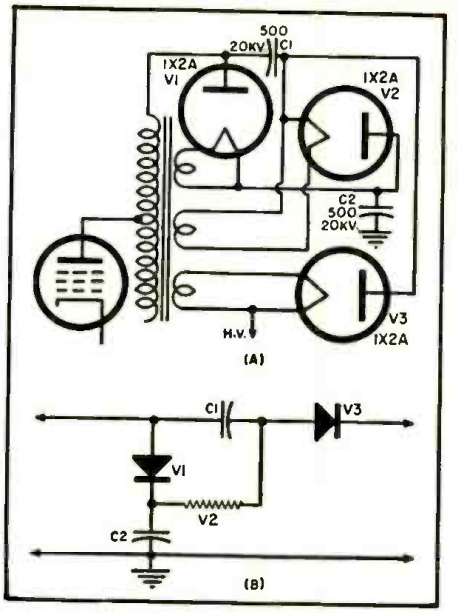


Fig. 3. HV doubler using a diode as HV resistance. (A) Circuit used in G-E S21T1-B receiver, and (B) the equivalent circuit.

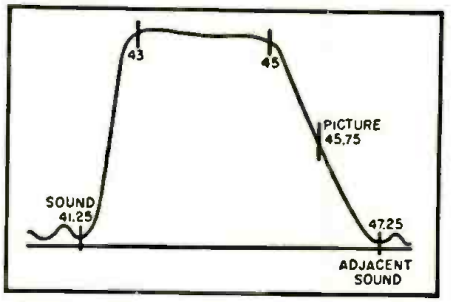
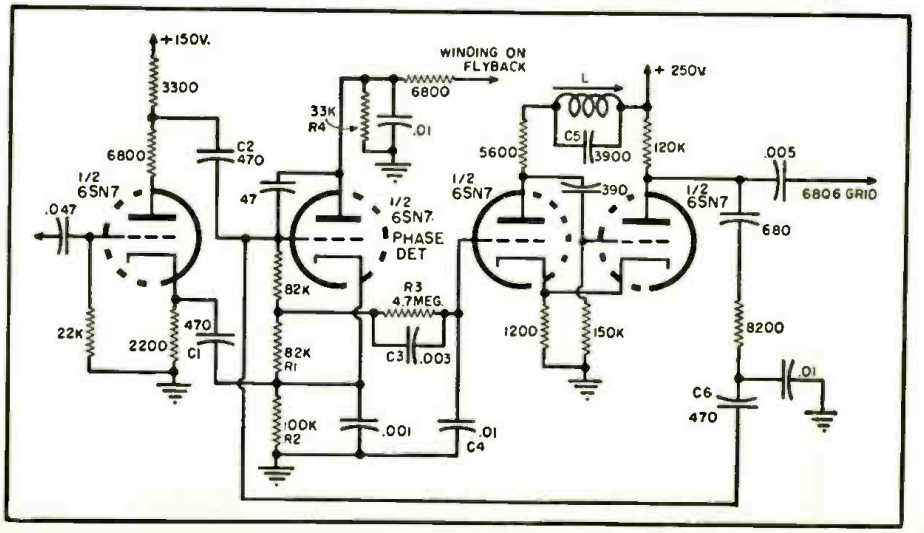


Fig. 4. Response curve with a 40 mc. i.f.

respectively. The control grid gets a low-level video signal from the second detector whose amplitude depends on the setting of a "fringe lock" potentiometer. The converter grid gets a signal of opposite phase from the plate of the first video amplifier. With only 28 volts at the plate of the 6BE6, plate saturation will take place and this provides one sort of limiting. The output of the 6BE6 is clean and constant

(*Continued on page 78*)

Fig. 5. The triode phase detector circuit as used in the Sentinel 454-7 receiver.



A VIBRATION-PICKUP AMPLIFIER

By LOUIS E. GARNER, JR.

Construction details on a useful gadget designed to permit the analysis of various types of mechanical vibrations.

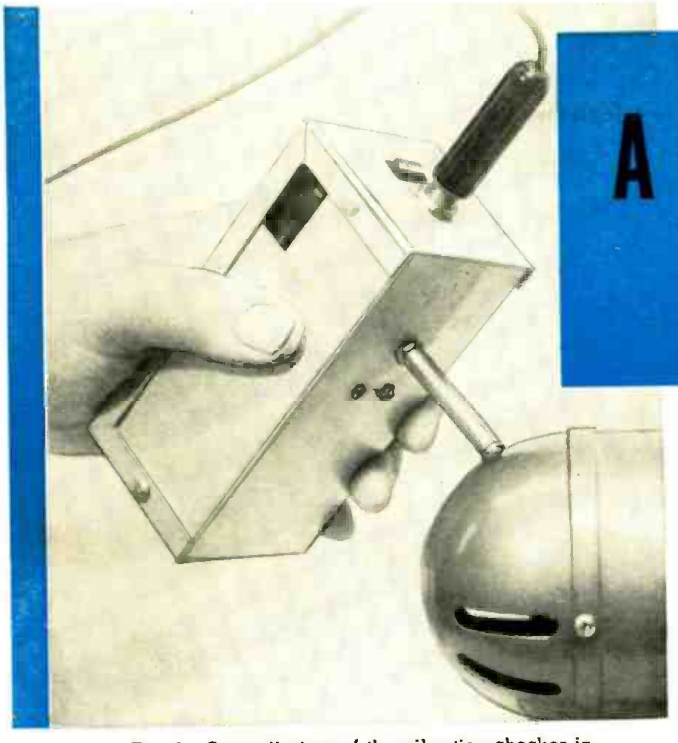


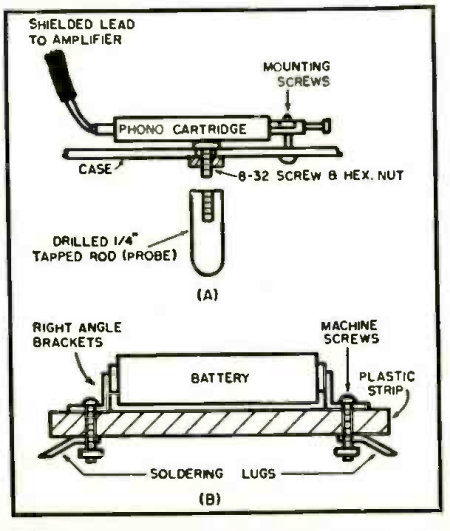
Fig. 1. Over-all view of the vibration checker in operation. It was built from hearing-aid parts.

ALTHOUGH the instrument shown in Fig. 1 is basically a general-purpose vibration pickup, it was originally built as an aid to a locksmith in opening balky safes. However, in addition to its more romantic role in opening safes, it is of value to watch repairmen, to refrigeration and washing machine mechanics, to automobile mechanics, or to almost any worker needing to listen to and identify vibrational sounds in machinery or industrial equipment.

A vibration pickup and amplifier is not a "new" instrument, for commercial models have been available on the instrument market for a number of years. Unfortunately for the average potential user, however, these instruments have been very expensive, with the average cost running into hundreds of dollars. Such a price is not excessive when it is remembered that the commercially-available, laboratory-type instruments are designed for such purposes as accurately measuring the amplitude of vibration, frequency of vibration. and other characteristics. The instrument shown in Fig. 1, on the other hand, is designed solely to permit the user to listen to any vibrations that may be present—relying on his own experience to identify the various sounds. The instrument may be built for as little as $30, exclusive of labor!

The "heart" of the instrument is a used hearing-aid amplifier, and the purchase of this item represents the largest single cost of all items used in the construction of the device.

Fig. 2. (A) Cross-sectional view showing the mounting of the pickup cartridge and probe. (B) How the batteries are mounted by means of small right-angle brackets and plastic.

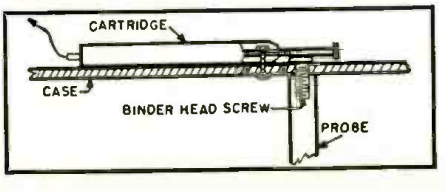


Circuit Description

The schematic diagram given in Fig. 4 applies to the hearing-aid amplifier used by the author. This is from an older hearing-aid and does not supply as much gain as may be obtained from newer units. However, the results obtained were satisfactory.

In operation, the probe is held against the safe (or piece of machinery). Any vibrations present are transferred along the probe to the case of the crystal cartridge, where a relative movement is set up between the crystal element and the case. This movement results in an a.c. signal voltage being developed which is proportional to the amplitude and frequency of vibration.

Fig. 3. Details of the probe illustrated in the photographs. See text for full details.



The a.c. signal developed is applied to the grid of a subminiature tetrode amplifier, V_1, with R_1 acting as the grid resistor. An amplified signal appears across the inductive load (coil CH_1) and is coupled through condenser C_2 to volume control R_4.

R_3 and C_3 are the screen-dropping resistor and bypass condenser, respectively, for the first amplifier stage. R_2 is a filament dropping resistor, used because the filament voltage requirement of V_1 is less than supplied by a standard penlight cell.

The signal is next applied to the grid of the power amplifier stage, V_2, which is coupled to the earphones by means of a miniature output transformer, T_1. C_5 is a small bypass condenser used to bypass higher frequency signals and thus to simultaneously reduce effects of harmonic distortion and to reduce any tendency towards parasitic oscillation. A conventional "losser"-type tone control is employed, consisting of C_4 and R_6.

Power is supplied by a penlight cell "A" battery (B_1) and a hearing-aid type "B" battery (B_2). Switch S_1 is a small slide switch, but, if preferred, may be a rotary switch on either the *"Volume"* or *"Tone"* controls.

Construction Hints

Although the diagram in Fig. 4 is for a commercial hearing-aid amplifier, it may be duplicated with easily available parts, as indicated in the accompanying parts list. Tube base connections are given in the inset.

However, it is recommended that the builder purchase a used hearing-aid to obtain the necessary amplifier, both from the viewpoint of ease of construction and lower actual cost. Hearing-aid amplifiers in good condition can generally be purchased at from eight to fifteen dollars, less batteries, but with tubes. (It is not necessary that the circuit in Fig. 4 be duplicated.) If there is no local source of used hearing-aids, the *Centralab* Model 200 *"AMPEC"* printed circuit amplifier may be used instead. This small amplifier may be purchased from almost all mail-order radio supply houses.

The general interior arrangement of the amplifier, batteries, and crystal pickup cartridge is shown in Fig. 5, while a cross-sectional view showing the mounting of the pickup cartridge and probe is given in Fig. 2A. All components have been mounted in a small *Bud* "Minibox."

The length of the probe rod is not critical, but it should not be longer than 8" for maximum efficiency. The probe used in the author's model is only about 3" long. Steel or brass (¼ or ⅜ in. dia.) should be used for the rod. *Do not make the probe rod of polystyrene, bakelite, or similar plastic.*

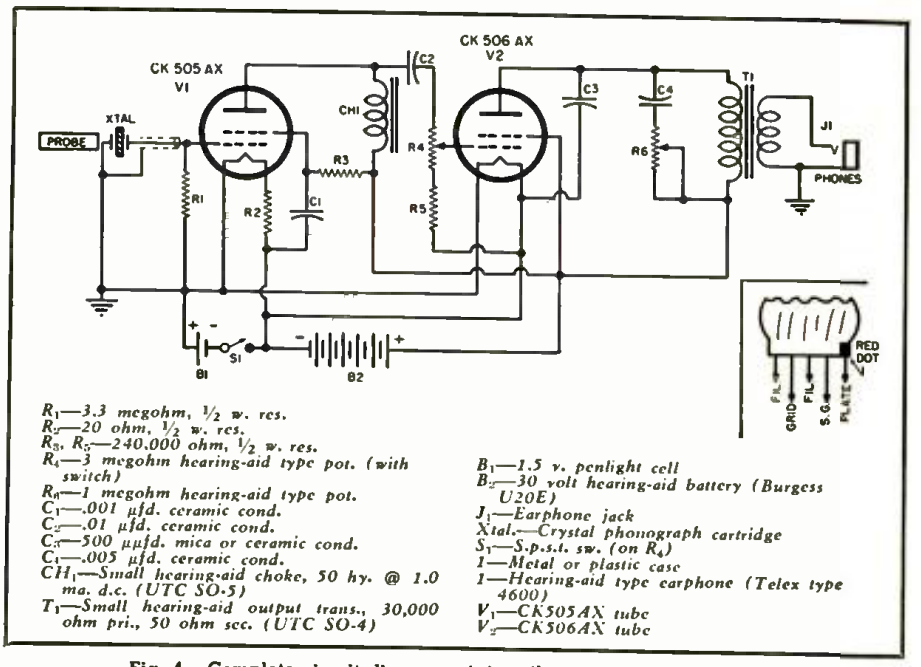
To assemble the complete unit, remove the hearing-aid amplifier from its original case (where a used hearing-aid has been purchased, the original case will generally be cracked or damaged), and mount the amplifier in a standard metal utility box (steel or aluminum). Choose the smallest available box that will still provide room for easy mounting of the amplifier, batteries, crystal cartridge, and phone jack. A narrow box is preferred so that the entire unit may be easily held in one hand (Fig. 1).

The microphone used in the original hearing-aid is disconnected and removed.

Mount the crystal cartridge and probe in the box as shown in Fig. 2A, and connect a *shielded* lead from the cartridge to the previous microphone input connections. Almost any type of phonograph crystal cartridge may be used in this application. However, for best results, a high output cartridge should be employed. A metal-cased cartridge is much preferred over a plastic-cased cartridge. In general, the *less expensive* cartridges will give better results in this application.

Make sure, however, that the probe rod bears against the case of the cartridge (through the mounting screw). A binding head screw should be used to provide a large bearing area. Even then, the screwhead may be filed flat to improve contact.

If a modern hearing-aid amplifier is used, mounting clips for the required batteries will already be provided. However, if an older amplifier (or the *Centralab "AMPEC"* unit) is employed, it will be necessary for the builder to assemble his own mounting clips. This may best be done by using small right-angle brackets and a piece of bakelite or other plastic (see Fig. 2B).



R_1—3.3 megohm, ½ w. res.
R_2—20 ohm, ½ w. res.
R_3, R_5—240,000 ohm, ½ w. res.
R_4—3 megohm hearing-aid type pot. (with switch)
R_6—1 megohm hearing-aid type pot.
C_1—.001 µfd. ceramic cond.
C_2—.01 µfd. ceramic cond.
C_3—500 µµfd. mica or ceramic cond.
C_4—.005 µfd. ceramic cond.
CH_1—Small hearing-aid choke, 50 hy. @ 1.0 ma. d.c. (UTC SO-5)
T_1—Small hearing-aid output trans., 30,000 ohm pri., 50 ohm sec. (UTC SO-4)
B_1—1.5 v. penlight cell
B_2—30 volt hearing-aid battery (Burgess U20E)
J_1—Earphone jack
Xtal.—Crystal phonograph cartridge
S_1—S.p.s.t. sw. (on R_4)
1—Metal or plastic case
1—Hearing-aid type earphone (Telex type 4600)
V_1—CK505AX tube
V_2—CK506AX tube

Fig. 4. Complete circuit diagram of the vibration-checker amplifier.

Longer-life mercury cells may be substituted for the penlight "A" battery if preferred. However, the battery mounting clips will have to be designed accordingly. (Mercury "A" batteries are available in a wide variety of shapes and sizes—the *Mallory* type RM-1200 is about the same shape and size as a standard "Z" penlight cell.)

A standard phone jack is used in place of the small hearing-aid jack generally provided to permit better contact and a sturdier connection.

The output shown in Fig. 4 may not always be provided. In some cases, a choke or resistor will be used as the output load in place of transformer T_1. Where the "AMPEC" amplifier is used, the output load is not part of the amplifier, and either a transformer, choke, or resistor may be used, at the discretion of the builder.

In general, the type of load will not appreciably affect the operation of the unit (although somewhat better low frequency response is obtained with resistive loads), but it will govern the type of earphones used. Where a transformer is used, low impedance (128 ohm or 50 ohm) earphones should be employed. Where a choke or resistor output is provided (with d.c. blocking condenser), high impedance (2000 ohm) earphones must be used, and crystal headphones are preferred.

Once the wiring and assembly have

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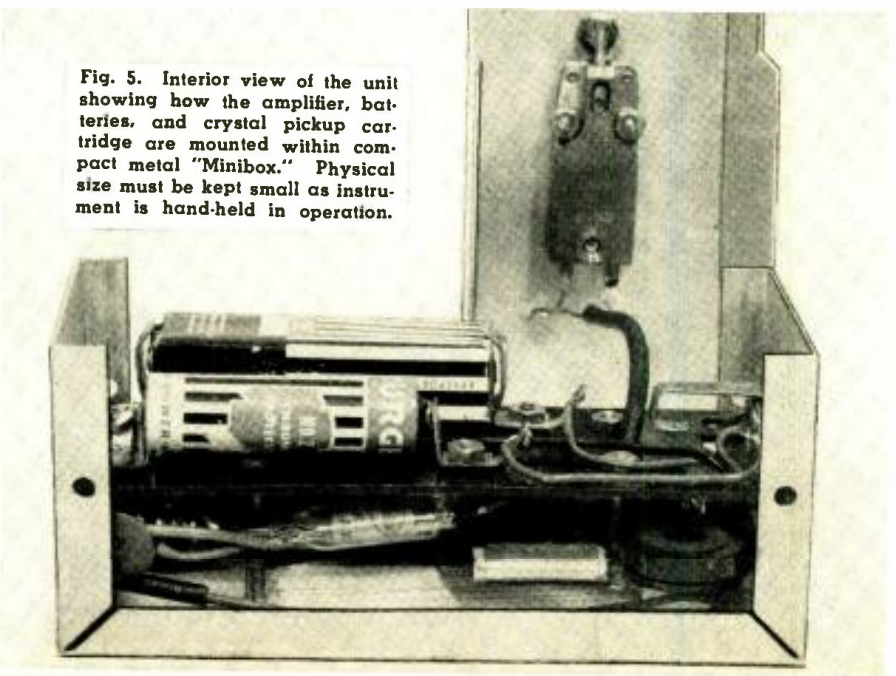
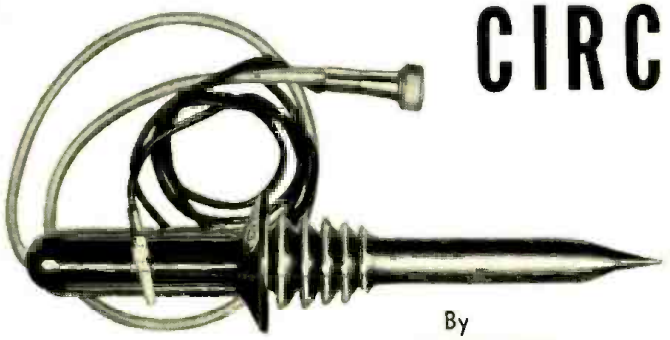


Fig. 5. Interior view of the unit showing how the amplifier, batteries, and crystal pickup cartridge are mounted within compact metal "Minibox." Physical size must be kept small as instrument is hand-held in operation.

SIGNAL TRACING IN HIGH-VOLTAGE TV CIRCUITS



The RCA WO-56A oscilloscope and the company's WG-289 high-voltage probe. This equipment was employed in making signal-tracing tests described.

By
ART LIEBSCHER
Tube Dept., Radio Corporation of America

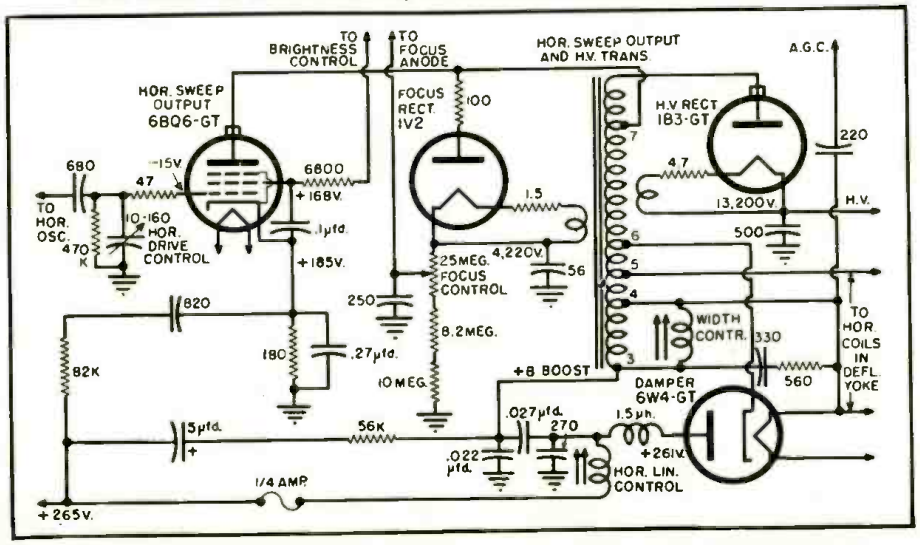
Trace high-voltage circuit troubles rapidly and efficiently using signal-tracing techniques described in this article.

TROUBLES in high-voltage circuits, such as the horizontal-deflection-output and high-voltage stages of a television receiver, can often be located and corrected very quickly if signal-tracing techniques and a suitable oscilloscope are used. The high voltages involved, however, require that a high-voltage probe be used for personal safety and to prevent damage to the oscilloscope input circuits. A probe such as the *RCA* high-voltage probe WG-289 is suitable for such applications. When it is connected to the vertical amplifier d.c. input of an oscilloscope, such as the *RCA* WO-56A, the multiplying resistor in the probe and the internal resistance of the oscilloscope function as a voltage-dividing network. This arrangement can provide a reduction ratio on the order of 1000 to 1, depending upon the internal resistance of the oscilloscope. A 20-kilovolt source, for example, would provide a 20-volt signal to the scope input.

Oscilloscopes having provision for a.c. input only require the addition of an external one-megohm resistance between the vertical-input connector and ground to complete the d.c. path. If this d.c. path is not provided, the full applied high-voltage can be present at the probe output and may cause breakdown of the oscilloscope input condensers or other parts rated for lower voltages.

The a.c. voltage division with this arrangement is, of course, not as accurate as d.c. voltage division because the capacitance between the probe body and ground varies with every change in the position in which the probe is held. Because this capacitance shunts the spiral-wound probe resistance and its distributed capacitance, the divider ratio for a.c. is variable. These a.c. voltage-divider variations, due to capacitance variations, are particularly noticeable at the 15,750 cycle horizontal-deflection frequency. For high-voltage signal-tracing purposes, however, it is not necessary to measure the amplitude of a voltage waveform; usually all the indication required is the presence and shape of the a.c. voltage.

Horizontal output and high-voltage section of the RCA 17T153 television receiver which was used in obtaining the waveform photographs shown in article.



General Considerations

Before waveforms indicative of component failures in typical horizontal-deflection and high-voltage circuits are discussed, it is desirable to consider some general problems concerning high-voltage signal tracing. Experience and careful observation are, of course, two major requirements for the mastery of any troubleshooting technique.

As the probe approaches within a short distance of a high-voltage point, the same waveform that is observed when contact is made with this point is usually produced on the oscilloscope screen, although less distinctly. Sudden sharpening of the waveform at the moment of contact is more noticeable than change in amplitude. Corona or arcing prior to contact is identical to that experienced when d.c. measurements are made. The oscilloscope image obtained as the high-voltage-probe tip approaches the cap of a 1B3GT rectifier in a conventional horizontal-deflection and high-voltage circuit is shown in Fig. 1A. The apparent vertical spread of the trace is actually a multiplicity of traces produced at varying d.c. levels as the corona breaks down to form unlike but successive ionized air paths. Fig. 1B shows the waveform obtained by direct contact with the cap of the 1B3GT. The high-voltage TV horizontal pulse will fall in the center of the scope sweep trace if the sweep is timed to be the

equivalent of two horizontal lines. The tapered waveform between pulses is highly damped oscillation originating with the return-trace action. The presence of a high-voltage waveform gives assurance that the 15,750 cycle pulse is reaching the rectifier tube. Failure to obtain a high-voltage d.c. output can then be attributed to a defective rectifier or other trouble in the d.c. circuit.

Although the peak voltage of the pulse applied to the rectifier should theoretically equal the d.c. level at the rectifier output, an uncompensated probe cannot be expected to measure the peak value correctly. For test purposes, therefore, it is more practical to depend on the calibrated d.c. measurement of an unloaded rectifier output as a good indication of the peak input voltage.

The photograph of the waveform at the plate connection of the horizontal-output tube, shown in Fig. 2B, looks considerably like that of the high-voltage waveform shown in Fig. 1B. There are, however, two discernible differences: In Fig. 2B, the damped wave between pulses is less pronounced, and the pulse peaks are not as pointed. It is the similarity between the two waveforms, however, that is important because the response of both waveforms to the same defects in the deflection circuit is also similar. This similarity makes it possible to observe significant changes at the output tube where the normal pulse voltage is on the order of 6 kv., rather than at the high-voltage connection where the voltage may be more than twice as high.

Crosstalk

Another factor which should be considered when a high-voltage probe is used is that crosstalk fields in and around the high-voltage section of a TV receiver enter the unshielded portion of the probe and produce undesired currents in the internal dropping resistor. These currents mix with the desired currents and distort the observed waveform.

For purposes of comparison, Fig. 2A shows a typical waveform obtained when a low-capacitance probe (WG-216B) is placed near the plate cap of the horizontal output tube. Because of the relatively low peak rating of that probe, direct contact with the plate cap was avoided. Essential duplication of the waveform in Fig. 2A is obtained by direct contact of the high-voltage probe, as shown in Fig. 2B. The effects of crosstalk can be seen by a careful comparison of Fig. 2A and Fig. 2B. In Fig. 2B a change of waveform appears in the form of a short ripple immediately following the pulse. This point of change, which does not resemble the corresponding points in Figs. 2A or 1B, can only be observed in the absence of crosstalk.

Although the crosstalk due to the higher voltage applied to the rectifier plate is present around the plate cap

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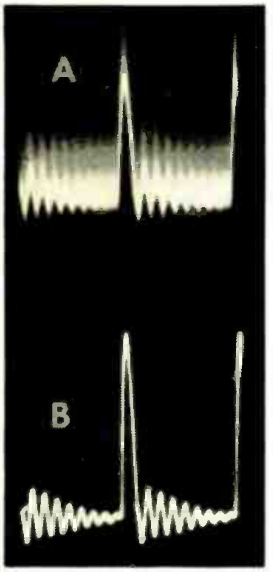


Fig. 1. (A) Waveform at top cap of HV rectifier, probe held short distance from cap. (B) Waveform at top of the HV rectifier with probe touching cap.

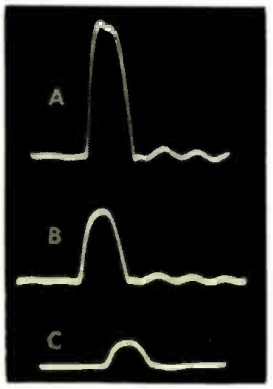
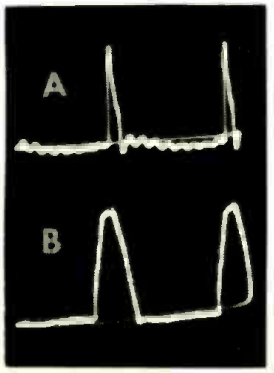


Fig. 5. Expanded waveform at plate of horizontal output tube with (A) normal 117-volt line voltage. (B) Line voltage reduced to 80 volts. (C) Line voltage reduced to 60 volts. Note reduction in pulse amplitube is coincident with leveling of the baseline.

Fig. 9. Waveform at plate of horizontal output tube. (A) One-half of horizontal deflecting yoke shorted, and (B) open-circuited horizontal deflecting yoke.



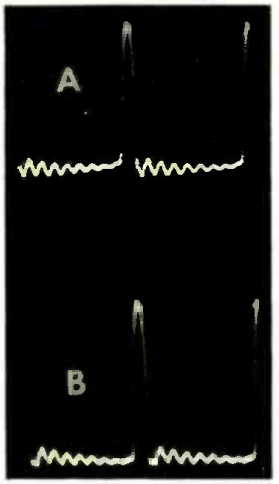


Fig. 2. (A) Waveform at the plate of horizontal output tube. Low capacitance probe held short distance from cap. (B) With high-voltage probe making a contact.

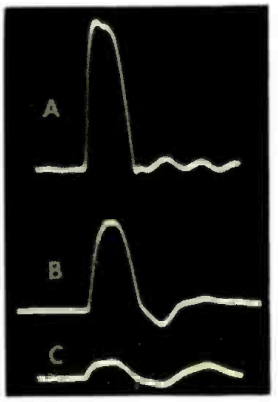


Fig. 6. Expanded waveform at plate of horizontal output tube with: (A) Normal damper tube operation. (B) Damper tube heater voltage reduced approximately 50 per-cent. (C) Damper tube heater voltage reduced approximately 70 per-cent. Note how the baseline becomes warped with a reduction in the amplitude of the pulse.

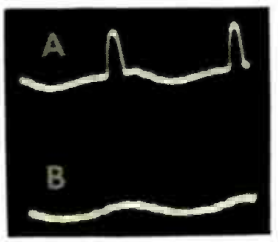


Fig. 8. Waveform at plate of horizontal output tube. (A) Damper tube heater-to-cathode leakage of 10,000 ohms. (B) Damper tube with a heater-to-cathode short.

Fig. 10. Waveform at plate of horizontal output tube. Linearity control shorted.

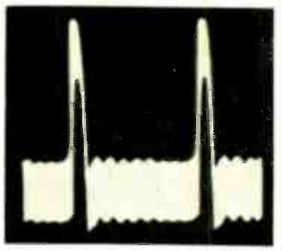


Fig. 3. Hum mixed with high-voltage waveform can be the cause of a vertically expanded trace.

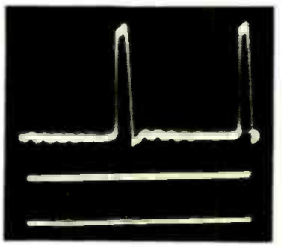


Fig. 4. The d.c. scope indication of different "B+" voltage levels. This triple exposure shows: (top) waveshape and boosted "B+" voltage level at damper cathode, (center) "B+" level, and (bottom) the zero d.c. signal level.

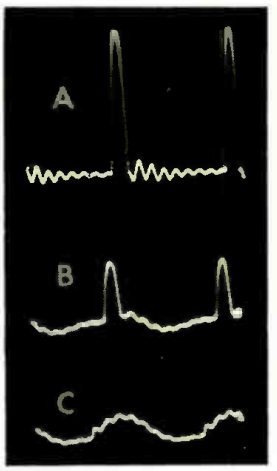
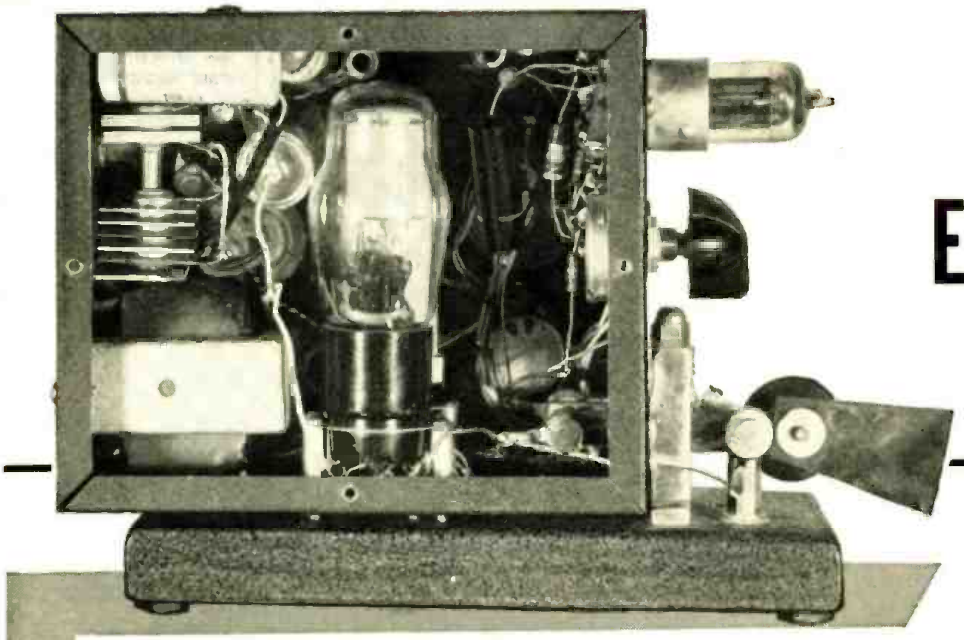


Fig. 7. Waveform at plate of horizontal output tube. (A) Normal operation. (B) Insufficient damper emission. (C) Damper emission too low for raster lighting.

Fig. 11. Waveform at plate of horizontal output tube. Open winding on portion of output transformer shunted by width control.

A BETTER ELECTRONIC KEY

By
JACK D. GALLAGHER
W5HZ8



Left-hand view of keyer with plate removed. The power supply can be seen in the left end of the box. T_1 is at the bottom and the selenium rectifiers are above. The 2050 tube and socket are in the center. The key mechanism extends into the box through two 1 1/8" holes cut in the cabinet for that purpose.

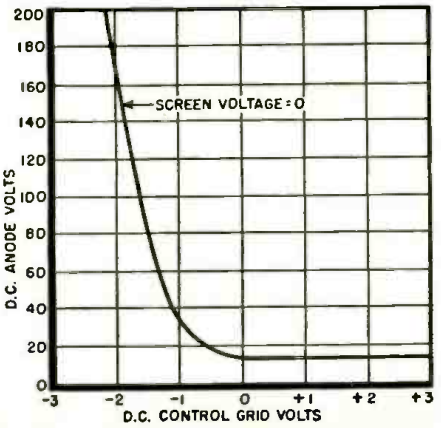
Construction details on an electronic keyer which produces self-completing dots and dashes, with or without a relay.

WITHIN the past few years numerous circuits have been developed which produce automatic dots and dashes. These keyers have been developed to the point where it is impossible for the operator to cut dashes short, or crowd dots and dashes together into an unrecognizable series of sounds. Such an arrangement, of course, permits the operator to send better and tends to develop spacing between letters or words. It is important for the potential builder to scan the available literature for an electronic key which will produce automatic self-completing dots and dashes. The keyer should be easy to construct, flexible with respect to adjustments, and stable in its operation. The use of more than one relay should not be a requirement of the circuit. A better electronic key would be one which would work with or without a relay.

The circuit diagram shown in Fig. 2 will meet all of these requirements. Extreme care has been taken by the author to provide only those elements which are absolutely required, that is: a timing circuit, a d.c. amplifier, a keyer tube or relay, a power supply, and a keying mechanism. Over a dozen different circuits were tried over a period of approximately three months before the final circuit was produced. Many types of neon lamps and VR tubes were tried in place of the 2050 thyratron without success. The 2050 tetrode was converted into a very sensitive triode thyratron by connecting the screen to the cathode. Referring to the curve in Fig. 1, small changes in grid bias change the firing point of the tube. Once the tube has been fired by voltage being applied to its plate, the grid no longer controls the tube conduction. The tube will stop conducting when the plate potential has been reduced to the extinguishing point. The miniature type 2D21 thyratron will also work with minor changes in bias voltages.

The complete operation of the circuit is not complicated and can best be explained by referring to Fig. 2. The following events will take place when the key lever is pushed to the right to produce dots:

Fig. 1. Performance curve of the 2050 tube.



1. The ground is removed from R_5.

2. The cathode of V_1 is grounded, firing the tube, which discharges C_1, and makes the grid of V_{2a} negative with respect to its cathode. The lower positive voltage now present on the cathode of V_{2a} causes the grid of V_{2b} to become negative with respect to its cathode and is cut off. This change causes the plate voltage of V_{2b} to rise. This rise in voltage causes the grid of V_3 to become positive with respect to its cathode and V_3 conducts, operating the relay.

3. As soon as the plate voltage on V_1 drops to the extinguishing voltage, V_1 ceases to conduct. The grid of V_{2a} becomes zero and the timing circuit charges through V_{2a}. As the positive voltage on the cathode of V_{2a} rises, V_{2b} conducts cutting off V_3 and opening the relay.

4. When the voltage in the timing circuit has reached a point corresponding to the firing point determined by the negative voltage on the grid of V_1, the tube will fire again, and as long as the key is held in the dot (or dash) position this operation will repeat.

In the dash position, the key retains the ground on the dot-dash ratio control, R_5, through the normally-closed contact on the key mechanism, and at the same time grounds the cathode of V_1 causing the timing circuit to discharge. Since R_5 remains shorted when dashes are made, a greater voltage exists on C_1 and hence a longer discharge time occurs. The difference in charging voltage appearing across C_1, due to the addition or subtraction of R_5, causes the circuit to produce dots and dashes.

In the idle condition the cathode of V_{2a} is positive with respect to ground. The cathode of V_{2b}, the d.c. amplifier, is adjusted so that the tube conducts. The voltage drop from the plate of V_{2b} through R_{12} and R_{13} to ground causes the grid of V_3 to be slightly positive with respect to ground. R_{14}

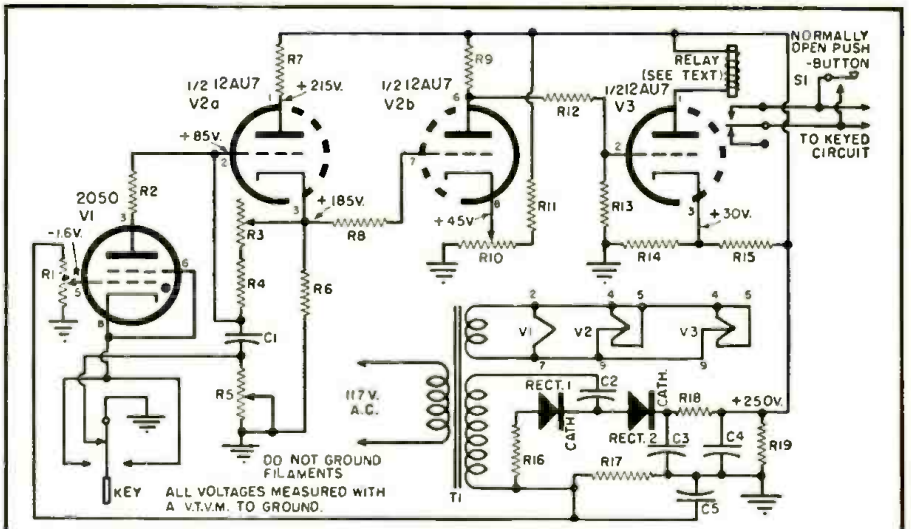
and R_{15} are of such value as to cause the cathode of V_3 to be more positive than the grid. The difference in these voltages should be sufficient to cause whatever triode keyer tube is used to be in a non-conducting condition. Such an arrangement, of course, allows the keying relay to be disregarded entirely. For instance, if a transmitter is equipped with an oscillator whose plate current is on the order of 10 ma. or less, the plate of V_3 may be connected directly to the cathode of the oscillator as in cathode keying. Adjustments of the bias voltages in the keyed stage and in the keyer tube will have to be made. If a larger current carrying capacity is required in the keyer tube, the elements of the 12AU7 may be paralleled, or another tube may be substituted with appropriate changes in bias voltages.

If 6SN7's are to be used in place of the 12AU7's, it is necessary to make the following changes: Remove the 22,000 ohm resistor in series with the plate of V_{2a}. Remove R_8 and replace with a 1.5 megohm, ½ watt resistor. Replace R_9 with a ½ megohm, ½ watt resistor. Replace R_{12} with a 1 megohm, ½ watt resistor. Replace R_{11} with a 2200 ohm, 1 watt resistor. For preliminary adjustments R_{14} should be variable until the best operating point is obtained. Other than changing pin numbers, the changes mentioned are the only ones necessary when using the 6SN7 type tube. Other combinations of resistances will also allow the circuit to perform as it should, but trial and error substitution can be a tedious and time consuming operation.

Like most hams, the author continued to experiment with the circuit of this key and found that the circuit performed just as well by removing R_{13}, R_{14}, and C_5. The junction of R_{16} and the secondary of the transformer T_1 should be grounded, of course. This leaves the grid (pin 5) of the 2050 open, which is of no consequence. Some of the steady-state voltages of Fig. 2 will change slightly, but adjustments of R_5 and R_{10}, as described later in the article, will have to be made. If the foregoing changes are made, changing the value of R_4 from 1 megohm to 1.5 megohms will reduce the speed if desired. No other changes are necessary.

The adjustment of the key can be carried out with ease if the values shown in the circuit of Fig. 2 have been followed. If the line voltage is lower than 117 volts, all of the voltages will be proportionally lower and small changes in R_1 and R_{10} will have to be made. A single selenium rectifier power supply is not recommended, since the adjustments become critical at this voltage and further changes in the line voltage will cause noticeable changes in the timing circuit. However, there has been no cause to regulate the supply to this keyer since small changes in line voltage do not materially affect the operation.

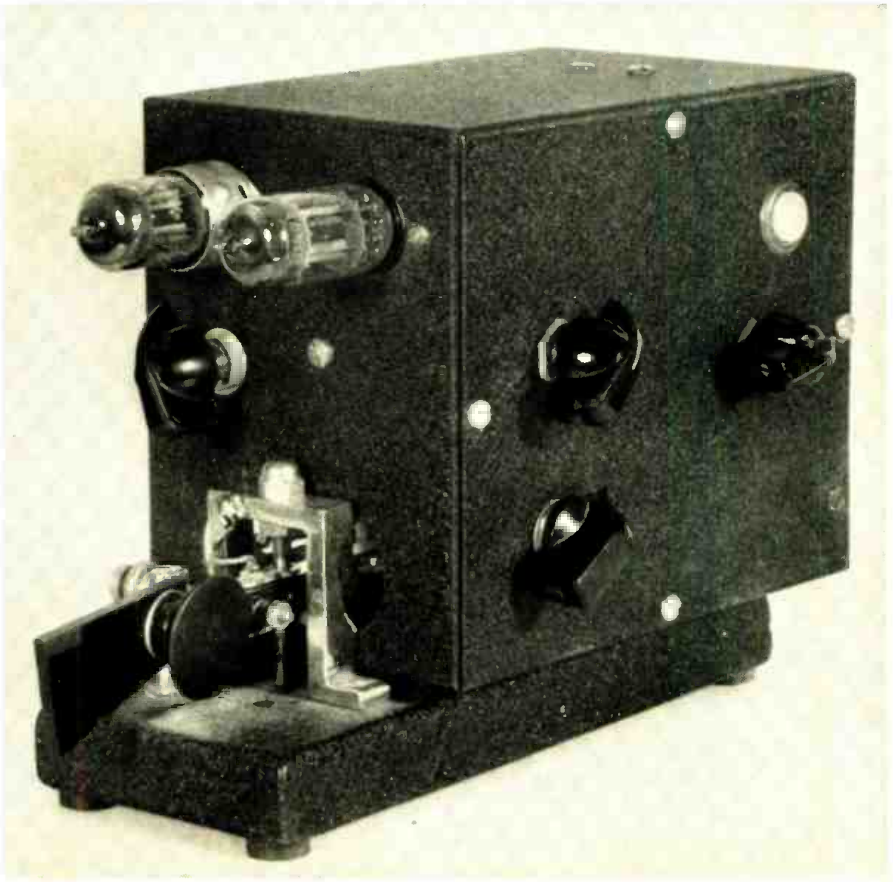
The relay in the plate of V_3 can be any type having "on-off" contacts, adjustable or non-adjustable. The d.c.



R_1—5000 ohm, 1 w. pot.
R_2—100 ohm, ½ w. res.
R_3—1 megohm, pot., linear taper ("Speed Control")
R_4, R_6, R_{12}—1 megohm, ½ w. res.
R_5—100,000 ohm pot. ("Dot-Dash Ratio Control")
R_7—150,000 ohm, ½ w. res.
R_8—22,000 ohm, ½ w. res.
R_{10}—30,000 ohm pot., linear taper ("Weight Control")
R_{11}—50,000 ohm, 1 w. res.
R_{13}—1.5 megohm, ½ w. res.
R_{14}—500,000 ohm, ½ w. res.
R_{15}—2700 ohm, 1 w. res.
R_{15}, R_{19}—20,000 ohm, 10 w. wirewound res.
R_{16}—39 ohm, 2 w. wirewound res.
R_{17}—200 ohm, 1 w. res.
R_{18}—500 ohm, 1 w. res.
C_1—.05 µfd., 600 v. cond.
C_2—40 µfd., 150 v. elec. cond.
C_3, C_4—20/20 µfd., 450 v. elec. cond.
C_5—50 µfd., 25 v. elec. cond.
S_1—Push-button sw. (normally open)
T_1—Power trans. 120 v. @ 50 ma. and 6.3 v. @ 1.5 amp. sec. (Merit P-3045 or equiv.)
Rect. 1, Rect. 2—65 ma. selenium rectifier
Relay—Any type having "on-off" contacts, adj. or non-adj., d.c. coil resistance may vary from 2000 to 14,000 ohms (See text)
Key—See text
V_1—2050 tube
V_2, V_3—12AU7 tube

Fig. 2. Complete circuit diagram and parts list covering the electronic key.

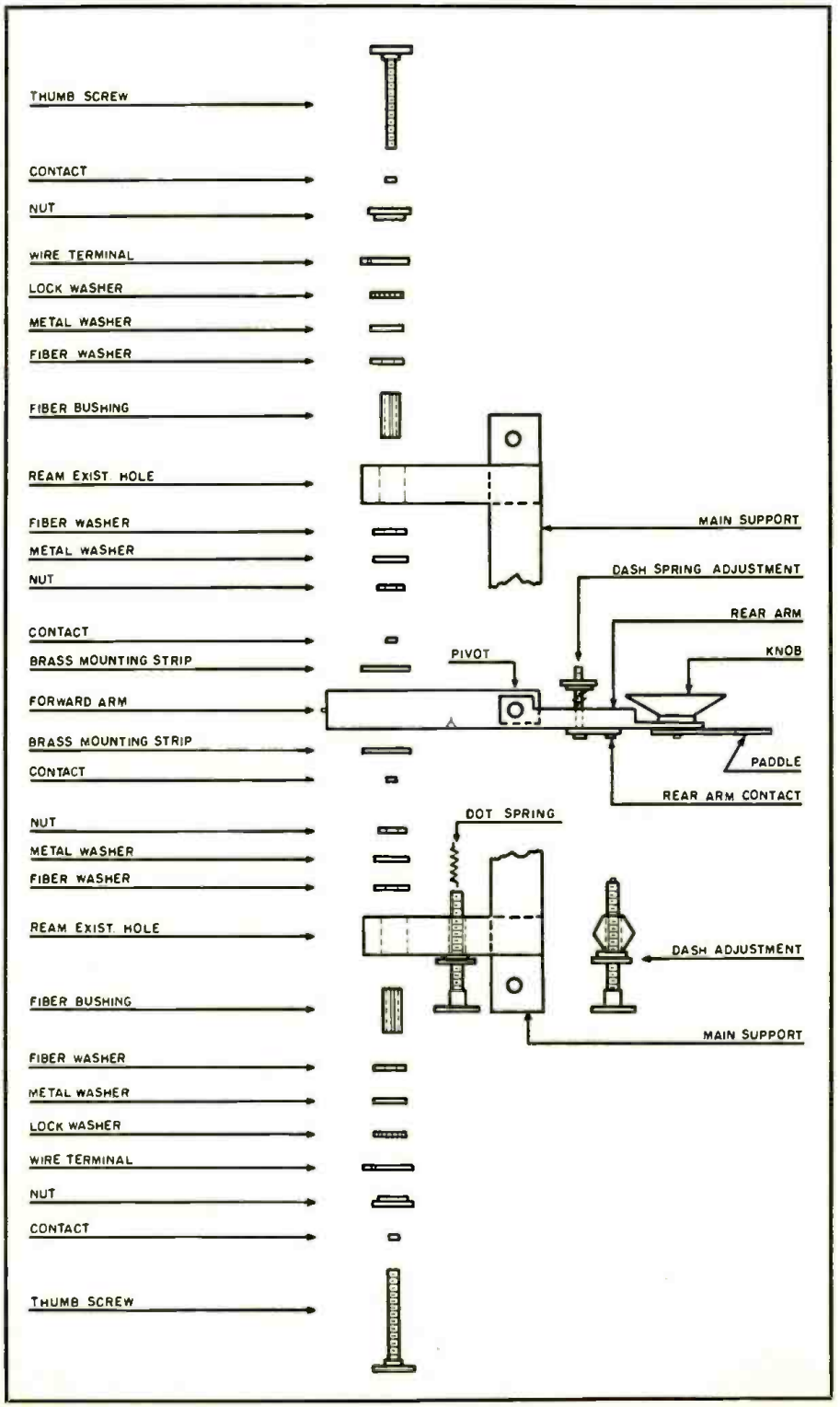
Right-front view of keyer showing placement of various controls. On the front, at the top left-hand corner of the 4" x 5" x 6" metal box, V_2 is mounted directly above the speed control. V_3 is to the right. On the right side of keyer and on the left end of the removable side plate, the weight control, R_{10}, is mounted directly above the "dot-dash ratio control," R_5. The grid bias adjustment on the 2050 is mounted below the normally-open push-button switch at rear.



coil resistance may vary from 2000 ohms to 14,000 ohms. V_1 will still key the relay, but it must be remembered, of course, that the relay should operate at the current for which it was designed. For instance, one type of relay having a coil resistance of 2500 ohms and designed for low current operation worked quite well at all speeds. Another type of relay whose coil resistance was 2000 ohms, but which was not designed for keying purposes also worked quite well at slow speeds, and with adjustments worked at all speeds. The relays found in surplus Beacon receivers marked "BK-35", having a coil resistance of about 14,000 ohms, worked very well in the circuit when a resistance was placed in series with its winding to limit the current to 2 ma. A relay whose coil resistance was 4000 ohms and was sealed against manual adjustment also worked very satisfactorily.

Before any adjustments are made, short the leads of an ohmmeter and adjust for full-scale reading. Connect these leads to the open contacts on the relay. Set the "dot-dash ratio control," R_8, for maximum resistance. Set the speed control, R_9, to about three-fourths of the highest speed and push the lever to the left to produce dashes. As the relay opens and closes, adjust the weight control, R_{10}, so that three-fourths of full-scale deflection is obtained on the ohmmeter. Then move the key lever to the right and adjust the "dot-dash ratio control," R_8, until half-scale deflection is obtained on the ohmmeter. When the speed control, R_9, is advanced or decreased, the readings obtained on the ohmmeter should not vary greatly from those obtained by previous adjustments of R_{10} and R_8. Over the entire speed range no pronounced variation will be apparent, except at very slow speeds where the swing of the ohmmeter will become difficult to determine.

Fig. 3. Details for constructing the "bug" to be used with electronic keying unit.



In order to check the accuracy of the "dot-dash ratio control," an electric counter was connected to the open contacts on the relay after these adjustments were completed. Dashes and dots were counted over a 10 second interval from slowest to fastest speeds with only a slight variation in dot-to-dash ratio. After a few minutes of practice, the "dot-dash" ratio can be set remarkably close simply by listening to the relay or the transmitted signal in the receiver. This control should not have to be re-adjusted once it has been set correctly.

The key mechanism was made from a standard "bug" by removing everything on the base back to the forward arm as shown in Fig. 3. Since not all keys of this type are standardized as to method of construction, Fig. 3 shows a method of utilizing the main support and key lever, or arm, without constructing a special one for use with this type of keyer. The one shown in the photographs was purchased in kit form from the *Electric Specialty Mfg. Co.*, Cedar Rapids, Iowa a few years ago for less than $4.00. The additional contacts were taken from surplus relays and mounted as indicated. Two of the contacts may be salvaged from the part of the key that has been removed. The problem of making the key mechanism isn't as difficult as might be expected, and the method of mounting the contacts on the forward arm is left to the ingenuity of the individual. On this particular key, the forward arm is of brass and the contacts and brass mounting strips were simply soldered to the arm. Different makes of "bugs" present different problems, of course, but utilization of the existing construction greatly reduces the amount of work involved.

In closing, the writer wishes to thank W5FRE for his valuable suggestions on the development of certain portions of the circuit.

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1. Bartlett, F. A.: *"Compact Automatic Key Design," QST, December, 1951.*
2. Brann, Roy: *"In Search for the Ideal Electronic Key," QST, February, 1951.*

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TELEVISING TODAY'S NEWS

By **RALPH HOWARD PETERSON**
Director, "Camel News Caravan"

A 15 minute newscast on your screen represents hours of preparation and the services of a highly-trained staff.

John Cameron Swayze before the cameras for the "Camel News Caravan."

PUTTING together the "Camel News Caravan" every day for the television network of the *National Broadcasting Company* might be compared to running a push-button desk for myriad magic carpets and genii all over the world. Because that is what we do through the magic carpets of modern communications and transportation, through the coordinated efforts of a highly skilled staff as we bring actual events from all over the world to the television screen each day.

Only, it is not that simple, nor that easy.

To carry televiewers from Seoul to Budapest, from baseball field to the White House, to picture "Today's News Today," calls for a fabulous organization, a highly complicated operation and great expense. We must be ready with manpower and equipment to cover anything that happens in any accessible point on the globe.

This series was started in February 1948 as a straight newsreel program. Newsreel film was edited and put on the network with suitable commentary background. However, television outgrew this form of news coverage very quickly, so the program was turned over to the *NBC*-TV News Division which developed the technique of mixing live action pickup with film.

Often the program involves at least a dozen switches from New York headquarters to other cities and back again.

Film is being rushed in constantly from more than 100 cameramen stationed strategically around the world.

Producing television's most popular network news show is a 24-hour-a-day job. But take the typical day at the *NBC*-TV Uptown Studios in the Pathe Building at 106th Street, Manhattan, our headquarters.

Editor John Lynch checks over the incoming news, then he confers with our staff, including Chief Writer Reuven Frank and myself. We decide what is the day's big news and how we can cover it. We check over reports from correspondents and representatives all over the world. Telegrams, cables, radiograms, and trans-oceanic phone calls carry the assignments and instructions.

We spend the day rushing back and forth between our offices with its news teletypes and the movie projection room where we review film as it arrives.

In the last year, "Camel News Caravan" ordered 250 miles of 16 mm. and 35 mm. film shot. Thirty-five miles of film were shown on the program.

This film may be brought by the cameraman himself from a local fire or a local political event around the corner, or rushed by special courier, jet plane, trans-ocean air liner, and motorcycle from some remote corner of the globe. Most of it arrives undeveloped and is prepared for viewing by a laboratory staff here. For this reason, many of our cameramen never see the film they shoot and send in film that millions of televiewers see as a routine part of their evenings at home.

One-third of all films included on the Caravan arrive too late to be developed and printed by air time. To make the evening deadline with them, we project the negatives by a special apparatus with reversed polarity. This gives a normal picture to show last-minute news.

To the 16 mm. and 35 mm. sound and silent films from all over, we add the on-camera commentary by John Cameron Swayze in New York, by Bill Henry and David Brinkley in Washington, by Edward Wallace in Cleveland, by Clifton Utley, Jim Hurlbut, and Clint Youle in Chicago, by others in Boston, Los Angeles, and San Francisco.

Also in the New York studio, we carry the film story with off-camera voices of newscasters like Kenneth Banghart, Radcliffe Hall, Don Goddard, and Bob Wilson. Connie Lempke is the off-camera voice of fashion.

We go through the motions of a rehearsal about 7:15 o'clock to make up our show. This is essential in blending as many as fifteen different segments into the smooth-flowing news program that appears on the coast-to-coast hookup at 7:45 p.m., New York Time. But, at rehearsal, probably half of the segments are not shown. These are picked up from other cities during the actual show, or received at our studios between the rehearsal and the telecast.

Our technique has been improving steadily through the years; our world covering staff grows in size and skill. *NBC* Vice-President William F. Brooks has described the Caravan as "a major step in adapting the tools of a new medium, television, to the age-old job of reporting news." Also, he might add, it is adapting the great developments of a scientific age to the art of news reporting. -30-

PHASE-SHIFT TONE CONTROLS

By

GLEN SOUTHWORTH

An interesting and thought-provoking article on a novel method of achieving tone control with simple RC circuits.

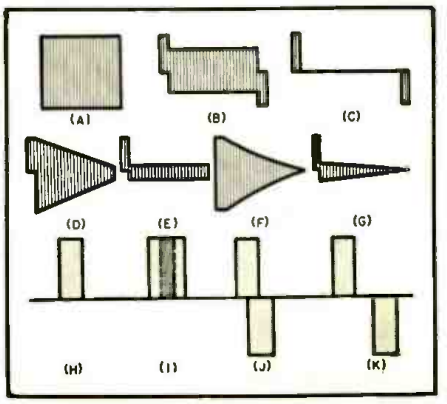
UP TO the present time interest in the effects of phase shift on audio reproduction has largely been confined to the designers of wide-band amplifiers employing large amounts of inverse feedback. In other elements of the reproducing chain, such as loudspeakers, pickups, and other devices, relatively large phase shifts may occur. Previously, phase distortion has been held to be of little importance in monaural reproduction due to the fact that much larger phase shifts may occur due to acoustics and similarly some listening tests involving controllable phase shifts in the audio circuits appeared to indicate that the average listener was very tolerant of this form of distortion.

In considering the possible effects of phase it should be noted that a special case with important characteristics results when two signals of varying phase are mixed. A situation of this nature can arise at several points in the reproducing setup: at the microphone, in equalization circuits, in feedback circuits containing reactive elements, in electro-mechanical devices, and in the acoustic environment of the listener. Some of the possible effects are shown in the accompanying illustrations. If one wave train is delayed for one-half cycle, or 180 degrees, and mixed with another wave train of equal amplitude, the cancellation of all but the first and last half cycles will result. If an audio system were constructed with this form of characteristic over a wide frequency range, the resultant reproduction would greatly discriminate against sine-wave trains and would pass nothing but transients and the products of rapidly damped or modulated wave trains. A condition of this kind can sometimes exist in phonograph equipment and leads to an apparently excessive ratio of needle scratch to high frequencies.

If an asymmetric transient is applied to a system in which phase shift occurs and the resultant signal is mixed with the original, an actual lowering of pitch may result. The same characteristic may hold true for continuous wave trains of a lopsided nature, such as might be caused by second harmonic distortion in an amplifier stage. The reverse of this proposition may occur if phase inversion, such as produced by an amplifier stage, is produced before the mixing occurs. In this case, the pulse now becomes symmetrical and the duration of each half cycle is shortened. Both of these effects can occur acoustically and may be the cause of a certain indistinctness of tone of some instruments when heard from a distance.

The primary effect of phase-shift mixing appears to be to change the relationships between sine waves and transients in sound reproduction and the author's experience strongly indicates that this may be one of the

Various relationships which may occur due to phase-shift mixing. (A) Pattern of continuous wave train. (B) Pattern resulting when one continuous wave train is mixed with another with less than 180 degrees of phase delay. (C) Pattern produced by two wave trains of equal amplitude but 180 degrees out-of-phase. (D) Pattern of linearly damped wave train. (E) Resultant pattern of mixing two damped wave trains 180 degrees out-of-phase. (F) Semi-logarithmically decaying wave train. (G) Pattern of result of 180 degree mixing. (H) Asymmetrical pulse. (I) Pulse delayed for less than 180 degrees and mixed with original pulse, showing increase in duration of resultant signal. (J) Pulse both delayed and inverted then mixed with original signal. (K) Resultant symmetrical signal produced, with each element having a shorter duration than original signal.



important differences between monaural and binaural hearing. The effects that can be obtained by appropriate phase delay and subsequent mixing appear to closely approximate the advantages that are claimed for binaural hearing, *e. g.*, reduction in apparent reverberation time of room acoustics, reduced audibility of background noise, and greater clarity with less apparent distortion. The first of these characteristics may be attributed to the fact that phase mixing would tend to emphasize transients and rapidly damped wave trains while discriminating against fairly continuous sounds like hum or symmetrical noise, and tending to lower the pitch of unsymmetrical noise to a less audible region. In lowering the apparent distortion of the signal it should be noted that the recognition of distortion is to some degree a function of the duration of the distorted tone. For example, in the case of a cymbal clash, frequencies of 10,000 and 10,020 cps might be present which, if passed through a nonlinear element, would presumably give rise to a twenty-cycle beat note. If, however, the two high frequency components maintain a fixed relationship for only a few milliseconds then no effective twenty-cycle note will be generated. A similar phenomenon may be noted in sweep-frequency audio oscillators in which the low-frequency response is limited by the duration of the sweep. In general, it seems reasonable to assume that intermodulation distortion products will be most objectionable in situations where two or more frequencies bearing a constant relationship to each other are produced for an appreciable length of time. Inasmuch as a phase mixing system would tend to reproduce such sounds at a level considerably lower than otherwise, this would give the effect of lower apparent distortion in the reproduction.

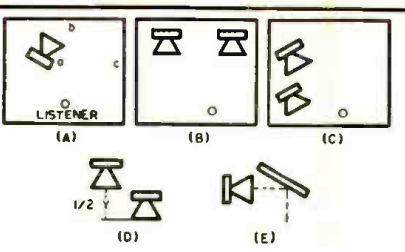
Phase-shift mixing can be produced in several ways. One of the most interesting methods is acoustic mixing which may be done either by utilizing wall reflections, multiple speaker arrangements, or special baffles. In the case of wall reflections it usually seems desirable to have the speaker located out in the room with all or part of the radiation directed toward a nearby wall or corner. Variations in tonal quality may be secured by varying both the angle and the distance of the speaker from the reflecting surface and proper positioning is sometimes necessary to avoid a "hollow" effect. In addition to the phase-mixing effect an additional advantage may be obtained due to the fact that the wall reflection represents a virtual source of sound which, in combination with the direct radiation from the speaker, may be interpreted by the ears in its binaural equivalent. Similarly, the virtual sound source may cover an appreciable area of wall space and give a pleasing effect of diffusion.

In the event that it is considered

impractical to place the speaker and housing out on the floor, an alternative method is to use two or more separate speaker assemblies physically displaced from each other. This displacement may be either in a line away from the listener or horizontally. A large number of possible combinations may be obtained with a setup of this kind and it is desirable to provide for adjusting the relative levels of the different speakers as well as varying location and sound directivity. Under some circumstances an arrangement of this kind can be used as a form of attenuator to reduce spurious or unwanted sounds. For example, one half wavelength at 50 cycles will be approximately ten feet and in some cases the cancellation effect can be used to reduce low-frequency hum or loudspeaker hangover. In the high frequency region a similar technique could be used to reduce or eliminate a single unwanted frequency by the staggering of two closely-spaced tweeters, one slightly behind the other. Similarly, in the high-frequency region it would be practical to design special baffles with reflecting surfaces in order to achieve phase-shift effects. Such an arrangement is usually impractical at low frequencies, however, due to the large physical dimensions required.

Electronic phase-shift mixing may be achieved by means of a variety of circuits and has the advantages of convenience and compactness over the acoustic methods previously described. At low frequencies the electronic phase-shift methods are generally somewhat more effective than acoustic techniques when used in a room of limited dimensions. Electrically, a phase shift of 180 degrees is relatively easy to produce at twenty cycles, while acoustically such a phase delay would require a path length of about twenty-five feet. At high frequencies very large phase rotations may be produced acoustically as compared to those available with conventional electronic circuits.

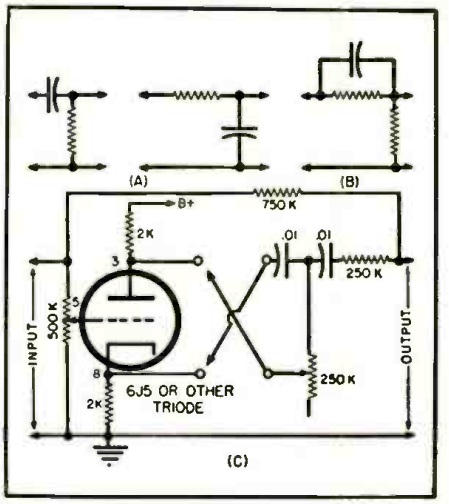
One of the most interesting applications to which electronic phase-shift mixing may be put is in the improvement of signal-to-noise ratios in program material such as phonograph recordings. In conventional 78 rpm shellac recordings it is usually assumed that surface noise begins to be noticeable from about 3000 cps upward. This noise is largely due to small irregularities in the groove, such as caused by dirt or abrasive in the record material. These irregularities tend to cause the production of an asymmetrical transient when struck by the pickup needle. As noted earlier, when the phase of an asymmetrical waveform is shifted and inverted and then mixed with the original signal the apparent frequency of the waveform will increase. If a 90 degree phase shift is used prior to inversion and mixing, this will cause the asymmetric components of needle scratch to be doubled in frequency, thus permitting the



(A) Use of wall reflections to obtain the phase-shift mixing. Points b and c represent virtual sound sources. (B and C) Some of the possible combinations of multiple speaker spacing. The basic factor in all these three examples is to produce multiple sound sources at varying distances from the listener's ears. (D) Staggering of two speakers may be used to reduce or eliminate undesirable resonances or frequency accentuations. Separation should be approximately a half-wavelength at the unwanted frequency. (E) Simple means of securing high frequency phase shift from speaker in fixed location by means of a small reflecting panel. This method will provide better high frequency response for the listener located off the speaker axis.

reproduction of sine waves on the recording up to approximately 6000 cycles before noise interference begins to occur. If a 45 degree phase shift is used this will presumably extend the noise region to 12,000 cps and above, although in both cases it should be noted that the peak amplitude of the transient impulses will be considerably greater in relation to the musical sine wave components. This is offset by the fact that the noise now occurs in a less audible region and may be easily attenuated by a filter network.

Several factors should be noted about a noise-reducing system of this kind. Due to the fact that it alters the frequency characteristics of transients or asymmetric waveforms only, it is not effective in reducing noise such as may be produced by a pickup with a severe ringing needle resonance. Similarly it may alter the tonal characteristics of certain sounds in the high frequency region, *i.e.*, raising the apparent pitch of instruments such as cymbals, a not undesirable effect in recordings with a restricted frequency range. Assuming that a good pickup is used, the author's experience is that reproduction from conventional shellac recordings approaches that of vinylite or shellac with very little abrasive content. Occasional ticks or pops may be noted but the average background noise tends to become a continuous, unobtrusive, low level sound. As a matter of interest it might be noted that some pickup equalization circuits appear to be similar in operation to the phase mixing arrangement. In these circuits inverse feedback is usually applied either to the pickup itself or through some phase-shifting element thus providing the previously specified condition of phase shift, inversion, and mixing.

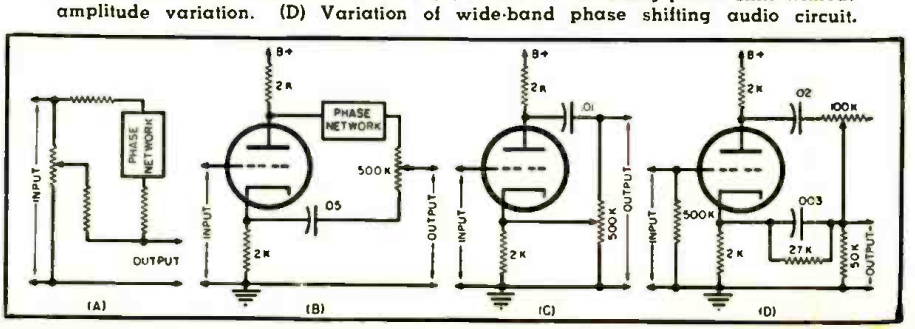


(A) Simple phase-shifting circuit. The phase-shift will equal 45 degrees when reactance of the condenser is equal to that of the resistive element. Sections may be used in series for larger phase shifts. (B) Type of high frequency equalizer that is not recommended by author because it lowers the pitch of transients such as needle scratch. (C) Phase shifting and mixing system which may be used to provide variable high or low frequency cut-off.

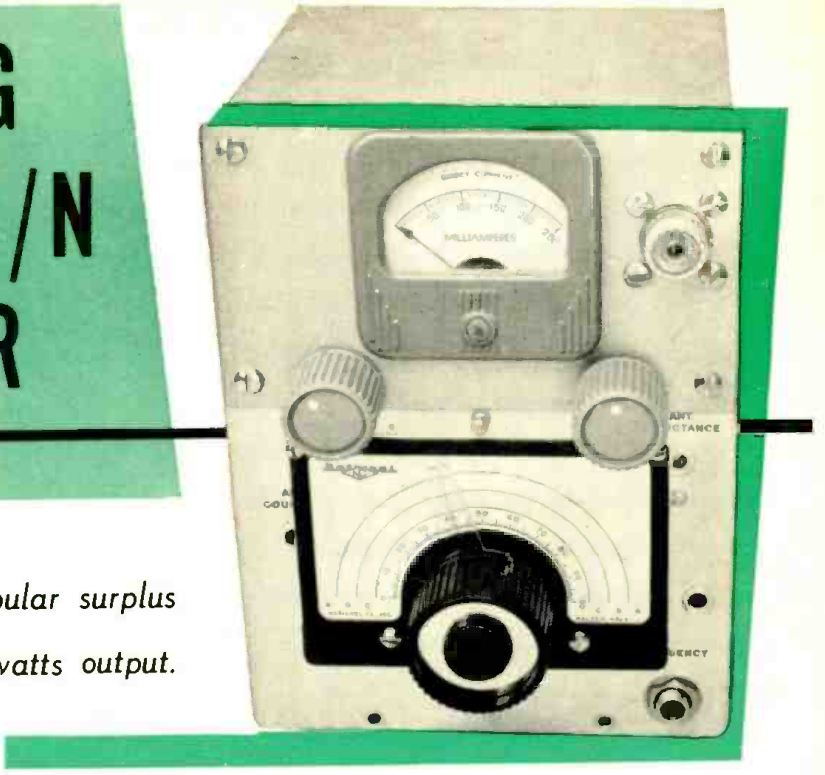
Some of the circuits that can be used for phase-shift mixing are shown in the accompanying diagrams and may be used in many different combinations. Similarly it should be realized that many conventional tone controls or equalizer circuits introduce some phase shift mixing with results which may be considered desirable or not, depending upon the associated

(*Continued on page* 152)

(A) Generalized circuit for obtaining phase mixing. The pot. is used to obtain amplitude balance between the out-of-phase components. (B) Circuit for obtaining phase mixing and inversion. An audio transformer with the centertap grounded may be used in place of the triode, if desired. (C) Circuit for obtaining phase shift without amplitude variation. (D) Variation of wide-band phase shifting audio circuit.



MODERNIZING THE SCR-274/N TRANSMITTER



Step-by-step data on converting a popular surplus unit to operate c.w. on 40 m. at 40 watts output.

By
CARL V. HAYS, W6RTP

Front panel view of the converted SCR-274/N transmitter. Read instructions carefully before starting disassembly.

SINCE the release of the surplus stock of the well-known SCR-274/N series of transmitters to the amateur buyer, several articles have appeared on adapting the rig to typical amateur uses. While excellent in themselves, most of the information left much to be desired, from our point of view.

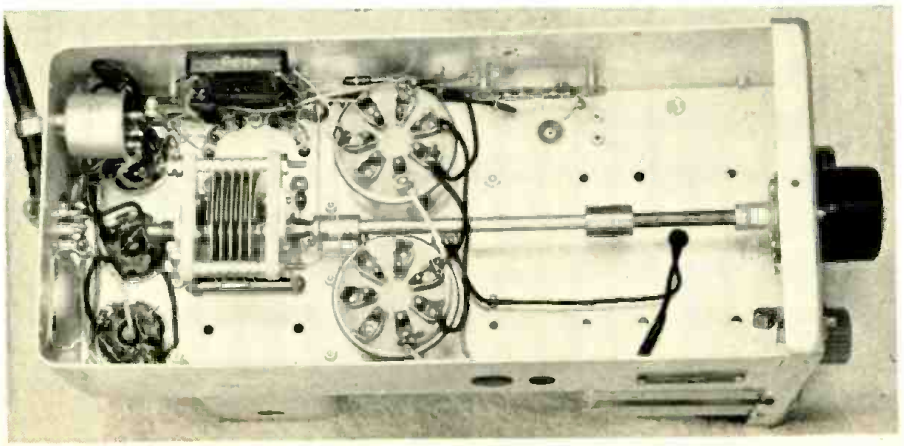
From working with the little transmitters during most of the war years, we had naturally given some thought to how easily they could be converted to a complete c.w. rig, with a minimum of work and cost. Featuring a simple, stable v.f.o., parallel beam-power output tubes (the equivalent of 807's), with neatness and compactness, they were a natural.

The BC-459A, with coverage from 7 mc. to 9.1 mc., was our choice, since the 40 meter band is our primary c.w. favorite. Other than for the difference in frequency involved, the BC-696A (3 mc. to 4 mc.) is also an ideal ham rig, and either will respond to similar treatment, giving either full 80-meter or 40-meter coverage, as may be desired.

Setting our shiny, brand-new BC-459A on the bench, we lit a pipe, and started looking and thinking. The photos will give a quick, clear picture of the final result envisioned, and it was surprising how little time and effort were required to achieve the desired results. A meter, a dial, a phone jack, an r.f. choke, and a condenser were all the new parts required to give a neat-looking, smooth working 40-meter rig, for a ridiculously small investment.

Removal of the top and bottom covers is the first order of the day. With the innards exposed, we removed all tubes (for safety's sake) and then carefully removed all three tuning and padding condensers below the chassis, including the dial assembly. A small *Bristo* wrench makes this a quick and easy operation, since the gears are secured to the shafts by this type of screw. From the top of the chassis we removed the final tank coil, the antenna loading coil, and the associated hardware.

Underchassis view. A neat job will result if author's instructions are followed.



Next step is the removal of the antenna relay (immediately above the antenna loading coil) and the power relay (located below the chassis). The antenna feedthrough insulator also comes out, as well as the removable calibrated window on the panel.

The next step involved paralleling the filaments, since these rigs originally operated from a 28 volt source. Inspection of the wiring diagram will show how easily this can be done, involving only two actual wiring changes. Removal of the relay wiring facilitates this step.

Since the crystal furnished with the unit in question is an 8000 kc. one, we had no further use for the tuning eye stage (1629), so no effort was made to utilize it. Removal of its plate dropping resistor was a simple means of eliminating this stage. Reference to the diagram will show all wiring changes, as well as the pin numbers in use in the modified version.

With the wiring changes out of the way, the next step was mounting the oscillator tuning condenser C_2, a 70 $\mu\mu$fd. dual-bearing job (*Johnson*). This particular condenser is almost ideal for the critical job, and is recommended highly. Not only is it a ruggedly built and smooth operating thing, it just so happens that its mounting feet and its shaft-center-to-chassis measurements make an easy job out of adding it to the circuit.

Since its mounting involves going

into the oscillator shield can area (to get the holes drilled for the feet) you will find it will fit with a minimum of headache. While the oscillator shield is off, the following steps are *carefully* done to the stage itself: extend the grid-leak condenser lead, taken from the original oscillator tuning condenser lug, up through the chassis hole, and solder it to the top of the coil (junction of coil and oscillator bandset condenser in the shielded area). This is necessary, since we are going to tap the new oscillator tuning condenser across part of the coil only, for bandspread purposes.

Next step is the soldering, with short rigid leads, of an auxiliary 50 $\mu\mu$fd. silver mica or ceramic condenser C_1 across the bandset condenser. This is not an absolute necessity, but better bandspread is obtained with its addition. Its use is optional, but recommended. Now is a good time to loosen the *Bristo* screws holding the arm of the rotor clamp on the bandset condenser, and turn it full in, re-locking securely.

Final step in re-working the oscillator is the soldering of a rigid length of bare hook-up wire from the stator of the 70 $\mu\mu$fd. tuning condenser C_2, to the fifth turn from the top of the oscillator coil. This spreads 40 meters over about 80% of the *National* MCN dial, and gives plenty of bandspread for spotting frequency.

The indispensable grid-dipper is a handy thing to have about this time, but calibration can wait, if necessary, until power is applied, checking against the station receiver.

Comes now the final amplifier work, and here unfortunately a bit of hacksawing is a must, in order to utilize the former final amplifier ganged tuning condenser for our purpose. Carefully saw around the frame of this condenser just below the gear drive support arms that hold the worm gear. It is a nuisance, but look at the dough you save, and the pyrex-ball insulated condensers of the SCR-274 are worth the effort alone, besides the monetary saving accomplished.

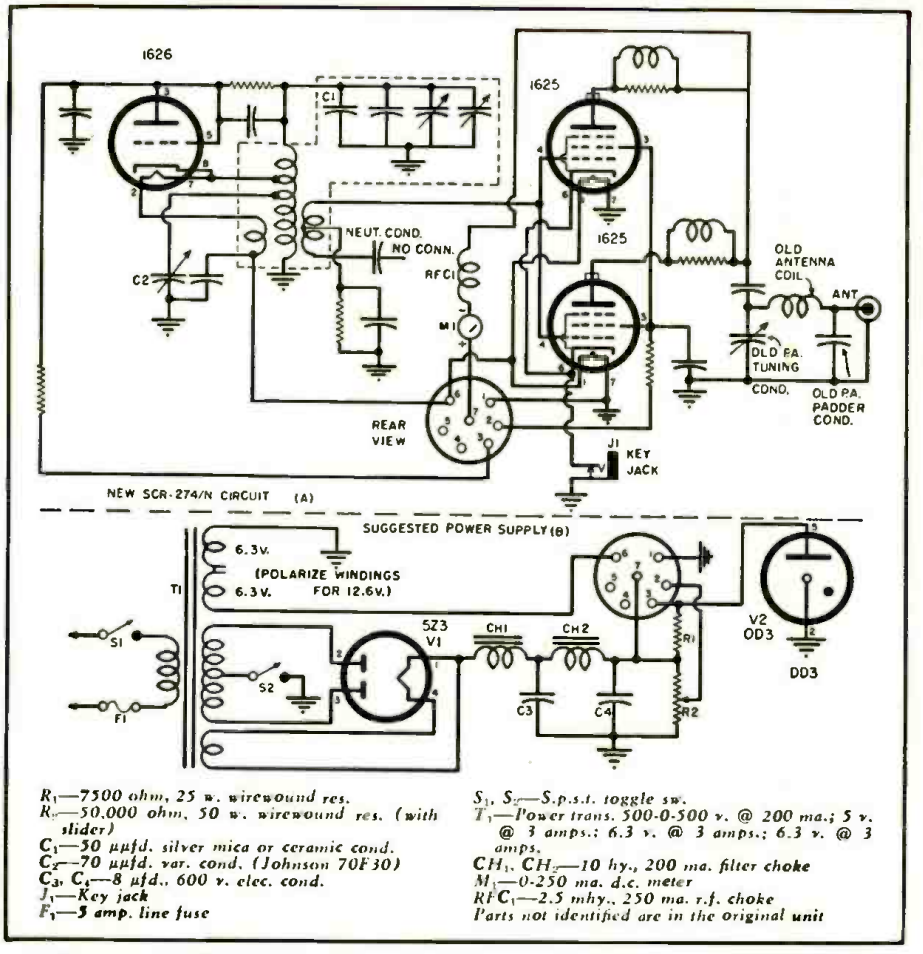
With this done, it will be found that this condenser will fit nicely to the left of the chassis, topside, immediately behind the panel. In its duplicate position on the right will also fit the former final amplifier padding condenser. An extension for its shaft will be found necessary, in order to fit it with a knob. Spot and drill holes in the panel to clear the two shafts (the panel referred to is the scrap piece of aluminum shown in the panel photo which is bolted to the front of the rig, flush with top and both sides). The two condensers are mounted to the side lips of the front panel by means of 6/32 screws, tapping into the already existent holes in the condenser frames. Be sure and allow for the 2¼ in. meter mounting hole during this process, since there is just enough room for all of them to fit.

Using the former clearance hole for the previous dial as a marker point, lay out your oscillator tuning condenser shaft center-point, and file or punch the panel to accept the MCN dial assembly drive unit. Some additional chopping of this unit opposite the factory cutting will allow it to fit nicely under the chassis. Ten minutes' work will do the trick, and the resulting operation will justify it.

Retrieve the mounting lugs from the former final amplifier tank coil assembly, the 1625 plate clips with the parasitic suppressors attached, and using the lugs, mount the former antenna loading coil (minus, of course, its slider assembly) in the spot formerly occupied by the old tank coil. Careful use of short bits of the old tank coil wire, soldered to the lugs, and inserted in the convenient holes found in the ceramic form ends, will secure it rigidly and quickly to the chassis.

Make up, from the former mica 1625 plate bypass condenser and the two plate clips, and a 2.5 mhy. r.f. choke RFC_1, the parallel feed system shown

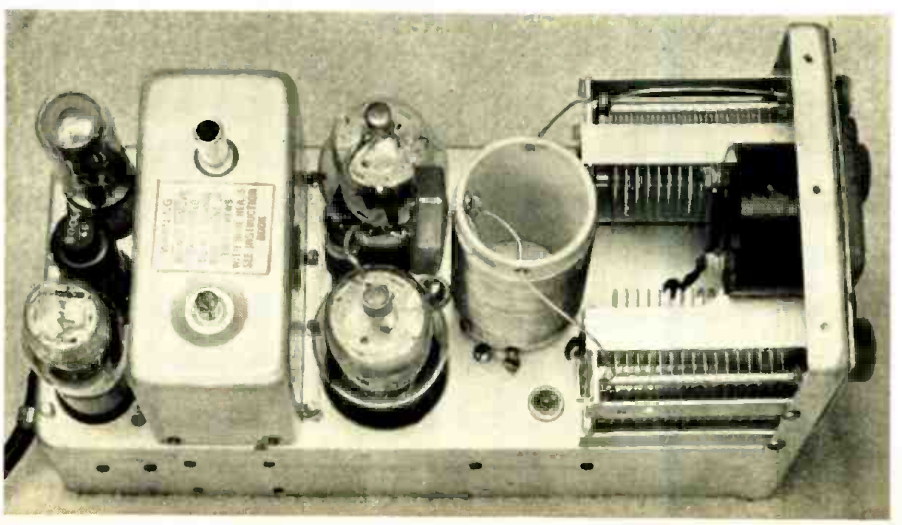
(*Continued on page* 125)



R_1—7500 ohm, 25 w. wirewound res.
R_2—50,000 ohm, 50 w. wirewound res. (with slider)
C_1—50 $\mu\mu$fd. silver mica or ceramic cond.
C_2—70 $\mu\mu$fd. var. cond. (Johnson 70F30)
C_3, C_4—8 μfd., 600 v. elec. cond.
J_1—Key jack
F_1—5 amp. line fuse
S_1, S_2—S.p.s.t. toggle sw.
T_1—Power trans. 500-0-500 v. @ 200 ma.; 5 v. @ 3 amps.; 6.3 v. @ 3 amps.; 6.3 v. @ 3 amps.
CH_1, CH_2—10 hy., 200 ma. filter choke
M_1—0-250 ma. d.c. meter
RFC_1—2.5 mhy., 250 ma. r.f. choke
Parts not identified are in the original unit

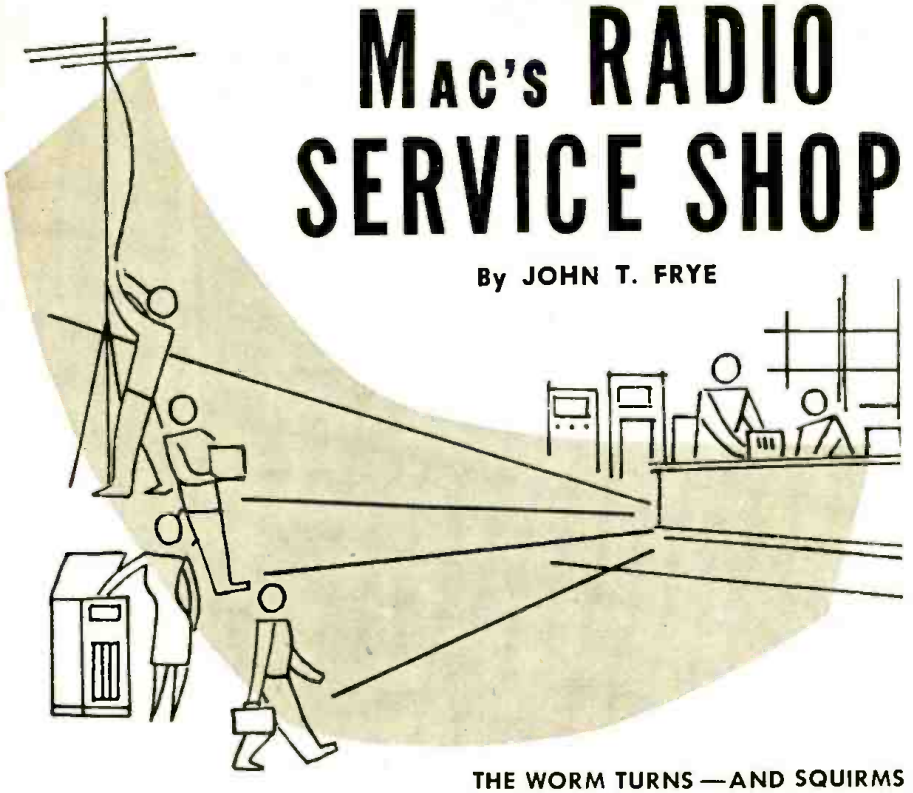
(A) Diagram of SCR-274/N showing required changes. (B) Suitable power supply for unit.

Top chassis view of converted unit. A compact, stable unit for c.w. is the result.



MAC'S RADIO SERVICE SHOP

By JOHN T. FRYE



THE WORM TURNS — AND SQUIRMS

MAC had to stop at the bank during his noon hour, so he was a little late getting back to his service shop. When he finally did step in out of the raw January wind, the outer office was empty; but he could hear Matilda Perkins, the office girl, giggling like a high school freshman back in the service department. Walking softly across to the door, he opened it upon a strange sight.

Barney, his assistant, was sitting cross-legged on the service bench, his red thatch of hair concealed beneath an improvised turban of paper towels. In his left hand he clutched a small, misshapen doll, and with his right hand he was repeatedly thrusting a sharp scribing tool into its soft body. All the while he kept muttering to himself in a low monotone. Matilda was perched on a service bench stool in front of him trying to stop her almost hysterical laughter by cramming a handkerchief into her mouth.

"What's with Balmy Barney *now?*" Mac asked her.

"He's getting rid of his inhibitions," she managed to gasp.

"I never thought he had any," Mac said; "but how does all that help?"

"He read in a magazine that children often can be freed from their secret hates and angers by allowing them to deface and destroy pictures of people they dislike," Matilda explained, wiping her eyes. "He says if that's good for kids it ought to be good for him, too; so at noon he bought that kit of modeling clay and made that little man-figure that stands for all the manufacturers, engineers, and production men who dream up radio and TV sets that are hard to service. Now he's punishing this effigy and so ridding himself of a suppressed desire to commit mayhem on the persons of these men."

"Sounds like witchcraft to me," Mac commented as he sat down on the other service stool and picked up a lump of the colored clay.

Like most good Irishmen, Barney Gallagher had a little of the ham (sock-and-buskin as well as key-and-mike variety) in him, and he was playing this scene to the hilt and way beyond—say about half-way to the elbow. He had sat silent with his chin on his chest like a brooding Buddha during this exchange between his boss and Matilda, but now he took up his sing-song chant again:

"So you will run leads from a set down through a hole in the cabinet shelf and then *solder* them to the speaker so a man has to use a soldering iron just to get the chassis out, will you? And how about that business of stapling loop antennas into console cabinets? Too cheap to use a couple of wood screws, aren't you? But when it comes to putting backs on console and TV cabinets you don't mind using screws. Oh no! Then you throw in one about every two inches so a poor guy has to take out a whole hatful of them just to change a tube. Speaking of antennas, my bucko, this jab is for cementing a loop inside a plastic cabinet and then using short leads soldered to chassis connections so a party can't even pull out the chassis and turn it over without breaking those solid-wire leads. Why couldn't you fasten the loop to the chassis where it belongs? You knew that putting the chassis back into the case, into the field of the loop, would upset any alignment done outside; yet you made no provision for reaching the alignment screws with the set in the cabinet. Another prize crock you have pulled is in mounting a loop with its turns wound in a horizontal plane. You certainly should know that the only way a customer can pick up any but the stronger vertically-polarized signals on that loop is to turn the set on its side.

"This gouge is for the crimes you have committed in the name of dials and dial-drives. Take the case of those transparent dial covers that are riveted to metal or celluloid backing plates with only room for the pointer to move in between. How do you think the technician is going to clean those dial covers? Do you think he is going to remove and put back all those eyelet rivets each time, or did you intend for him to replace the whole works every time the cover got dirty?

"Another thing: are you trying to see how much you can overload a poor little dial cord? You rig up contraptions requiring the dial cord to turn the tuning condenser, work a slug-tuning assembly, move a pointer back and forth, and revolve forty-eleven pulleys besides—and sometimes you are too tight even to use wooden pulleys! You know that cord will start slipping on the shaft before the set is out of the store a month. If *you* can't make the thing work longer than that, how do you expect the technician to do so?

"Take that and that for the things you have done with record changers! Only a bird with malice in his heart would ever design a changer that must maintain tolerances and clearances to a few thousandths of an inch and then make the thing out of warping, wearing pot metal. All you want to do is get the thing out of the factory. A lot you care if it is impossible to keep in adjustment in the field. You prove that again by cooking up a changer design that taxes every last ounce of power of the phono motor. When everything is clean and brand-new, the motor barely has enough power to complete the change cycle; but as soon as a little gum forms in it and the drive wheel loses a tiny bit of its traction, the motor no longer can do the job. You never thought of designing in a little reserve of power, I presume."

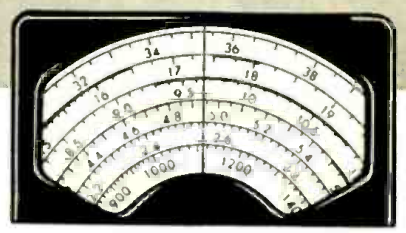
Barney stopped for breath, and Mac reached over and took the sharp-pointed scriber out of his hand.

"Let me try a little of this voodoo stuff," he drawled as he held up a little figure he had molded from various colored bits of clay while Barney was talking. "Now this little figurine stands for a few technicians I have known in my time and who have gotten into my hair more than somewhat in that period."

"The first sharp prick we give you, my friend," Mac said to the little clay doll, "is to deflate your ego. I often hear you heaping fine scorn on radio and television manufacturers for the mistakes they have made. You never give these men any credit for having

(*Continued on page* 101)

International SHORT-WAVE



Compiled by KENNETH R. BOORD

THANKS go to Simon Scheiner, New Jersey, for this data which he received from officials of *Radio Republic Indonesia*, Djakarta, USI:

Overseas Service—YDF, 11.770, 100 kw., Djakarta (Java), beamed to India, Middle East, Europe (may be used during European winter); YDC, 15.150, 50 kw., Djakarta, beamed with Antenna 1 to Australia, Antenna 2 to China, Antenna 3 to India-Europe; YDB2, 4.910, 1 kw., Djakarta; YDB3, 7.270, 7.5 kw., Djakarta, beamed to Indo-China; YDE, 11.770, 7.5 kw., Djakarta, beamed to West Coast USA.

Home program in Indonesian—YDB, 2.260, 1 kw., Djakarta; YDB2, 4.910, 1 kw., Djakarta; YDF, 6.045, 100 kw., Djakarta; YDO, 9.585, 50 kw., Djakarta.

Second home program—YDD, 3.205, 1 kw., Djakarta; YDB3, 7.270, 7.5 kw., Djakarta; YDE, 11.770, 7.5 kw., beamed to Sumatra; YDE, 11.770, 7.5 kw., beamed to East Indonesia.

Other domestic outlets—YDA2, 2.415, 150 w., Bandung (Java); YDA, 3.390, 3 kw., Bandung; YDA3, 4.945, 150 w., Bandung; YDA6, 2.390, 100 w., Tjirebon (Java) is relay station for Bandung; YDJ, 7.060, 7.5 kw., Djogjakarta (Java); YDJ2, 7.100, 1 kw., Djogjakarta; YDJ3, 2.450, 300 w., Djogjakarta; YDG, 6.170, 3 kw., Surakarta (Java); YDG2, 2.300, 100 w., Surakarta; YDI, 3.240, 1.2 kw., Surabaya (Java); YDI2, 3.980, 5 kw., Surabaya; YDI3, 2.467, 300 w., Surabaya; YDH, 2.500, 150 w., Semarang (Java), YDH2, 3.945, 1 kw., Semarang; YDG6, 2.370, 300 w., Madiun (Java) which is relay for Surabaya; YDI6, 2.335, 300 w., Djember (Java) is relay for Syrabaya; YDU, 4.840, 1 kw., Denpassar (Bali); YDQ, 3.365, 300 w., Makassar (Celebes); YDQ2, 9.550, 8 kw., Makassar; YDQ3, 7.295, 300 w., Makassar; YDR, 4.865, 1 kw., Ambon (Moluccas); YDR2, 2.420, 150 w., Ternate (Moluccas) is relay for Ambon; YDS, 3.230, 1 kw., Manado (Celebes); YDO, 3.380, 1 kw., Bandjarmasin (Borneo); YDO-2, 5.960, 1 kw., Bandjarmasin; YDN, 2.350, 300 w., Pontianak (Borneo); YDK, 4.855, 1 kw., Palembang (Sumatra); YDL2, 2.320, 300 w., Padang (Sumatra); YDL, 3.960, 1 kw., Padang; YDM, 3.270, 300 w., Bukittinggi (Sumatra); YDM2, 5.030, 1 kw., Bukittinggi; YDP, 4.930, 1 kw., Medan (Sumatra); YDP2, 3.350, 300 w., Medan; YDP3, 7.240, 7.5 kw., Medan; YDN, 2.390, 100 w., Kotaradja (Sumatra).

Radio Republic Indonesia officials listed transmitting hours for the Home Service as weekdays 1730-1945, 2330-0215, 0430-1030; Sundays and holidays 1830-0215, 0430-1030. Overseas Service as 0600-0700 *English* for Australia (YDC) and Malaya (YDB2); 0700-0800 Chinese for China (YDC) and Malaya (YDB2); 0800-0900 Arabic for Southeast Asia (YDC, YDB2); 0900-0930 Urdu for Pakistan (YDC) and Malaya (YDB2); 0930-1030 *English* for India-Pakistan (YDC) and West Coast USA (YDE); 1030-1100 Hindi for India (YDC) and Malaya (YDB2); 1030-1130 French for Indo-China (YDB3) and Malaya (YDB2); 1100-1200 Arabic for Middle East (YDF7, YDC); 1200-1300 French for Middle East and Europe (YDF7, YDC); 1300-1400 Dutch for Europe (YDF7, YDC); 1400-1500 *English* for Europe, New Zealand (YDF7, YDC).

* * *

Radio Club Notes

Japan—The Japanese Short-Wave Club, P.O. Box 29, Sendai, Japan, is now issuing a monthly house organ that is entirely in the *English* language. Editors are Kenro Wada and Akira Ogawa. Welcomes members from all over the world.

Sweden—QRA of Malmo Kortvagsklubb (The Malmo Short-Wave Club) is Fack 7026, Malmo 7, Sweden. This club's house organ, "Malmo DX-aren," is published in Swedish and *English*.

USA—The Universal Radio DX Club, 21446 Birch St., Hayward, Calif., observed its 19th anniversary when it issued its December 1 bulletin.

The amended by-laws and constitution of the Newark News Radio Club have been compiled in attractive booklet form by Peter J. McKenna, Albuquerque, New Mexico, vice-president, and the publication has been sent to all members of the club. James J. Hart, former short-wave editor for NNRC, headed up the By-Laws Committee. Your *ISW DEPARTMENT* editor recently was honored with a "Member of the Month" citation from NNRC.

* * *

This Month's Schedules

Afghanistan—*Radio Kabul*, 9.975, is noted weekdays around 1135-1150; on Sundays extends sessions with a listeners' request program to around 1215. Wishes to receive reception reports; hopes soon to put in two new high-powered transmitters; is trying to trace sources of QRM to present 9.975 channel. (Pearce, England) Reports may be sent to Director of English Programs, Kabul Radio, Post Box 24, Kabul City, Afghanistan, or to Edris Ali Shah, London Agent, Kabul Radio, 134, Fellows Road, London, N.W. 3, England. (ISWC, London) Kary, Pa., has received word from the London Agent that the station hopes to have "at least one 100-kw. transmitter" in use before long.

Albania—*Radio Tirana*, 7.852A, has strong signal ending broadcast in French, 0100, then closes down. (Pearce, England) Is heard in USA now with news 2345. (Stark, Texas, others) And is sometimes audible to fair during 1600 news. (Kary, Pa.)

Algeria—Radio Algerie has moved from 6.145 to 6.160 for Arabic transmissions; heard sometimes to around 1800. (Kary, Pa., others) Niblack, Ind., notes the 9.57 outlet 1730-1800 with French session.

Andorra—Radio Andorra, 5.990, noted 1730 when identified in Spanish. (Croston, Pa.)

Anglo-Egyptian Sudan—*Radio Omdurman* sent schedule as Arabic 2315-

(*Continued on page 82*)

(Note: Unless otherwise indicated, all time is expressed in American EST; add 5 hours for GCT. "News" refers to newscasts in the English language. In order to avoid confusion, the 24 hour clock has been used in designating the times of broadcasts. The hours from midnight until noon are shown as 0000 to 1200 while from 1 p.m. to midnight are shown as 1300 to 2400.) The symbol "V" following a listed frequency indicates "varying." The station may operate either above or below the frequency given. "A" means frequency is approximate.

This young DX-er is Roland Engberg of Sweden. He is a contributor to the ISW DEPARTMENT and one of the "most valuable" contributors to "Radio Sweden's" DX program.

Fig. 1. Front cabinet view of home-built audio oscillator. The dial scale on author's unit is nonlinear in the interest of simplicity but may be made linear.

A low-cost AUDIO OSCILLATOR

By **C. R. GERBER**

This unit, housed in a 5" x 6" x 9" box, uses standard parts, covers 20 cps to 200 kc. in four ranges, and requires no re-calibration.

THE second instrument the average electronic experimenter finds necessary in his hobby (the first is a good v.t.v.m.) is usually a variable audio oscillator. The usefulness of a good audio oscillator is hard to overrate; it can be employed for tasks as mundane as determining frequency response; as expedient as code-practice signal, or variable b.f.o.; as unusual as determining the operating time or contact bounce of relays. Unfortunately, a really good oscillator costs money. Almost equally important for the apartment-dweller, it is large and difficult to store in the hall closet.

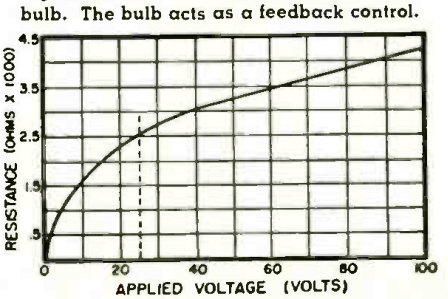
The desire being felt, and the major conditions known (lack of space, lack of money), the only way out was to design and build an oscillator with whatever could be begged, borrowed, or salvaged. Optimistically, it was to be the equivalent in performance of a certain well-known laboratory standard. Blissfully confident in what luck and sweat could do, a list of specifications was set up as follows: 1. Cost—as close to nothing as possible; 2. Size—to be housed in a 5 x 6 x 9 inch box; 3. Range—20 cps to 200 kc. in four decaded ranges; 4. Stability—zero drift under any conditions; 5. Distortion—zero; 6. Amplitude—constant; 7. Components—non-precision; and 8. Calibration—one-time only.

Despite the optimism, the resulting circuit to be described comes surprisingly close to the ideal. Two of these instruments were constructed initially and have been in operation for over a year; a third was recently breadboarded by a very critical engineer and checked by means of a CRO against a commercially-built oscillator guaranteed to have less than ½% harmonic distortion. There was no measurable distortion in the breadboard circuit. (This method of checking distortion will be described later for those interested.)

During the developmental period a number of different circuits were constructed and tested, including the heterodyne, the phase shift, the bridged-T, and the Wien bridge circuits. All of these have been described at one time or another in this magazine. Without discussing the "why's" and "why-not's," the circuit used was a modified Wien bridge, with a dual 10,000 ohm potentiometer as the variable element.

To anyone familiar with v.f.o.'s the previous sentence packs a whale of a lot of information. In the first place, textbooks and constructors alike frown on the dual or triple pot. as a frequency-varying element, principally citing the non-tracking characteristic of such pots., with variation with age and temperature running a close second. Let it be said once and for all that the non-tracking bugaboo is seriously overrated; in this circuit the resistances have been deliberately unbalanced by 5% with no change in amplitude or waveform, and only a slight shift in frequency.

Fig. 2. Characteristic of a 3-watt, 117-volt bulb. The bulb acts as a feedback control.



Since the device must be calibrated in any event, this is no drawback. This highly-touted warning is the result of trying to use high-resistance carbon pots.; use of a low resistance, wire-wound unit sidesteps this difficulty.

The small value of resistance adds one very important feature: stability. To tune the 20-200 cps range, 1.2 μfd. is needed. As many radio amateurs know, the stability of an *LC*-tuned circuit is inversely proportional to the *LC* ratio, for condensers are by nature more stable elements than coils. The situation is precisely similar for *RC* nets. Most commercial oscillators for the audio ranges use *RC* nets for the tuning element, employing 4-gang variable condensers. Hence, it may be observed that the frequency shifts when the hand is brought near the dial, unless the instrument is unusually well shielded. The circuit being discussed is so stable that a finger may be placed on the oscillating grid without disturbing the frequency.

Also in the key statement lies the limitations of this circuit; use of a linear pot. as the variable element means a very nonlinear dial calibration. There are two electrical methods known to the author to minimize this, and one mechanical makeshift which will not be discussed. Neither method was employed in the initial instrument, and it has operated so satisfactorily that no effort has been made to alter the circuit.

Theoretically, the limiting high frequency of this circuit occurs when the inductive reactance of the pot. becomes an appreciable fraction of the total impedance; practically, however, extreme care is required to reach 2.0 mc., with 200 kc. as an easily obtained value. Above this frequency the am-

plitude falls off due to the increasing shunting effect of tube and wiring capacitance. With the tubes and circuit constants indicated, 1.0 mc. represented the upper limit, and the completed unit was not extended beyond 200 kc.

The circuit and component values are shown in Fig. 3. Figs. 5 and 6 show top and bottom views of the completed unit without the case to indicate the parts layout. The tuned-circuit condensers are in the shielded box at the rear of the chassis. The layout is not critical unless the extreme range of frequency is desired. Likewise, none of the components are precision. However, if single-dial calibration is desired, the condensers must be hand-picked. Don't let this discourage you; when constructing the two original units selection was made from standard-value condensers. Five each of the 1.0, 2.0, and 5.0 values from 100 μμfd. to 1.0 μfd. were obtained and measured on a capacitance bridge. Two sets of decaded pairs, matched within ½% in pairs and 1% in decades were assembled. An illustration of the method follows:

Nominal:	1.000	0.200	0.010
Measured:	1.012	0.220	0.0115
	1.004	0.217	0.0110
	0.982	0.195	0.0102
	0.980	0.191	0.0096
	0.977	0.188	0.0089

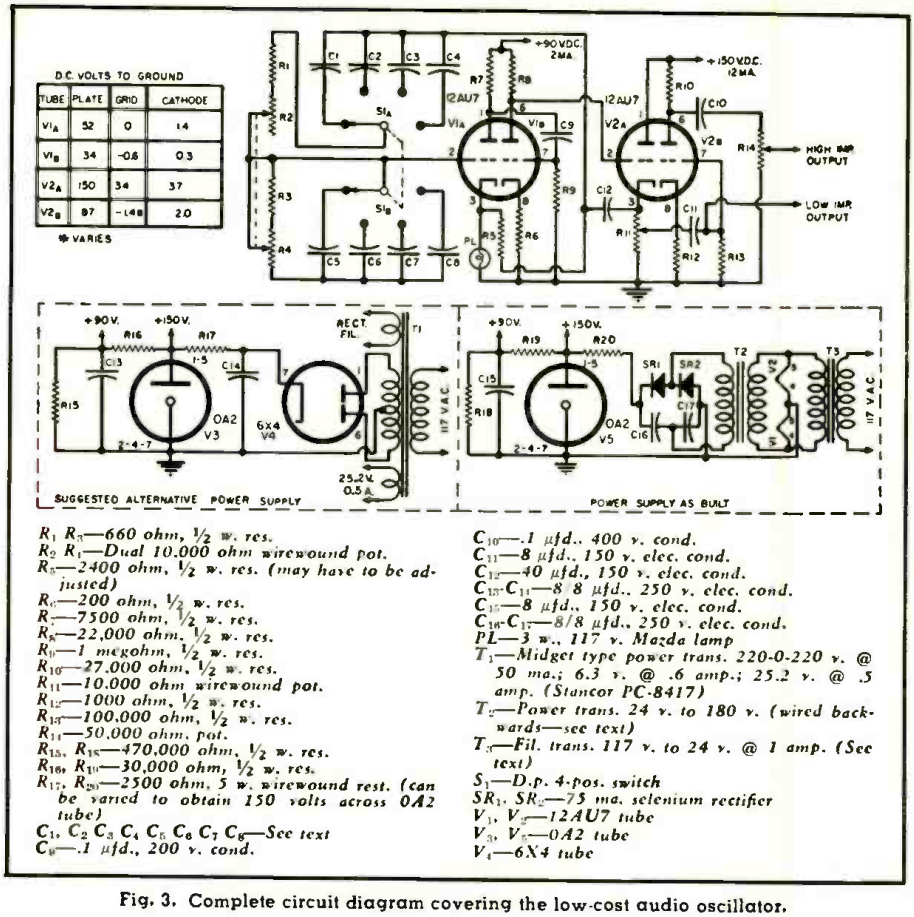
These values were from a random selection of five as taken from stock; note that the measured values are both above and below the nominal value, and vary as much as 20% from the nominal value.

For a 10,000 ohm pot., and a dial of exactly 180 degrees rotation, 6666 ohms is the maximum resistance to be used, corresponding to 20 cps. The necessary value of capacitance is then 1.200 μfd. Therefore two 1.200 μfd. condensers must be assembled. Examining the list, the following possible combinations will work:

A	B	C	D	E
1.012	1.004	0.982	0.980	0.977
0.188	0.195	0.217	0.220	0.220
1.200	1.199	1.199	1.200	1.197

Of these, *A* and *D* are the obvious choice, with *B* and *C* as second choice. However, *A* and *B* could be used together with only 0.1% unbalance, and even the worst case of *A* and *E* would result in only 0.3% unbalance—which is notably better than the 1% to be expected from precision condensers costing five times as much. The other decade values are built up in the same manner, always trying for the best balance between pairs, and accurate decading. Usually such balance can be obtained with two condensers each, as demonstrated, although in some cases a third may be necessary. If more than three are required, try some other combination.

Now this is work, but mainly paper work, juggling the measured values until the desired precision is attained. A capacitance bridge such as the *General Radio* capacitance bridge is a necessity, and the use of one can usually be obtained from a local firm, technical school, or university. A total of sixty



R_1 R_3—660 ohm, ½ w. res.
R_2 R_4—Dual 10,000 ohm wirewound pot.
R_5—2400 ohm, ½ w. res. (may have to be adjusted)
R_6—200 ohm, ½ w. res.
R_7—7500 ohm, ½ w. res.
R_8—22,000 ohm, ½ w. res.
R_9—1 megohm, ½ w. res.
R_{10}—27,000 ohm, ½ w. res.
R_{11}—10,000 ohm wirewound pot.
R_{12}—1000 ohm, ½ w. res.
R_{13}—100,000 ohm, ½ w. res.
R_{14}—50,000 ohm, pot.
R_{15}, R_{16}—470,000 ohm, ½ w. res.
R_{18}, R_{19}—30,000 ohm, ½ w. res.
R_{17}, R_{20}—2500 ohm, 5 w. wirewound rest. (can be varied to obtain 150 volts across 0A2 tube)
C_1, C_2 C_3 C_4 C_5 C_6 C_7 C_8—See text
C_9—.1 μfd., 200 v. cond.
C_{10}—.1 μfd., 400 v. cond.
C_{11}—8 μfd., 150 v. elec. cond.
C_{12}—40 μfd., 150 v. elec. cond.
C_{13}-C_{14}—8 8 μfd., 250 v. elec. cond.
C_{15}—8 μfd., 150 v. elec. cond.
C_{16}-C_{17}—8/8 μfd., 250 v. elec. cond.
PL—3 w., 117 v. Mazda lamp
T_1—Midget type power trans. 220-0-220 v. @ 50 ma.; 6.3 v. @ .6 amp.; 25.2 v. @ .5 amp. (Stancor PC-8417)
T_2—Power trans. 24 v. to 180 v. (wired backwards—see text)
T_3—Fil. trans. 117 v. to 24 v. @ 1 amp. (See text)
S_1—D.p. 4-pos. switch
SR_1, SR_2—75 ma. selenium rectifier
V_1, V_2—12AU7 tube
V_3, V_5—0A2 tube
V_4—6X4 tube

Fig. 3. Complete circuit diagram covering the low-cost audio oscillator.

condensers of standard values is still considerably less expensive than precision components, and those not selected can be used in other applications less stringent in their requirements.

The basic value of capacitance (1.2 μfd. in the previous example) is set by the maximum resistance and the dial angle desired. In the original model, 1.2 μfd. was the basic value since 180-degree coverage was desired, using a 10,000 ohm pot. The potentiometer winding covered 300 degrees; 180 degrees corresponds to 6000 ohms. Since this is the maximum resistance of the pot. that will be used, it corresponds, in turn, to 20 cps. With zero pot. resistance, the dial will have covered 180 degrees, and this must correspond to 200 cps. Of course for 200 cps and a 1.2 μfd. condenser, the resistance must be 600 ohms. This must be a fixed resistor in series with the potentiometer. The total resistance for 180-degree rotation will then be 6000 plus 600, or 6600 ohms. This, in turn, makes the fixed resistor value 660 ohms—this see-saw could be continued as far as desired. To a reasonable percentage of accuracy, the fixed resistor should be 666 ohms, and 6666 ohms as the total resistance at 180-degree rotation. The value of capacitance is then found to be 1.2 μfd., which has a reactance of 6660 ohms at 20 cps.

It should be pointed out that it is not necessary to use this exact value of capacitance if a dial angle of slightly more or less than 180 degrees is permissible, nor if the decaded frequency can be other than 20 cps. In fact, the second unit constructed was based on a 18 cps decade, since of the original five sets of condensers a second matched pair of 1.200 μfd. could not be constructed easily after the first pair has been removed. The basic value of capacitance for this oscillator was 1.34 μfd. Also, the linear pot. is not necessary; in fact a nonlinear pot. would be an advantage in rectifying the dial spacing. Finally, the 10 to 1 decading is not essential; a 3-to-1 span would be considerably better as far as dial spacing is concerned. This means twice as many condensers and switch points, but the added cost is small if the nonlinear dial is a particular disadvantage. The method outlined can be applied just as easily with these modifications in the design. The purpose of this article is not so much to describe one particular design as to outline methods of designing an oscillator to fit the user's individual needs and desires.

The extreme stability afforded by a low-impedance tuning circuit has an attendant disadvantage. A glance at the circuit shows a two-stage *RC*-coupled amplifier with connecting positive and negative feedback loops. The difficulty appears when trying to couple the low-impedance positive feedback circuit to the plate of the second tube. The low-impedance value is bad enough, although this may be overcome by proper design; however, adding a 10 to 1 variation in impedance (frequency) causes an amplitude

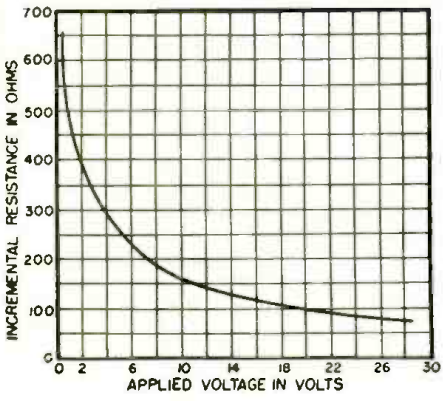


Fig. 4. Curve showing incremental resistance which governs action of the 3-watt lamp.

variation of 20 db. Without a complex circuit addition, it is impossible to hold the oscillator output even reasonably constant. The amplitude-constant feature is the function of the 3-watt lamp in the cathode circuit of the first tube, representing a variable resistive element. But it will perform this function over a very limited range of voltage—more like 3 db than 20 db. Therefore a means had to be developed to keep the oscillator output reasonably constant *before* the feedback lamp added its correction. The means developed makes the oscillator a usable instrument, and adds a second feature of a low impedance output with no extra complexity. The means referred to is the insertion of a cathode-follower after stage two, taking the feedback loops around the cathode follower, stage three. At the same time the cathode resistance of this stage is made a potentiometer, the arm of which is the low-impedance output tap (approximately 500 ohms) and also acts as a vernier control for stage four. The last stage is merely an amplifier, and serves no other function. The output from the low impedance tap is 3.0 volts r.m.s., maximum; over 20 volts r.m.s. is available at the high impedance output, with an impedance of approximately 25,000 ohms.

The cathode follower, with an output impedance of less than 500 ohms, will allow a load variation (the tuned circuit) of from $R_L = \infty$ to $R_L = 500$ ohms before the amplitude decreases to ½, which is 6 db, voltage-wise. The feedback lamp can now handle the remaining correction; amplitude is constant ± 2 db, from 20 cps to 200 kc.

The tubes used require no selection—in fact, almost any triode will operate as the oscillator—a 12AU7 is specified, but a 12AX7 may be used with a slight change in the feedback resistance. To take advantage of the amplitude stability of this circuit, a regulated power supply is desirable, most easily accomplished with a VR tube. The current drain is surprisingly low, so that the oscillator may not need a separate power supply. However, for those who desire a self-contained unit, two circuits are suggested in Fig. 3. The first employs a 6X4 tube, plus transformer and filter. The second is more compact, being a full-wave voltage doubler with double transformer isolation from the line. Two 6, 12, or 24 volt transformers are operated with the low-voltage windings interconnected, the two 12-volt tube filaments being appropriately connected. The "B" voltage is derived from the high-voltage side of the reversed transformer. This arrangement permits grounding one side of the "B" supply, and provides very effective shielding from spurious noise voltages generated on the 117-volt power line, as well as keeping the oscillator signal off the line. Although this point is seldom mentioned by most authors, it is surprising how an audio signal can ooze its way along the power line to some other device operated on the same branch.

Transformers T_2 and T_3 used in the actual construction of the oscillator were specially-built units that were on hand. As far as it was possible to determine, there are no direct replacements for these units. For transformer T_3 the commercial unit which comes the closest to meeting the specifications is the *Stancor* P-6169. Its rating is 117 volts primary to 25.2 volts @ 1 amp. secondary. This is slightly higher than the 24 volts desired but can be used directly without difficulty.

Transformer T_2 is not replaceable. If you are in a position to do so, you could have the transformer built to your specifications. It is possible, however, by removing turns, to use the same transformer as is used for T_3. In reworking this transformer, remove a sufficient number of turns from the low-voltage winding until the required 180 volts are obtained across the high-voltage winding. When checking this voltage, it is advisable to connect the transformer in the circuit as shown in Fig. 3. This removal of turns requires some skill and, in the event that the transformer used is not conservatively rated, may cause overheating.

Because of this "custom" aspect, it is recommended that the alternative

(*Continued on page* 123)

Fig. 5. Top chassis view of the home-built audio oscillator.

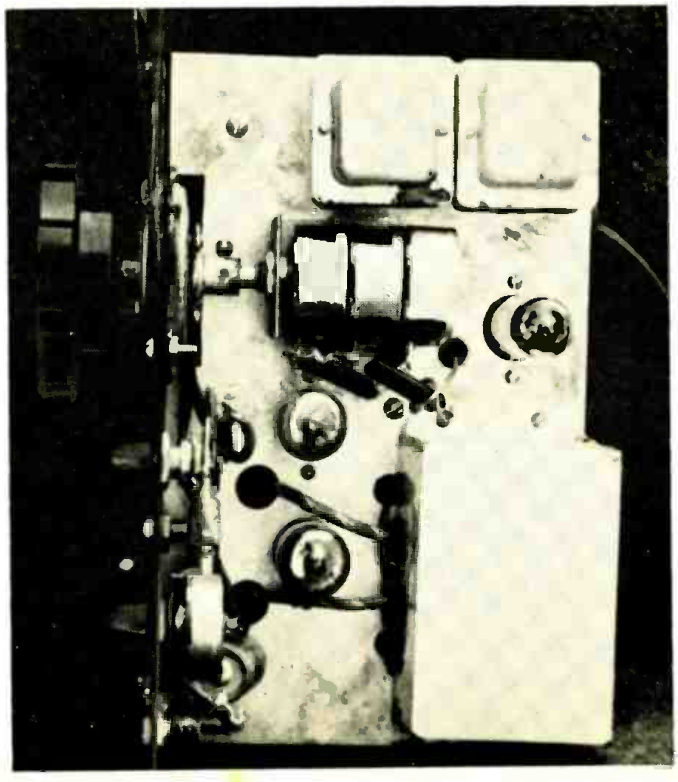
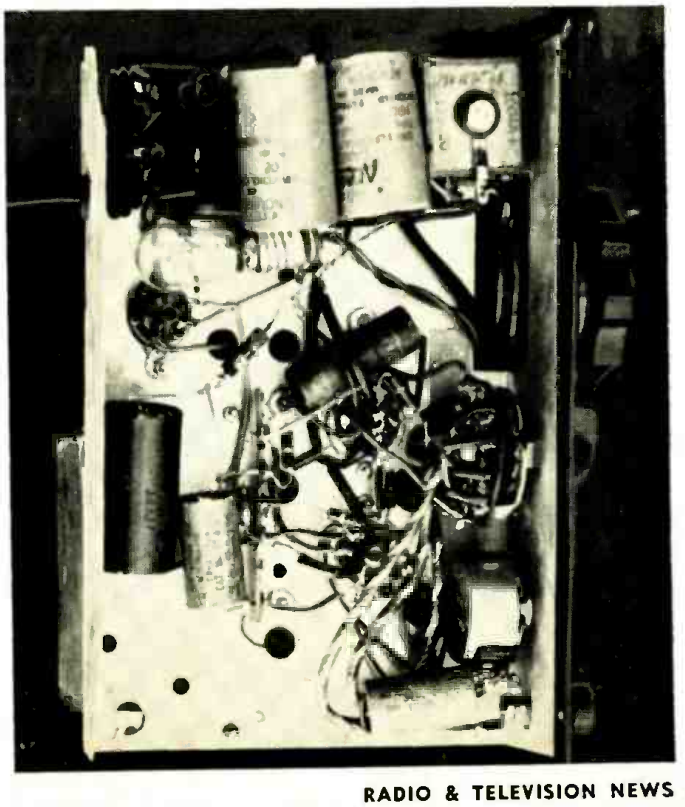


Fig. 6. Bottom view of unit showing layout of component parts.



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25-WATT UTILITY UNIT

By

GEORGE ANGLADO

Details on a versatile ham item that can be used as a crystal oscillator, straight amplifier, or a doubler.

HERE'S a neat little unit that the author built about two years ago which is still giving good service. The unit can be used as a 20-watt crystal oscillator on 160, 80, or 40 meters or it can be used as a 25-watt straight amplifier on any amateur band from 10 to 160 meters, or it may be used as a 20-watt frequency doubler on any band from 10 to 80 meters.

When used as an amplifier, the unit may be either link-coupled or capacity-coupled to the exciter tank. When used as a crystal oscillator, the crystal is plugged into the two socket holes as indicated in Fig. 1. The same two connections are used when the unit is capacity-coupled. The coils incorporate a jumper so that when one is plugged into the grid socket the tuning condenser (the 100 μμfd. midget) is cut into the circuit.

We have used ready-made plug-in coils of the 50-watt, end-link type and have added the jumper to these units. Duplicate coils are not required for the grid and plate as the plate tank makes use of the coil designated by the manufacturer as being usable on the next higher frequency band (except on 10 meters). This provides a higher value of "*Q*" in a single-ended plate tank circuit. On 10 meters a "10-meter" coil is used in the plate circuit since a "5-meter" coil requires an excessive amount of capacity to hit 10 meters. For operation on all bands from 10 to 160 meters, two 10-meter coils would be required but only one coil is required for each of the lower frequency bands.

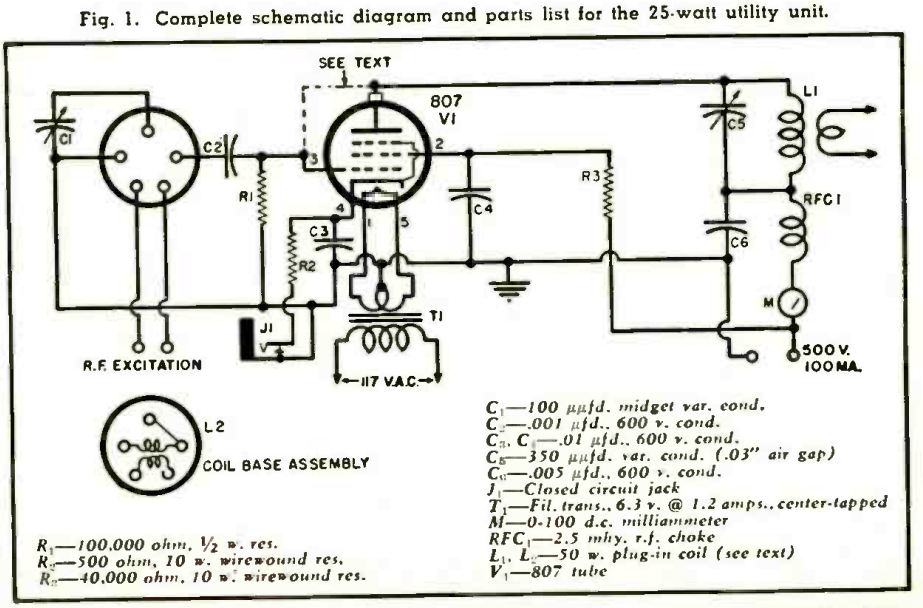
Because of the small diameter of the coils, coupling can be kept to a minimum by spacing them far enough apart. Electrostatic coupling between the grid and plate circuits is prevented by a shield baffle which supports the 807 socket.

When the unit is used as a crystal oscillator there is not sufficient feedback to support oscillation except, possibly, on 40 meters. Thus when the unit is to be employed as an oscillator a small piece of wire must be tied to the grid prong of the 807 and run over the shield partition toward the top of the 807 for a distance of about 3 inches. More feedback coupling than that required to support stable oscillations should not be used on any band since excessive feedback capacity will result in a high value of r.f. crystal current.

Sufficient cathode bias is provided to limit the plate current to a safe value when no excitation is applied. This permits the unit to be used as an r.f. amplifier after a keyed oscillator or v.f.o.

The unit can be plate-screen modulated with excellent results. The only requirement is that there be sufficient excitation and that the 807 is not too heavily loaded. This latter restriction applies particularly when modulating the unit as a frequency doubler. —30—

Fig. 1. Complete schematic diagram and parts list for the 25-watt utility unit.



C_1—100 μμfd. midget var. cond.
C_2—.001 μfd., 600 v. cond.
C_3, C_4—.01 μfd., 600 v. cond.
C_5—350 μμfd. var. cond. (.03" air gap)
C_6—.005 μfd., 600 v. cond.
J_1—Closed circuit jack
T_1—Fil. trans., 6.3 v. @ 1.2 amps., center-tapped
M—0-100 d.c. milliammeter
RFC_1—2.5 mhy. r.f. choke
L_1, L_2—50 w. plug-in coil (see text)
V_1—807 tube

R_1—100,000 ohm, ½ w. res.
R_2—500 ohm, 10 w. wirewound res.
R_3—40,000 ohm, 10 w. wirewound res.

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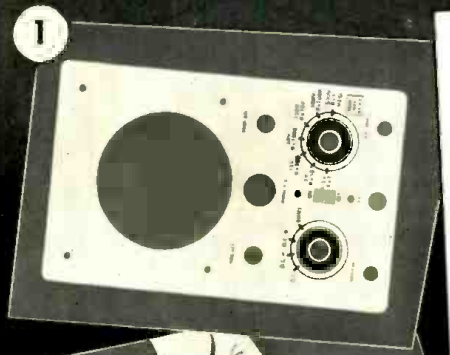

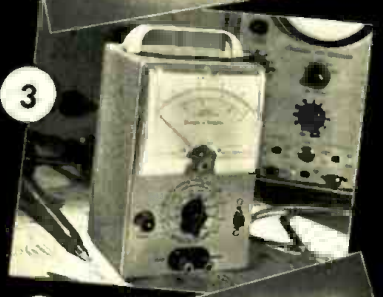

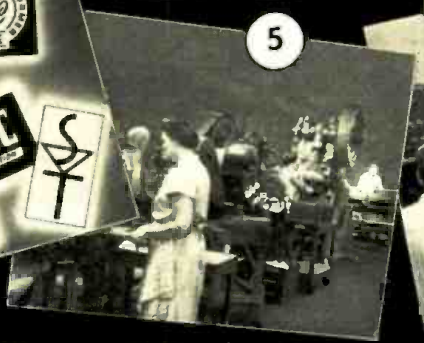

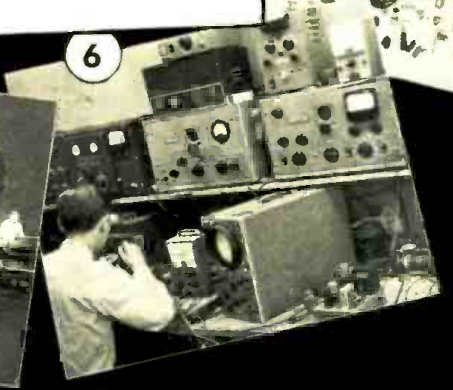

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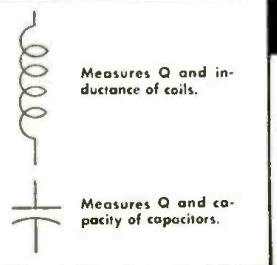

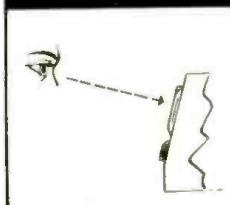
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The entire kit consists of 12AT7, 6AL5, 6C4, OD3 and 6X5 tubes. 50 microampere Simpson meter, power transformer, cabinet and all other parts necessary for construction as well as instructions for assembling, testing and operation of the completed instrument.

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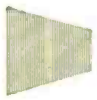

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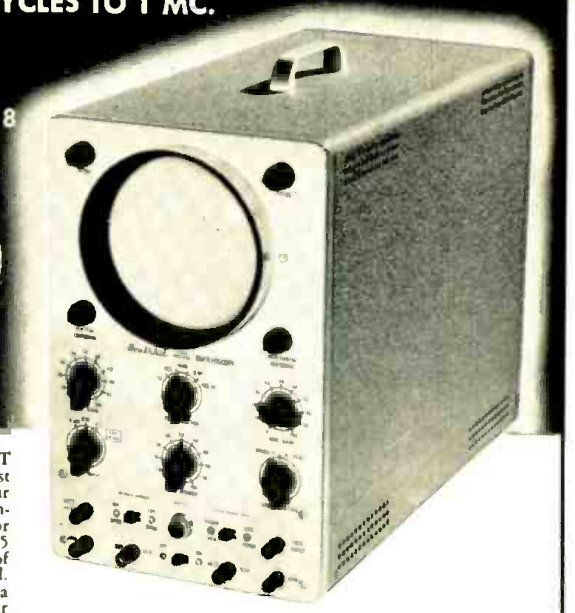
MODEL O-8

SHIPPING WT. 29 LBS.

$43.50



- New wider band vertical amplifier ± 2 db from 10 cycles to 1 megacycle useful to over 5 megacycles.
- High sensitivity in vertical amplifier. .025 volts RMS per inch deflection.
- New 3 step input attenuator input ranges X1, X10, X100.
- New 5CP1 intensifier type tube for greater brilliance.
- Terminal board and rear cabinet opening provisions for direct connections to deflecting plates.
- Newly styled formed and ventilated aluminum cabinet.
- Wide band sweep generator, 15 cycles to over 100 kc. Will synchronize with 5 megacycle signal.
- 10 tube circuit featuring push pull operation of vertical and horizontal amplifiers.
- Internal synchronization on either positive or negative peaks.
- Reproduces faithfully the front and back porches of TV sync pulses. Excellent square wave reproduction to over 100 kc.
- Optional Intensifier kit available for 2200 volt operation.

Proudly announcing the new 1953 HEATHKIT Model O-8 OSCILLOSCOPE featuring the finest performance ever offered in this extremely popular kit instrument. Improved wider band vertical amplifier featuring a new 3-step input attenuator affording smooth control of the excellent .025 volts per inch vertical sensitivity. Possibility of overloading the vertical input circuit is minimized. Greater band width in the vertical channel is a decided advantage to TV service men. Permits clear observation of all TV sync pulse detail and excellent square wave reproduction over 100 kc. 5CP1 intensifier type CR tube provides a brilliant trace with normal accelerating voltages. A handsome, ventilated cabinet with smooth rounded corners and a snug fitting drawn panel adds to the smartly styled professional appearance. Longer life is assured through cooler instrument operation. Push pull output stages in both vertical and horizontal amplifiers for balanced deflection of the spot. All of the many fine features of the previous model have been retained. Rear cabinet access to terminal board for direct connection to CR plates. The entire kit of all 10 tubes, parts, cabinet and panel as well as detailed construction manual for assembly and operation of the instrument included.

INTENSIFIER KIT: For extreme trace brilliance in special applications such as photography, group demonstrations or operation in brightly lighted areas an optional Intensifier kit providing 2200 volt operation of the CR tube is available. Kit includes high voltage filter condenser, high voltage selenium rectifier, etc. $7.50.

Heathkit SCOPE DEMODULATOR PROBE KIT

Trouble shooting or aligning TV, RF, IF and video stages requires demodulation of high frequency signals before Oscilloscope observation. The HEATHKIT SCOPE DEMODULATOR PROBE KIT was specifically developed for this application. Kit consists of a probe housing, crystal diode detector circuit, shielded cable and spade lugs. Assembly is simple and the probe will quickly prove its usefulness as an Oscilloscope accessory.

No. 337
SHIP. WT. 1 LB.
$4.50

NEW *Heathkit* VOLTAGE CALIBRATOR KIT

MODEL VC-1
SHIPPING WT. 5 LBS.
$9.50

Use the Heathkit Voltage Calibrator with your oscilloscope to measure peak-to-peak TV complex waveshapes. TV manufacturer's specifications indicate correct peak-to-peak voltages and this kit will permit making these important measurements.

A big help to engineers in circuit work. Makes peak-to-peak voltage measurements of complex waveshapes of all kinds. Flat topped semi-square wave output of calibrator assures fast and easy measurement of any voltage between .01 and 100V peak-to-peak.

The Voltage Calibrator can remain connected to your oscilloscope at all times for instant use. "Signal" position connects signal under study directly through calibrator and into scope input circuit for direct observation. Eliminates transfering leads from calibrator. *A wonderful scope accessory.*

Heathkit ELECTRONIC SWITCH KIT

A few dollars spent for this accessory will increase the usefulness of a scope immeasurably. An electronic switch will open up a whole new field of scope applications for you. The S-2 allows TWO SIGNALS to be observed at the SAME TIME — this important feature allows you to immediately spot phase shift, clipping, distortion, etc. The two signals under observation can be superimposed or separated for individual study. Each signal input has an individual gain control for properly adjusting scope trace patterns. Has both coarse and fine frequency controls for adjusting switching time. Multivibrator switching frequency is from less than 10 cps to over 2000 cps in three overlapping ranges. Kit comes complete including 5 tubes, power transformer, all controls, instruction manual, etc. *Every scope owner should have one!*

MODEL S-2
SHIPPING WT. 11 LBS.
$19.50

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. . . BENTON HARBOR 15, MICHIGAN

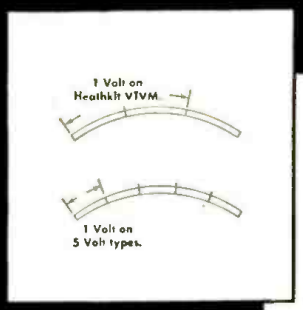
Heathkit VACUUM TUBE VOLTMETER KIT

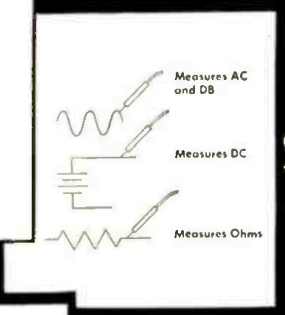
• NEW 1½ VOLT RANGE ON 1953 VTVM.

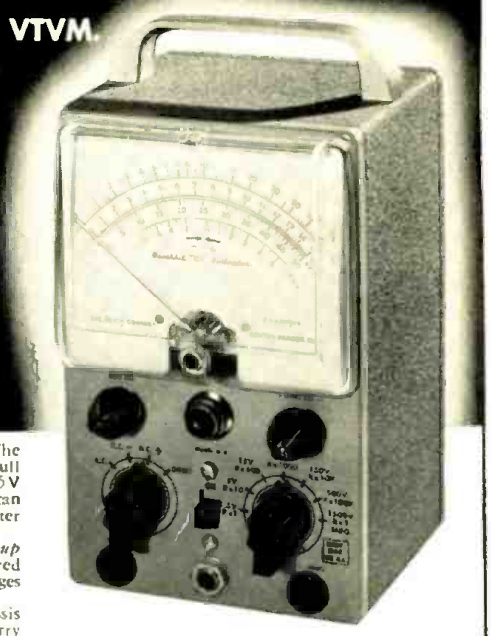
MODEL V-6

SHIPPING WT., 7 LBS.

$24.50







- New 1½ volt low range gives over 2" of scale per volt instead of less than ¾" found on 5 volt range type.
- Increased accuracy due to expanded scales.
- New 1500 volt DC high range gives 50% greater coverage.
- Seven ranges in all. 1½, 5, 15, 50, 150, 500 and 1500 volts DC (1000 volts maximum AC only).
- Provides proper service ranges 150 volts for AC DC work and 500 volts for AC type service.
- High input impedance, 11 megohms minimizes circuit loading.
- Variety of accessory probe kits available.
- 1% precision resistors in multiplier circuits.
- 200 microampere Simpson meter.
- Center scale zero adjust.
- Transformer operated.
- Test leads included.
- New cabinet styling.
- Large, clearly marked meter scales indicate ohms, AC volts, DC volts and DB.

The 1953 Heathkit V-6 VTVM has improved ranges! The lowest range has been moved way down to 1.5V full scale. This gives 3½" of actual scale length for the 1.5V covered — *that's 2⅓ inches per volt!!* Now you can make your low level measurements faster and with greater accuracy.

And the upper range has been moved up. *Readings up to 1500V DC* can be readily made with new, improved VTVM — plus readings up to 1000V on AC. Higher ranges for extended use.

New vertical chassis mounting gives added chassis space for really easy wiring — no tight corners to worry about. Uses only highest quality components throughout. Simpson 200 microampere meter movement combined with 1% precision resistors in multiplier circuit insure highly accurate and dependable readings.

AC and DC voltage ranges are 0-1.5V-5V-15V-50V-150V-500V-1500V. (1000V max. reading on AC) — a total of seven ranges for convenient, accurate readings. Instrument also measures resistance from .1 ohm to over 1 billion ohms in seven handy ranges of RX1, X10, X100, X1000, X10K, X1 Meg., — all convenient multiples of 10 with no skips. Has Db scale in red for easy indentification.

New panel has tough *baked on enamel finish* for freedom from scratches and maximum durability. Modern styled, formed, compact cabinet with rounded edges and crackle finish is truly handsome.

Comprehensive, detailed instruction manual with step-by-step instructions, figures, pictorials, etc. makes assembly a cinch.

Be sure and look over the special accessory VTVM probes below — for added usefulness.

Heathkit R. F. PROBE KIT

SHIP. WT 1 LBS. No. 309 **$5.50**

Extends RF range of HEATHKIT 11 megohm VTVM to 250 megacycles ± 10%.

Heathkit 30,000 V. D.C. PROBE KIT

SHIP. WT. 2 LBS. No. 336 **$5.50**

Provides DC multiplication factor of 100 for any 11 megohm VTVM.

Heathkit PEAK TO PEAK VOLTAGE PROBE KIT

SHIP. WT. 2 LBS. No. 338 **$6.50**

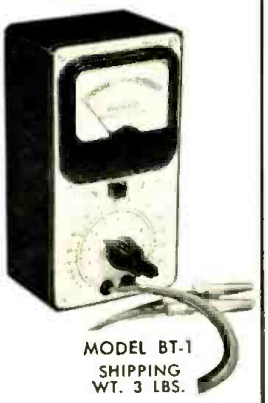
Reads on DC scale of any 11 megohm VTVM 5 kc to 5 megacycle range.

NEW Heathkit BATTERY TESTER KIT

The new Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three-color GOOD-WEAK-REPLACE scale that your customers can readily understand. Operation is extremely simple and merely requires that the leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for A or B battery types.

The Heathkit Battery Tester features compact assembly. An accurate meter movement and wire wound control mount in the portable, rugged plastic case.

Use the BT-1 to check portable radio batteries, hearing aid batteries, lantern batteries and photo flash gun batteries.

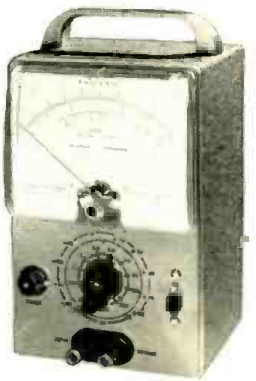


MODEL BT-1
SHIPPING WT. 3 LBS.

$7.50

Heathkit AC VACUUM TUBE VOLTMETER KIT

A new AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Ten full scale ranges of .01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts RMS. 10 DB ranges from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 kc. Simpson 200 microampere meter with large plainly marked meter scales. Precision multiplier resistors. Two amplifier stages using miniature tubes. A unique bridge rectifier meter circuit and a clean layout of parts. Order the AV-2 today and become acquainted with the interesting possibilities offered by this instrument.



MODEL AV-2
SHIPPING WT. 5 LBS.

$29.50

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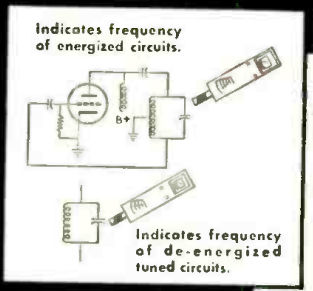
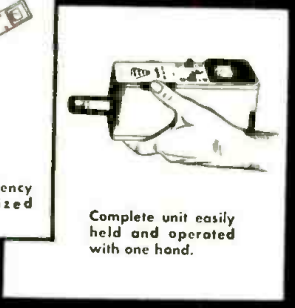
. . . BENTON HARBOR 15, MICHIGAN

NEW *Heathkit* GRID DIP METER KIT

• CONVENIENT ONE HAND OPERATION.





MODEL GD-1

SHIPPING WT. 4 LBS.

$19.50

- New GRID DIP METER with assembled calibrated coils.
- Uses quality Simpson 500 microampere meter.
- One hand operation, extremely compact. Only 2½" wide by 3" high by 7" long.
- Variable meter sensitivity control.
- Uses newest type 6AF4 high frequency triode in a Colpitts oscillator circuit.
- Continuous coverage from 2 megacycles to over 250 megacycles in 6 ranges.
- Head phone monitoring jack.
- AC power transformer operated for maximum safety.

Here is the GRID DIP METER KIT you have been asking for. This new HEATHKIT instrument is compact, highly sensitive and easy to use. Housed in a handsome formed aluminum cabinet—rounded corners—durable oven baked finish on panel and cabinet. The entire instrument can be easily held and operated in one hand, tuning accomplished with the thumb wheel drive. This excellent design feature leaves the other hand entirely free for making circuit adjustments. The instrument with many applications — with oscillator energized, use it for finding the resonant frequency of tuned circuits, locating parasitics, determining characteristics of filter circuits, roughly tuning transmitter stages with power off, and neutralizing transmitters. Useful in TV and radio repair work for alignment of traps, filters, IF stages, peaking and compensation networks within the 2 to 250 megacycle range. With the oscillator not energized, the instrument acts as an absorption wave meter and indicates the frequency of radiating power sources. Locates spurious oscillations, as a relative indication of power in various transmitter stages, etc. Phone jack permits monitoring of AM transmitter for determination of radiated hum, audio quality, etc. (Head phones not included). Complete kit includes plug-in coils, tube, all necessary parts and detailed assembly and instruction manual.

Heathkit IMPEDANCE BRIDGE KIT

MODEL IB-1B

SHIPPING WT. 15 LBS.

$69.50

The HEATHKIT IMPEDANCE BRIDGE is especially useful in educational training programs, industrial laboratories and for experimental work. Use it for measuring AC and DC resistance value of resistors, determination of condenser capacitance and dissipation factor, finding coil inductance and storage factor, electrical measurements work, etc. Quality components: GR 1000 cycle hummer, GR main control, Mallory ceramic wafer silver plated contact switches. ½% precision resistors, etc. The basic circuit is a self powered, 4 arm bridge. Choice of Wheatstone, Capacitance comparison, Maxwell or Hay bridge circuits. Resistance from 10 milliohm to 10 megohm. Capacitance 10 mmf to 100 mfd. Inductance 10 microhenry to 100 henries. Dissipation factor .002 to 1. Storage factor (Q) 1 to 1000. The IMPEDANCE BRIDGE has provisions for external generator use for measurement at other than the 1000 cycle level. Take the guess work out of electrical measurements. The HEATHKIT IMPEDANCE BRIDGE mounted in a beautiful polished birch cabinet with large easy reading panel calibrations will furnish years of accurate, trouble free measurement service.

Heathkit HANDITESTER KIT

The HEATHKIT Model M-1 HANDITESTER fulfills requirements for a portable volt ohm milliammeter. This kit features precision 1% resistors, 3 deck switch for trouble free mounting of parts, specially designed battery bracket, smooth acting ohms adjust control, beautiful molded bakelite case and a 400 microampere meter movement. 5 convenient AC and DC voltage ranges as follows: 10 - 30 - 300 - 1000 - 5000 volts. Ohms ranges 0 - 3000 and 0 - 300,000. DC milliampere ranges 0 - 10 milliamperes and 0 - 100 milliamperes. The instrument is easily assembled from complete instructions and pictorial diagrams. Test leads are included. Carry the HEATHKIT M-1 HANDITESTER in your tool box at all times for those simple jobs and eliminate that extra trip for additional testing equipment.

MODEL M-1

SHIPPING WT. 3 LBS.

$13.50

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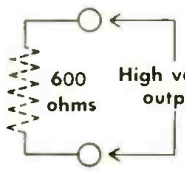
NEW Heathkit AUDIO GENERATOR KIT

• RANGE EXTENDED TO 1 MEGACYCLE

MODEL AG-8

SHIPPING WT. 16 LBS.

$29.50



Low impedance output
High voltage output

Sine wave output from 20 cycles to 1 megacycle.

- Improved design — new low price.
- Frequency coverage in five ranges from 20 cycles per second to 1 megacycle.
- Response flat 1 DB from 20 cycles to 400 kilocycles. Down 3 DB at 600 kilocycles. Down only 8 DB at 1 megacycle.
- Five calibrated output voltage ranges, continuously variable 1 mv, 10 mv, 100 mv, 1 v, 10 v.
- Low impedance output circuit. 600 ohms.
- Distortion less than .4 of 1% from 100 cycles per second through the audible range.
- New HEATHKIT universal type binding posts.
- Durable infra-red baked enamel panel.
- Transformer operated for safe operation.
- Sturdy, ventilated steel cabinet.

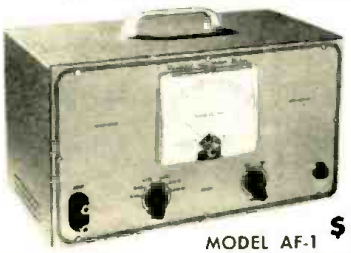
A new Audio Generator with features heretofore found in only the most expensive generators. Such features as complete coverage from 20 cycles to 1 Mc — response flat ±1 db from 20 cycles to 400 Kc, down 3 db at 600 Kc and down only 8 db at 1 Mc.

And it has calibrated output . . . Calibrated continuously variable and step attenuator output controls allow you to easily set calibrated output voltage. Moreover, distortion is less than .4 of 1% from 100 cps through the audible range.

Oscillator section consists of a two stage resistance coupled amplifier (6SJ7 and 6AK6) utilizing both positive and negative feedback for oscillator operation and reduction of distortion. Oscillator section drives a cathode follower output power amplifier (6AK6) which isolates the oscillator from variations in load and presents a low impedance output (600 Ohms). Power supply is transformer operated and utilizes 6X5 rectifier with 2 sections of RC filtering.

An unbeatable dollar value — for here is an audio generator with wide frequency coverage, excellent frequency response, stepped and continuously variable calibrated output, high signal level, low impedance output, and low inherent distortion.

Heathkit AUDIO FREQUENCY METER KIT



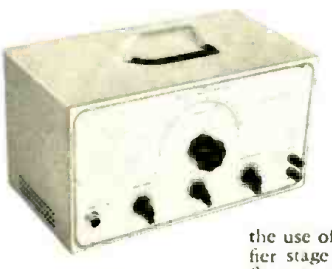
The HEATHKIT AUDIO FREQUENCY METER provides a simple and easy way to check unknown audio frequencies from 10 cycles to 100 kc between 3 and 300 volts RMS. The instrument features 7 ranges for accuracy and wide coverage. The meter itself has a quality 200 microampere Simpson movement and large clearly marked scales. The AUDIO FREQUENCY METER is transformer operated and features a voltage regulator tube to maintain constant plate voltage on the second stage. Kit supplied complete with all necessary construction material and a detailed construction manual.

MODEL AF-1

SHIPPING WT. 15 LBS.

$34.50

NEW Heathkit AUDIO OSCILLATOR KIT



A new Audio Oscillator with both sine and square wave coverage from 20 to 20,000 cycles . . . An instrument designed to completely fulfill the needs of the audio engineer and enthusiast — Has numerous advantages such as high level output (up to 10V obtainable across the entire range), distortion less than .6%, and low impedance output.

Special design features include the use of a thermistor in the second amplifier stage for keeping the output essentially flat across the entire range.

A cathode coupled clipper circuit produces good, clean, square waves with rise time of only 2 microseconds. Oscillator section uses 1% precision resistors in range multiplier circuit for greatest accuracy.

You'll like the operation of this fine new kit.

MODEL AO-1

SHIPPING WT. 14 LBS.

$24.50

Heathkit SQUARE WAVE GENERATOR KIT

The HEATHKIT SQUARE WAVE GENERATOR is an excellent square wave frequency source with wide range coverage from 10 cycles to 100 kc continuously variable. This feature makes it useful for TV and wide band amplifier work as well as audio experimentation. The output voltage is continuously variable between 0 and 20 volts. The circuitry consists of a multivibrator stage, a clipping and squaring stage and a cathode follower low impedance output stage. The power supply is transformer operated and utilizes a full wave rectifier circuit with two sections of filtering. Another excellent HEATHKIT value at this remarkable low price. Kit includes all necessary construction material as well as complete instruction manual for assembly and operation.

MODEL SQ-1

SHIPPING WT. 14 LBS.

$29.50

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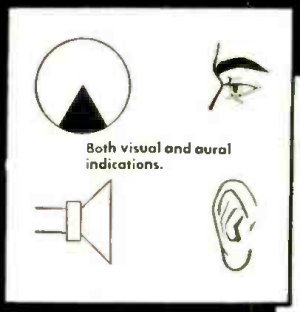
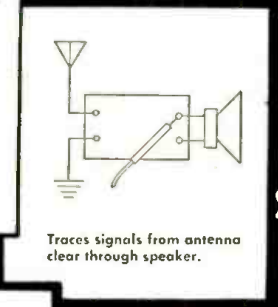
. . . BENTON HARBOR 15, MICHIGAN

NEW *Heathkit* VISUAL-AURAL SIGNAL TRACER KIT

• NEW NOISE LOCATOR AND WATTMETER CIRCUITS.



Both visual and aural indications.



Traces signals from antenna clear through speaker.

MODEL T-3

SHIPPING WT. 8 LBS.

$22.50

- Permits visual signal observation as well as aural operation.
- Two separate input channels.
- Tremendous RF channel sensitivity. Adequate for actual signal detection at receiver input.
- Separate high gain RF and low gain audio channels.
- A unique and useful noise locater circuit.
- Built-in calibrated wattmeter.
- Two separate shielded probes for RF and audio application.
- Additional test leads supplied.
- Substitution test speaker and output transformer eliminates necessity for speaker removal in service work.
- Utility amplifier. Check record changers, tuners, microphones, instrument pickups, etc.
- VTVM and Scope panel terminals.
- 5 tube transformer operated circuit.

The new HEATHKIT VISUAL AURAL SIGNAL TRACER represents one of the most convenient and useful instruments the service man can use in AM, FM and TV service work. The electron ray beam indicator constantly monitors both input channels for visual observation of the signal. Now, see and hear the signal level for easier estimation of signal strength and gain per stage in a receiver circuit. Separate high gain channel and special shielded demodulator probe for RF circuit work. Low gain channel for audio circuit investigation and for use as a noise locater. In this feature, approximately 200 volts DC is applied to a suspected circuit component and the action of the voltage in the component can be seen and heard to determine satisfactory operation. This feature alone will prove tremendously helpful in locating the source of objectionable noises in coils, transformers. resistors, condensers, cold solder joints, controls, etc. A convenient wattmeter permits rapid preliminary check for voltage distribution circuit breakdown as well as transformer failures. Use the T-3 as a universal test speaker and substitution transformer and save service time by eliminating the necessity for speaker removal on every service call. Additional service uses are: as a utility amplifier for checking the output of record changers, tuners, microphones, instrument pickups, etc. Separate panel terminals permit utilization of other shop equipment such as your Oscilloscope or VTVM. Entire kit supplied complete with 5 tubes. all necessary construction material along with a detailed step by step instruction manual for the assembly and operation of the instrument.

NEW *Heathkit* CONDENSER CHECKER KIT

MODEL C-3

SHIPPING WT. 7 LBS.

$19.50

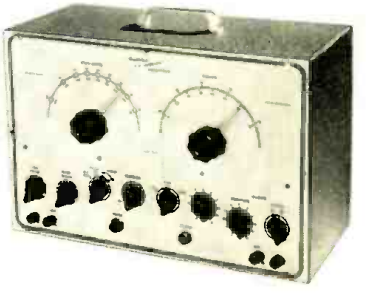
Announcing the new improved Model C-3 HEATHKIT CONDENSER housed in a new smartly styled professional appearing cabinet featuring rounded corners and snug fitting drawn panel. Adequate provisions for ventilation insures longer instrument life through cooler operation. Use the C-3 to accurately measure those unknown condenser and resistor values. All readings of condensers and resistors are read directly on the calibrated scales. Range of condenser measurements is from .00001 mfd to 1000 mfd. Calibrated resistance measurements can be made from 100 ohms to 5 megohms. A leakage test with a choice of 5 DC polarizing voltages will quickly indicate condenser operating quality under actual voltage load conditions. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard. An electron ray beam indicator tube is used in a new leakage test circuit for added sensitivity. The instrument is transformer operated for safety and will prove an extremely welcome addition to your shop equipment. The kit is furnished complete with all necessary parts, test leads and includes a step by step detailed construction manual for assembly and operation.

Heathkit TV ALIGNMENT GENERATOR KIT

MODEL TS-2

SHIPPING WT. 20 LBS.

$39.50



Here is an excellent TV ALIGNMENT GENERATOR designed to do TV service work quickly, easily and properly. The Model TS-2 when used in conjunction with an Oscilloscope provides a means of correctly aligning TV receivers. The instrument furnishes a frequency modulated signal covering in 2 bands the range of 10 to 90 megacycles and 150 to 230 megacycles. An absorption type frequency marker covers from 20 to 75 megacycles in 2 ranges: therefore you have a simple, convenient means of checking IF's independent of oscillator calibration. Sweep width is variable from 0 to 12 megacycles. Other excellent features are horizontal sweep voltage controlled with a phasing control — both step and continuously variable attentuation for setting the output signal to the desired level — a convenient stand by switch — and blanking for establishing a single trace with a base reference level. Make your work easier, save time and repair with confidence. Order your HEATHKIT TV ALIGNMENT GENERATOR now.

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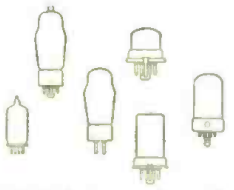
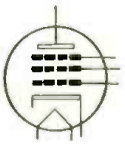
Heathkit TUBE CHECKER KIT



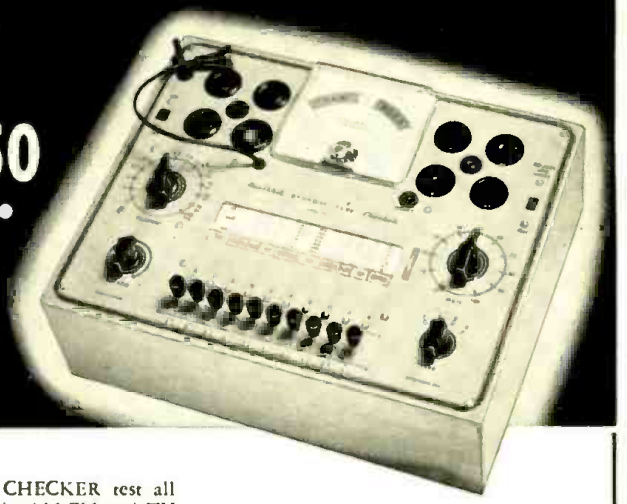
Checks 7, 8, 9 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, pilot lights.



Checks for opens, shorts, emission, filament and filament tap continuity.

MODEL TC-1
SHIPPING
WT. 12 LBS.

$29.50



- Beautiful counter type birch cabinet.
- 4½" Simpson 3 color meter.
- Simplified setup procedure.
- Built-in gear driven roll chart.
- Checks emission, shorted elements, open elements and continuity.
- Complete protection against obsolescence.
- Sockets for every modern tube.
- Blank for new types.
- Individual element switches.
- Contact type pilot light test socket.
- Line adjust control.

PORTABLE TUBE CHECKER KIT MODEL TC-1P

Same as TC-1 except supplied with polished birch cabinet (with removable lid) instead of counter type cabinet. Shipping weight 14 lbs. **$34.50**

No. 365 Polished Birch Tube Checker Cabinet only. Shipping Weight 7 lbs. **$7.50**

With the HEATHKIT TC-1 TUBE CHECKER test all types of tubes commonly encountered in AM-FM and TV receiver circuits. Test setup procedure is simplified, rapid and flexible. Tube quality is read directly on a beautiful 4½" Simpson three color BAD · ? · GOOD scale that your customers can readily understand. Panel sockets accommodate 4, 5, 6 and 7 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, a blank socket for new tubes and a contact type socket for quick checking of pilot lights. Built-in gear driven roll chart for instant reference. Neon short indicator, individual three position lever switch for each tube element, spring return test switch. line set control to compensate for supply voltage variations. At this low price, no service man need be without the advantages offered by the HEATHKIT TUBE CHECKER.

Heathkit TV PICTURE TUBE TEST ADAPTER

Use your HEATHKIT TUBE CHECKER with this new TV TEST ADAPTER to determine picture tube quality. Check for emission and shorts, independent of TV power supply. Consists of standard 12 pin TV tube socket, 4 feet of cable, octal socket connector and data sheet. Quickly prove TV picture tube condition to yourself and your customer.

No. 355
Ship. Wt. 1 lb.
$4.50

Heathkit RESISTANCE SUBSTITUTION BOX KIT

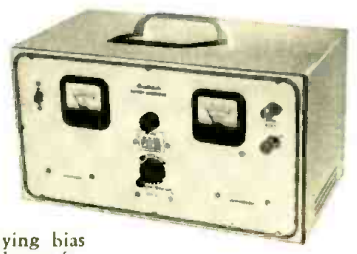
MODEL RS-1
SHIPPING
WT. 3 LBS.
$5.50

NEW HEATHKIT RESISTANCE SUBSTITUTION BOX KIT provides switch selection of any single one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 megohms. This coverage available in 2 ranges in decades of 15, 22, 33, 47, 68 and 100. Housed in rugged plastic cabinet featuring new HEATHKIT universal type binding posts. The entire kit priced less than the retail value of the resistors alone.

Heathkit BATTERY ELIMINATOR KIT

A clean 6 volt d-c supply source is definitely required for successful automobile radio servicing. Has a continuously variable d-c output from 0 to 8 volts. It can be safely operated at a steady 10 ampere level and will deliver up to 15 amperes for intermittent periods. The voltage output terminals are completely isolated from the chassis to accommodate additional service applications such as supplying bias voltages or d-c substitution voltages for battery operated tube filament circuits.

The output of the Battery Eliminator is constantly monitored by a d-c voltmeter and a d-c ammeter. The circuit features an automatic overload relay of self resetting type. For additional protection, a panel mounting fuse is provided. Build this kit in a few hours and pocket a substantial savings.



MODEL BE-3
SHIPPING
WT. 20 LBS.
$24.50

Heathkit VIBRATOR TESTER KIT

Repair time is valuable, and the Heathkit Vibrator Tester will save you hours of work. Instantly tells the condition of the vibrator under test — and the check is thorough and complete. Checks vibrator for proper starting, and the easy-to-read meter indicates the quality of output on large BAD-GOOD scales. Tests both interrupter and selfrectifier types of vibrators. Five different sockets for checking hundreds of vibrators.

Operates from any battery eliminator capable of delivering continuously variable voltage from 4 - 6V at 4 amps. The Heathkit BE-3 Battery Eliminator is ideal for operating this kit.

Faulty vibrators can be spotted within seconds and you're free to go on to other service jobs.

MODEL VT-1
SHIPPING
WT. 7 LBS.
$14.50

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Heathkit SIGNAL GENERATOR KIT

Modulated or unmodulated RF output.

400 cycle sine wave output.

MODEL SG-7

SHIPPING WT. 7 LBS.

$19.50

- Step attenuated RF ouput.
- 6 to 1 vernier dial ratio.
- Turret mounted coil sub-assembly.
- Pre-colibrated and adjusted coils.
- Hartley RF oscillator circuit.
- Colpitts oscillator 400 cycle sine wave output.
- Modulated or unmodulated RF output.
- Frequency coverage on fundamentals 160 kc to 5[illegible] negacycles in five ranges. 5[illegible] egacycles to 150 megacycl[illegible] on calibrated harmonics.
- RF output in excess of 100,000 microvolts.
- Audio output 1½ to 2 volts.
- AC transformer operated.
- Professionally styled cabinet.
- Infra red baked enamel panel.

The new HEATHKIT Model SG-7 SIGNAL GENERATOR easily fulfills requirements for a controllable, modulated or unmodulated source of variable frequency. A convenient 400 cycle sine wave output is available for audio work. All RF oscillator coils are precision wound and adjusted to calibration before shipment thereby assuring maximum accuracy. The coils, band switch and tuning condenser all mount as a turret assembly so as to offer the advantage of short wiring leads and easy mounting of parts. The RF output circuit is of the low impedance type obtained by the use of cathode coupling to the output jacks. The level of RF output is varied by means of the RF step and RF output control. Use the HEATHKIT SG-7 as an RF signal source modulated or unmodulated for radio repair, laboratory work, experimental testing, 400 cycle sine wave audio testing, checking RF stages, alignment of both AM and FM IF stages, marker generator for TV alignment, etc. The kit is transformer operated and utilizes miniature tubes for ease in handling high frequency. Panel jacks and a convenient switching system permit either external or internal modulation. The entire kit is supplied complete with tubes and all necessary material as well as a detailed step by step instruction manual for the assembly and operation of the instrument.

Heathkit INTERMODULATION ANALYZER KIT

MODEL IM-1

SHIPPING WT. 18 LBS.

$39.50

The HEATHKIT MODEL IM-1 is an extremely versatile instrument specifically designed for measuring the degree of interaction between two signals caused by a specific piece of apparatus, or a chain of equipment. It is primarily intended for tests of audio equipment but may be used in other applications such as making tests of microphones, records, recording equipment, phonograph pickups and loud speakers. Use it for checking tape or disc recordings, as a sensitive AC voltmeter, as a high pass noise meter for adjusting tape bias, cutting needle pitch or other applications. High and low test frequency source, intermodulation section, power supply and AC voltmeter all in one complete unit. Percent intermodulation is directly read on three calibrated ranges, 30%, 10% and 3% full scale. Both 4 to 1 and 1 to 1 ratios of low to high frequencies easily set up. At this low kit price YOU can enjoy the benefits of Intermodulation analysis for accurate audio interpretations.

Heathkit LABORATORY REGULATED POWER SUPPLY KIT

MODEL PS-2

SHIPPING WT. 20 LBS.

$29.50

New HEATHKIT LABORATORY POWER SUPPLY provides continuously variable regulated DC voltage output from 160 volts to 400 volts depending on load. Panel terminals supply separate 6.3 V. AC supply at 4 amperes for filament circuits. A 3½" plastic cased panel mounted meter provides accurate metered output for either voltage of current measurements. Exceptionally low ripple content of .012% admirably qualifies the HEATHKIT LABORATORY POWER SUPPLY for high gain audio applications. Ideal for laboratory work requiring a reference voltage for meter calibration or for plotting tube characteristics. In service work, it can be used as a separate variable voltage supply to determine the desirable operating voltage in a specific circuit. Use it as a DC substitution voltage in trouble shooting TV circuits exhibiting symptoms of extraneous undesirable components in plate supply circuits. Entire kit, including all 5 tubes now available at this low price.

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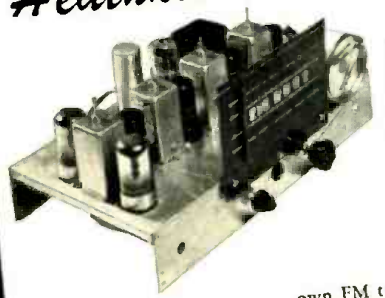
Heathkit WILLIAMSON TYPE AMPLIFIER KIT

The new HEATHKIT WILLIAMSON TYPE AMPLIFIER- incorporates the latest improvements described in Audio Engineering's "Gilding the Lily." 5881 output tubes and a new Peerless output transformer with additional primary taps afford peak power output of well over 20 watts. Frequency response ±1 db from 10 cycles to 100 kc. allows reproduction of highs and lows with equal crispness and clarity. Harmonic and intermodulation distortion have been reduced to less than ½ of 1% at 5 watts. This eliminates the harsh unpleasant qualities which contribute to listening fatigue. Make this amplifier the heart of your radio system to achieve the fine reproduction that is the goal of all music lovers.

The HEATHKIT PREAMPLIFIER (available separately or in combination with the amplifier kit) features inputs for magnetic or low level cartridges, crystal pickups and tuners, turnover control for LP or 78 type records, individual bass and treble tone controls each providing up to 15 DB of boost or attenuation. Special notched shafts on preamplifier controls and switches adaptable to custom installation. The preamplifier can be mounted in any position and a liberal length of connecting cable is supplied. No radio experience is required to construct this amplifier. All punching, forming, or drilling has already been done. The complete kit includes all necessary parts as well as a detailed step by step construction manual with pictorial diagrams to greatly simplify the construction.

ACROSOUND TRANSFORMER OPTION. If desired, the output transformer with the kit will be the Acrosound output transformer, type TO-300. The use of this transformer permits ultra-linear operation as described in Audio Engineering's "Ultra-Linear Operation of the Williamson Amplifier."

Heathkit FM TUNER KIT



MODEL FM-2

SHIPPING WT. 9 LBS.

$22.50

The HEATHKIT MODEL FM-2 TUNER specifically designed for simplified kit construction features a preassembled and adjusted tuning unit. Three double tuned IF transformers and a discriminator transformer are used in an 8 tube circuit. Smooth tuning is obtained through a 9 to 1 ratio vernier drive using a calibrated six inch slide rule type dial. The usual frequency coverage of 88 to 108 megacycles is provided. Experience the thrill of building your own FM tuner. Operate it through your amplifier or radio and enjoy all the advantages of true FM reception. Transformer operated power supply to simplify connections to all types of audio systems. The kit is supplied complete with all 8 tubes and necessary material required for construction. A complete instruction manual simplifies assembly and operation.

PRICES OF VARIOUS COMBINATIONS

W-2 Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. **$69.50**

W-2M Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only **$49.75**

W-3 Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. Shipped express only **$69.50**

W-3M Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only **$49.75**

WA-P1 Preamplifier Kit only. Shipping Weight 7 lbs. Shipped express or parcel post. **$19.75**

Heathkit ECONOMY 6 WATT AMPLIFIER KIT

MODEL A-7

SHIPPING WT. 10 LBS.

$14.50

The HEATHKIT Model A-7 amplifier features beam power, push pull output with frequency response flat ±1½DB from 20 to 20,000 cycles. Separate volume, bass and treble controls. Two input circuits, output impedances of 4, 8, and 15 ohms. Peak power output rated at full 6 watts. High quality components, simplified layout, attractive gray finished chassis, break off type adjustable length control shafts and attractive lettered control panel.

THE MODEL A7A amplifier incorporates a preamplifier stage with special compensated network to provide the necessary voltage gain for operation with variable reluctance or low output level phono cartridges. Excellent gain for microphone operation in a moderate powered sound system..... **$16.50**

Heathkit HIGH FIDELITY 20 WATT AMPLIFIER KIT

The HEATHKIT MODEL A-8 amplifier kit was designed to deliver high fidelity performance with adequate power output at moderate cost. The frequency response is within ± 1 DB from 20 to 20,000 cycles. Distortion at 3 DB below maximum power output at 1000 cycles is only .8%. The amplifier features a Chicago power transformer in a drawn steel case and a Peerless output transformer with output impedances of 4, 8, and 16 ohms available. Separate bass and treble tone controls permit wide range of tonal adjustment to meet the requirements of the most discerning listener. The amplifier uses a 6SJ7 voltage amplifier, a 6SN7 amplifier and phase splitter and two 6L6's in push pull output and a 5U4G rectifier. Two input jacks for either crystal or tuner operation. The kit includes all necessary material as well as a detailed step by step construction manual.

MODEL A-8

SHIPPING WT. 19 LBS.

$33.50

MODEL A8-A features an added 6SJ7 stage (preamplifier) for operating from a variable reluctance cartridge or other low output level phono pickups. Can also be used with a microphone. A 3 position panel switch affords the desired input service. **$35.50**

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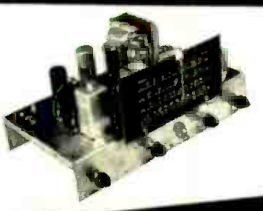
Heathkit SUPERHETERODYNE RECEIVER KITS

- High gain dual iron core tuned type IF transformers
- AC transformer operation for safety
- Continuously variable tone control
- Sturdy punched and plated steel chassis
- Ideal for custom installation
- Full AVC action
- Inverse feedback for improved frequency response
- Kit supplied with all necessary construction material except speaker and cabinet. (Available separately if desired).

6 tube all wave circuit. 3 ranges, continuous coverage 550 kc to over 20 megacycles, shipping wt. 11 lbs.

Model AR-1

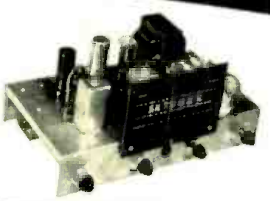
$23.50



5 tube broadcast band 550 to 1600 kc coverage, shipping wt. 11 lbs.

Model BR-1

$19.50



Two excellent radio receiver kits featuring clean design and open layout for simplified construction. Satisfy that urge to build your own radio receiver and select the model which meets your requirements. Both receivers feature continuously variable tone control, a radio phono switch and phono input and an AC receptacle for the phono moror. A six inch calibrated slide rule type dial with a 9 to 1 ratio vernier dial drive insures easy tuning.

SHIPPING INFORMATION

ON PARCEL POST ORDERS include postage for weight shown and insurance. (We insure all shipments.) Don't worry about sending more than the correct amount — if you send us too much, every extra cent will be promptly returned.

ON EXPRESS ORDERS do not include transportation charges. They will be collected by Express Agency on delivery.

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Orders processed on the same day received. Customers notified of unavoidable delay.

U. S. postal or express money orders, bank drafts or checks are acceptable. Do not send loose coins or stamps.

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QUANTITY	ITEM	PRICE	QUANTITY	ITEM	PRICE
	Heathkit Oscilloscope Kit—Model O-8 (29 lbs.)	$43.50		Heathkit Square Wave Gen. Kit—Model SQ-1 (14 lbs.)	$29.50
	Heathkit Intensifier Kit (O-8 only) No. 339 (1 lb.)	7.50		Heathkit AC VTVM Kit—Model AV-2 (5 lbs.)	29.50
	Heathkit Voltage Calibrator Kit—Model VC-1 (5 lbs.)	9.50		Heathkit Intermodulation Analyzer Kit—Model IM-1 (18 lbs.)	39.50
	Heathkit Electronic Switch Kit—Model S-2 (11 lbs.)	19.50		Heathkit Regulated Power Supply Kit—Model PS-2 (20 lbs.)	29.50
	Heathkit Scope Demodulator Probe Kit No. 337 (1 lb.)	4.50		Heathkit Handitester Kit—Model M-1 (3 lbs.)	13.50
	Heathkit T.V. Alignment Generator Kit—Model TS-2 (20 lbs.)	39.50		Heathkit Decade Resistance Kit—Model DR-1 (4 lbs.)	19.50
	Heathkit Q Meter Kit—Model QM-1 (12 lbs.)	39.50		Heathkit Decade Condenser Kit—Model DC-1 (4 lbs.)	16.50
	Heathkit Grid Dip Meter Kit—Model GD-1 (4 lbs.)	19.50		Heathkit Impedance Bridge Kit—Model IB-1B (15 lbs.)	69.50
	Heathkit VTVM Kit—Model V-6 (7 lbs.)	24.50		Heathkit Battery Tester Kit—Model BT-1 (3 lbs.)	7.50
	Heathkit RF Probe Kit No. 309 (1 lb.)	5.50		Heathkit Resistance Substitution Box Kit—Model RS-1 (3 lbs.)	5.50
	Heathkit HV Probe Kit No. 336 (2 lbs.)	5.50		Heathkit F.M. Tuner Kit—Model FM-2 (9 lbs.)	22.50
	Heathkit Peak-to-Peak Volt. Probe Kit No. 338 (2 lbs.)	6.50		Heathkit Broadcast Receiver Kit—Model BR-1 (11 lbs.)	19.50
	Heathkit Visual-Aural Signal Tracer Kit—Model T-3 (8 lbs.)	22.50		Heathkit Three Band Receiver Kit—Model AR-1 (11 lbs.)	23.50
	Heathkit Condenser Checker Kit—Model C-3 (7 lbs.)	19.50		Heathkit Amplifier Kit—Model A-7 (10 lbs.)	14.50
	Heathkit RF Signal Generator Kit—Model SG-7 (7 lbs.)	19.50		Heathkit Amplifier Kit—Model A-7A (10 lbs.)	16.50
	Heathkit Tube Checker Kit—Model TC-1 (12 lbs.)	29.50		Heathkit Amplifier Kit—Model A-8 (19 lbs.)	33.50
	Heathkit T.V. Tube Adapter No. 355 (1 lb.)	4.50		Heathkit Amplifier Kit—Model A-8A (19 lbs.)	35.50
	Heathkit Battery Eliminator Kit—Model BE-3 (20 lbs.)	24.50		Williamson Type Amplifier Kit (Type.) Shipped express only	
	Heathkit Vibrator Tester Kit—Model VT-1 (7 lbs.)	14.50		WA-P1 Preamplifier Kit (7 lbs.) (Shipped exp. or p.p.)	19.75
	Heathkit Audio Generator Kit—Model AG-8 (16 lbs.)	29.50			
	Heathkit Audio Oscillator Kit—Model AO-1 (14 lbs.)	24.50			
	Heathkit Audio Frequency Meter Kit—Model AF-1 (15 lbs.)	34.50			

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1953 TV Receivers

(*Continued from page 47*)

enough for the vertical multivibrator and the horizontal phase-detector type a.f.c.

The third unique design is illustrated in Fig. 3A. This is the high voltage portion of the new *G-E* Model S21T1-B and, at first glance, appears to be a HV tripler. If we analyze the circuit closely we find that V_2, a second 1X2A rectifier, is not really an active circuit element. The equivalent circuit in Fig. 3B shows that V_2 is only a resistance such as is commonly found in HV doubler circuits. Usually this resistance ranges between 2 and 6 megohms, and consists either of several carbon resistors in series or else of a special carbon film HV resistor. We know that a diode has a certain definite resistance R_p when current flows through it, and there is no reason why it could not be used in place of the regular fixed resistor. As a matter of fact, the diode resistance varies with the voltage across it. That is really the reason for its application here. Use of a HV diode greatly improves the regulation of the HV supply as more or less current is drawn. Assume for a moment that suddenly the picture on the screen gets brighter, resulting in increased current drain from the HV supply. This means that the voltage tends to drop both at V_1 and V_3. Naturally this also means a voltage drop across V_2. But when the voltage drops across this diode, its resistance increases substantially and the current through it is reduced. By reducing the current flowing through the bleeder resistance V_2 in Fig. 3B, the voltage available at V_3 is raised, counteracting the effect of the brighter picture on the screen. In actual practice the use of this diode really results in a substantial improvement of regulation and a more uniform focus and brightness on the screen. Keeping the anode voltage more constant also prevents blooming and the halo-effect often observed on some large screen picture tubes.

Some of the tubes listed here have made their appearance during the past year, but have only now found widespread acceptance and use. Detailed literature and performance data for each tube can be obtained from the manufacturers. Our purpose here is to give the reader an idea of each tube's use in the circuit and some indications as to the extent of its use. This will permit the service technician to recognize it in the set and also to get some idea as to how frequently he might encounter it in repairing new receivers.

6AH4GT: Octal, single triode, for vertical output amplifier. Used by *Sylvania, Philco, Zenith.*

6AQ7GT: Octal, duo-diode triode, horizontal a.f.c. circuit. Used by *Zenith.*

6AX4GT: Octal, diode, used as damper in autotransformer flyback circuits because of high cathode to filament breakdown voltage. Found in *Admiral, CBS-Columbia, Motorola, Packard-Bell, Philco, Zenith,* and others.

6BF5: 7-pin miniature pentode, used as video amplifier by *Sylvania.*

6BX7GT: Octal, dual triode used as vertical amplifier by *G-E.*

6BZ7: 9-pin dual triode, for r.f. cathode similar to 6BK7. Used by *Admiral, DuMont, Motorola.*

6U8: 9-pin triode-pentode combination. Often used as r.f. mixer and oscillator or else as video-audio i.f. amplifier. *Motorola* and *Zenith* are major users of this tube.

6X8: 9-pin triode pentode combination, similar to 6U8. Used as r.f. mixer and oscillator by *Westinghouse.*

6V3: 9-pin miniature diode with top cap for plate connection This tube is used as damper for autotransformer flyback circuits because of its high cathode-to-filament breakdown voltage. *Arvin, G-E, Philco, Sylvania,* and *Zenith* use it.

12AX4: Octal diode, same as the 6AX4 except for 12 volt filament. Used as damper by *Hallicrafters* and *Motorola.*

12BY7: 9-pin, pentode, used as video amplifier with G_m similar to 6AG7. *DuMont, Sylvania, Westinghouse,* and others use it.

12AZ7: 9-pin dual triode, used as r.f. mixer and oscillator by *Philco.* Similar electrically to 12AT7.

Conclusion

Although the new 1953 television receivers cannot boast of any radically new electrical development, many improvements in performance, economy and reliability of both circuits and components have been incorporated. New flyback transformers, simpler a.f.c. circuits and the new 40 mc. i.f. band are all further steps in reducing service troubles, eliminating instability, interference, and improving efficiency. While none of these innovations presents a new concept to the technician, it is still important to become familiar with the new circuits and components in order to service them correctly. Knowing new tube types helps in servicing, especially when regular tube manuals do not yet show these latest numbers. —30—

AUDIO TRADE-INS

OF interest to the audiophile is the establishment of a new firm, The Audio Exchange Inc., 159-19 Hillside Ave., Jamaica 32, N. Y., which has been set up specifically to provide an exchange service for all types of audio gear.

The enthusiast can now sell his old equipment at the same time he purchases the new components or system he desires.

The company has developed a market for the used-guaranteed equipment which is accepted in trade-in. The service will be operated on a nationwide basis. —30—

"WHY SHOULD I INSIST ON CBS-HYTRON?"

"YOU PROFIT MORE! HERE ARE 5 BIG REASONS WHY"

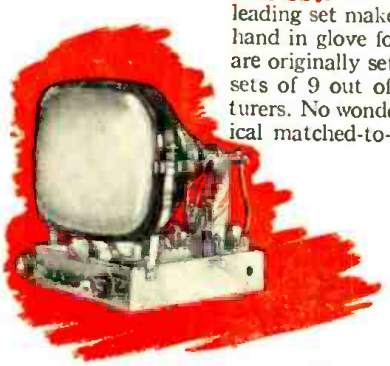
1. CBS-HYTRON IS *FAMOUS*... EASY TO SELL. The magic letters "CBS" are plugged for you on radio and TV station breaks... 102 BILLION times a year! CBS is known and respected by *all* your customers. CBS-Hytron is the profitable brand with endless sales assistance.

2. CBS-HYTRON *SPECIALIZES* IN RECEIVING TUBES. Since 1921, CBS-Hytron has concentrated on receiving types. Practice makes perfect. Put those years of know-how to work for you. Let time-proved CBS-Hytron dependability cut call-backs . . . make more money for you.

3. CBS-HYTRON *LEADS* IN TV TUBES. You know them. CBS-Hytron TV originals: 1AX2, 1X2A, 6BQ6GT, 12A4, 12B4, 12BH7, 12BY7, 12BZ7, 25BQ6GT, and the original rectangular 16RP4. Even CBS-Hytron standard TV tubes are designed-for-TV...tested-for-TV ...to give you peak performance and profit.

4. CBS-HYTRON IS *ULTRAMODERN.* CBS-Hytron is the tube of the future. Made in the world's most modern plants. On manufacturing equipment years ahead of the rest of the industry. CBS-Hytron advanced design and precision construction keep you always ahead. Give you tomorrow's trouble-free performance today.

5. CBS-HYTRON IS *MATCHED-TO-THE-SET.* Combined engineering skills of leading set makers and CBS-Hytron work hand in glove for you. CBS-Hytron tubes are originally set-engineered right into the sets of 9 out of 10 leading set manufacturers. No wonder CBS-Hytron is your logical matched-to-the-set replacement tube.



IT PAYS TO BE FUSSY! Just any standard brand won't do. If you want: Trouble-free, advanced performance. Maximum customer satisfaction. Minimum call-backs. More profit. Five big reasons point the way: Insist on CBS-Hytron!

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A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

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Germanium Diodes

Complete data yours for the asking. Write CBS-Hytron, DANVERS, MASS., today.

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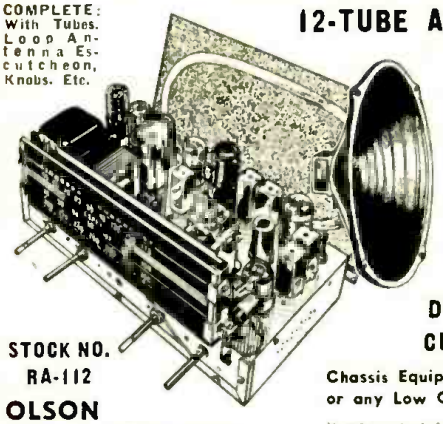
NEW LATEST 1953 MODEL ESPEY
12-TUBE AM-FM RADIO CHASSIS
COMPLETE WITH 12" MAGNAVOX SPEAKER

COMPLETE: With Tubes. Loop Antenna Escutcheon, Knobs. Etc.



LOOK HOW YOU SAVE

12" Magnavox Speaker . . $ 20.00
12 Tube AM-FM Chassis . 130.00

Regular List Price $150.00

DESIGNED FOR QUALITY CUSTOM INSTALLATIONS

Chassis Equipped with Built-In Pre-Amp for GE or any Low Output Variable Reluctance Pickup

STOCK NO. RA-112

OLSON SUPER BARGAIN!

BOTH FOR ONLY $66.66

Here's a deal for you! Don't pass it up. We got a terrific bargain by paying cash on the barrel-head. Olson passes it on to you. If we went out to duplicate this offer WE COULD NOT DO SO TODAY. Order Your Outfit Now!

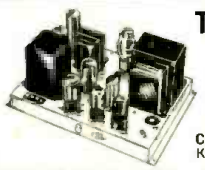
LOOK AT THESE FEATURES: You get a full size AM-FM Chassis including 12 tubes (4 are dual purpose, thus giving you the equivalent of 16-tube performance). Push-Pull Output Audio Stage delivers 10 Full Undistorted Watts. Improved FM Circuit, drift compensated. Built-in Automatic Volume Control. Inverse Feed-back. High-Fidelity assured on both AM and FM channels. Full Range Combination Bass-Treble Tone Control. Slide Rule Dial is indirectly illuminated. Equipped with 1.00-Antenna for AM and Folded Dipole Antenna for FM reception. Has provisions for external antennas too. Has Input Jack for both Crystal Cartridge Tone Arm or any Magnetic Low Voltage Cartridge. Also has Microphone Input for Public Address use. Fully licensed under both RCA and Hazeltine Patents.

Receives standard AM broadcast 550 to 1700 KC and FM 88 to 108 MC. The FM Circuit includes an aperiodic RF Amplifier Stage, 2 Stages of High-Gain Intermediate Frequency Amplification and an advanced design Ratio Detector Circuit which provides Low Noise Level between stations, freedom from AM interference, ease of tuning and ample gain.

High-Fidelity Reproduction is assured through well-engineered Circuits and the use of High Quality Parts throughout.

TUBE COMPLEMENT: 1—6BE6. 2—6BA6. 2—12AT7. 1—6SH7. 1—6AL5. 2—6SQ7. 2—6V6GT and 1—5Y3GT. Wide Frequency Response is assured by the Push-Pull Output Stage. Chassis size 13½" wide x 9" high x 9" deep. Complete with Tubes, Knobs, Front Escutcheon, Mounting Hardware and Full Size Layout Template. Operates on 115V AC 60 Cycle.

The 12" Magnavox FM Speaker is of the Highest Quality and is found in the most expensive Console Radios. You can depend upon it to render life-like tone when connected to the chassis. All metal parts are heavily cadmium plated. Full Size Heavy Alnico 5 Magnet is permanently centered. Cone is Full Frequency Construction and the Voice Coil is Fully Dustproofed both inside and out. A Rare Combination such as this AM-FM Chassis and Magnavox 12" PM Speaker is hard to find. Here is truly a generous offer. ORDER YOUR OUTFIT TODAY! Be the envy of everyone who hears the magnificent performance of Radio at its Best. Original Factory-Sealed Cartons. Shpg. wt. 25 lbs.



TECH-MASTER
New Williamson-Type Amplifier Kit

Stock No. AMP-12 COMPLETE KIT, ONLY $48.95 With Tubes

Full 15 Watts—Ultra Linear • Includes Altec Lansing Peerless Audio Transformer

Complete Kit of exact transformers, condensers, resistors, sockets, tubes, hardware, punched chassis—every part you need—as well as a full detailed wiring diagram. Utilizes the famous WILLIAMSON circuit for high fidelity reproduction. Only top quality parts are included—specially wound ALTEC LANSING Peerless Transformers, for instance, are employed. Easy to assemble.

SPECIFICATIONS: Output Impedance — 4-8-16 ohms. Input Impedance—High for crystal pickups, tuners, pre-amps, etc.; Response—8 cps to 80,000 cps — 1 db; 5 Tubes 12—6SN7, 2—5881, 1—5V4GG. 105-125V. 50-60 cycles 120 W. Size—9"x12"x 6½". Shpg. wt. 27 lbs.

TECH-MASTER 4 CHANNEL PRE-AMPLIFIER KIT

For Use with Williamson Amplifier

Stock No. AMP-13 $19.55 With Tubes

4 input channels and selector switch for: FM-AM or TV Tuner, crystal and reluctance pick-ups, tape or wire recorder, etc. 3 position equalizer switch permits selection of turnover and roll-off. 2 continuous controls for full bass and treble boost and attenuation. Power from main amplifier AC outlet permits main amplifier, etc., to be controlled by master switch. Complete with preprinted punched chassis, all components, tubes, cabinet and detailed instructions. Easy to assemble.

SPECIFICATIONS: 4 input channels—1 Low level-high gain, 3 Hi-impedance. Tube Complement 1—12AX7. 1—12AU7. Size—10¾"x4"x4". Shpg. wt. 4 lbs.

OLSON ELECTRIFYING BARGAIN!

THE NEW WONDER OF ELECTRONIC CONTROL CAN BE YOURS FOR PRACTICALLY NOTHING
THYRATRON REMOTE CONTROL
SERVICEMEN—HOBBYISTS—HAMS EXPERIMENTERS—RADIO SCHOOLS

You get the complete outfit, including cabinet, 3 tubes (6SL7, 6SN7, and GL-5662) and wiring diagram.

STOCK NO. RA-111 Single, each $5.99 Lots of 3, each $4.99

POWER CORD makes it easy to connect to 115 V AC line. Consists of 12 ft. heavy rubber covered wire with rubber molded plugs. STOCK NO. W116. ea., 49c.

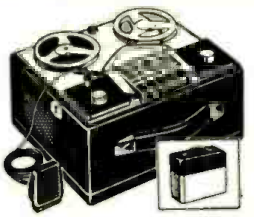
Here's the chance of a lifetime to own a genuine Thyratron Electronic Remote Control of your own at a fraction of its regular price! This mighty handful (only 3¾"x5"x3¼") of miracle control can be made to perform hundreds of practical, fascinating feats of remote control. A complete schematic showing the circuit is included with each unit.

It's a steal! Buy it just for the parts alone. Take it apart. See what you get: Over 30 components such as 6SL7GT, 6SN7GT, and GL-5662 Tubes; Cabinet; Condensers; Resistors; Transformer; Controls; Dial Assembly; Control Relay, etc. Valuable parts and tubes galore that you can so easily use in any other radio, amplifier, etc.—or for experimenting.

How can you lose? These parts are certainly worth THREE TIMES this amazing low cost. The General Electric Thyratron Type GL-5662 tube alone costs $3.30 wholesale. Besides, consider the plate sensitive relay, filament transformer, 6SN7 and 6SL7GT tubes, condensers, resistors (many of them 1% precisions). No matter how you use it, here's a great, great Olson Bargain.

PRECISION THYRATRON CIRCUITRY

These amazing Thyratron precision thermostatic controls can easily and quickly be modified by you for electronic remote control of: Transmitters; Turn Radio and TV on and off; Open and Close Garage Doors from your car; Remote Control of Appliances, Machinery, Power Tools; Remote Controls for Model Railroads, Planes, Boats, Trucks; Burglar, Fire, Temperature and Rain Alarm Systems; Poultry Brooder Controls, etc., etc. Operates on 115 Volts AC. Shpg. wt. 5 lbs.



SPECIAL SALE!
WILCOX-GAY RECORDIO TAPE RECORDER

2 Full Hours of Recording or Playback—Automatic—Foolproof Push-Button Controls • 2-Speeds • Records • Plays Back • Erases

STOCK NO. AMP-10 REGULAR $149.95 ONLY . . . $99.50

Order your Wilcox-Gay Tape Recorder for less than Dealer's Cost! This is the finest Recorder Olson has ever offered—at a price that is really give-away. We made a real deal and you get the benefit.

Five "Prest-o-matic" Push-button Controls allow instant choice of all operating functions—fast forward and reverse, record, stop, and playback. The easiest of all recorders to operate. Handles up to 7" reels. Full range of recording times—7" reel records for a full hour at 3.75" per second, plus another hour on other half tape; and at 7.5" per second you get a full recording hour on both halves of tape. Rewinds in less than 3 minutes.

Automatically records from FM or AM radio, phonograph, TV or mike. Plays back through powerful built-in amplifier and 5"x7" elliptical speaker. Frequency response—70-8,500 cps at 7.5" per second, and 90-6000 cps at 3.75" per second. Output—2 Watts. Maximum Fidelity gained by Automatic Speed Selector.

Complete with Controlled Reluctance Mike, Record Lock Button, External Speaker Jack, Full Range Variable Tone and Volume Controls. 4 Tubes—6BJ7, 6AQ5, 12AX7, 6X4 Rectifier. 7 ft. Cord. Neon Recording Indicator. Handsome Removable Cover.

Ideal for Office, School, Church, Club, Home, etc. Lightweight, only 23 lbs. complete. Portable size 12"x14"x8". 110-120 Volt 60 cycle AC. U.L. Approved. NO MORE WHEN THESE ARE GONE!

RECORDING TAPE—FAMOUS MFR'S CLOSEOUT!

PLASTIC BASE 1200 FT. REEL

Stock No. X-249. Single ea., $2.19 Lots of 10 each $1.99

Get the buy of your life. Save up to 64% on high quality RECORDING TAPE. A large manufacturer had to sell his inventory and he unloaded the whole deal. Olson now offers you this high grade recording tape at prices which defy competition. Standard ¼" wide, 1200 ft. long. Frequency response 50 to 8,000 cy. Plastic Reel included with each. Shpg. wt. 1 lb.

12" CO-AXIAL SPEAKER

$12.95 Stock No. S-168

Our new 1953 Model. Guaranteed to outperform any speaker in its price class. Equipped with two "high concentration" Alnico 5 magnets and a high frequency diffuser. The 12" section delivers the bass while the inner 3" tweeter speaker section delivers the treble tones. Together they give you "living tone." This speaker is unconditionally guaranteed to satisfy even the most critical user or Olson promises to refund your money. Only two wires to connect to any radio or amplifier. Voice coil impedance 8 ohms. Frequency response 30 to 17,500 cps. Shpg. wt. 10 lbs.

A MIRACLE in RESISTORS

KIT OF 130 NATIONAL RESISTORS

½ WATT—10% TOLERANCE

COMPLETE KIT YOU GET 13 SIZES 10 OF EACH SIZE ONLY $3.66 Stock No. AS-68

Less than 3c each. You get 10 each of the following 13 popular values. OHMS: 10,000, 15,000, 22,000, 27,000, 47,000, 56,000, 100,000, 270,000, 330,000, 470,000. MEGS: 1, 4.7, and 6.8. The degree of precision astounds experts. National Resistors are the product of a New Japan, the product of an electronic industry which already enjoys worldwide recognition for unsurpassed excellence. Olson made a deal whereby we obtained 260,000 units at a special price—so we could convince even the most skeptical. Every Resistor stamped with value. Size ¾"x⅜" with 1" tinned copper leads. Shpg. wt. 2 lbs.

COMBINATION DEAL!
10 WATT HI-FI PUSH-PULL AMPLIFIER COMPLETE WITH 12" CO-AXIAL SPEAKER

BOTH FOR ONLY $39.95 WITH TUBES — COMPLETELY WIRED NOT A KIT

STOCK NO. AS-67

Order this matched outfit today. You get the 10-Watt HI-FI Amplifier PLUS the 12" Co-Axial Speaker both as described below. Can be built into any cabinet or bookcase—giving you a complete Amplifier System of which you can be proud. Shpg. wt. 25 lbs.

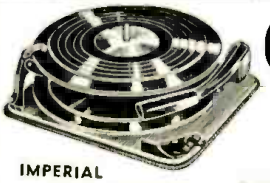
Amplifier is completely assembled and ready to play. Built-in PRE-AMP for G.E. and similar types of magnetic pickups. 4 Inputs: 1 crystal phono, 1 magnetic phono, 1 radio, 1 mike. 4 Controls: 1 Bass, 1 Treble, 1 Volume, 1 Phono-radio Switch. Output Impedances: 4, 8, 16 ohms. Peak power output 17 watts. Order this amplifier today and see what brilliant, realistic tone it will deliver. Supply is limited. Every one in factory-sealed carton. You couldn't buy the parts alone for this price. Remember this is a full size amplifier, transformer operated, not an AC-DC job. Frequency response 20 to 20,000 cps at less than ½ of 1% distortion. 5 Tubes: 1—6SL7, 1—6SC7, 2—6V6, 1—5Y3. Complete with tubes. Size 12" x 6½" x 5½".

Speaker is our new 1953 Co-axial Model. Guaranteed to outperform any speaker in its price class. Equipped with two "high concentration" Alnico 5 magnets and a high frequency diffuser. The 12" section delivers the bass while the inner 3" tweeter speaker section delivers the treble tones. Together they give you "living tone." This speaker is unconditionally guaranteed to satisfy even the most critical user or Olson promises to refund your money. Only two wires to connect to amplifier. Voice coil impedance 8 ohms. Frequency response 30 to 17,500 cps. Shpg. wt. 25 lbs.

USE HANDY ORDER BLANK ON NEXT PAGE ▶

MAIL YOUR ORDER TODAY—OLSON WILL RUSH IT RIGHT AWAY!

GIANT 3-SPEED RECORD CHANGER SALE!



IMPERIAL DELUXE MODEL
STOCK NO. RA-69

Equipped with single needle, with precious metal long-lasting tip. Plays all speed records, 33⅓, 45 and 78 RPM. Regular retail price $47.50. Shpg. wt. 15 lbs.

Single, each $19.99. In lots of 3, each, only.. **$18.99**

HI-FI DELUXE MODEL
STOCK NO. RA-113

Equipped with "Turnover" cartridge and dual needle. One side for 33⅓ and 45 RPM discs and other side for 78 RPM discs. Both sides equipped with precious metal long-lasting tips. Regular retail price $52.50. Shpg. wt. 15 lbs.

Single, each $22.99. In lots of 3, each, only.. **$21.99**

3-SPEED GENERAL INSTRUMENT AUTOMATIC RECORD CHANGER

Automatically Changes All Sizes—7", 10" and 12"

All Speeds—33⅓, 45 and 78 RPM

All the finest features are incorporated in these General Instrument Record Changers. Records Slide Gently down the center spindle. There is no wobble, no scrape, no slap. No chance of damaging your records. The newly-designed controls are so simple, they explain themselves. No instructions needed. All moving parts in every General Instrument Changer are factory adjusted thus insuring years of trouble-free performance.

These Changers are precision-built by craftsmen who have had years of experience. Every Changer is brand new—in original factory-sealed cartons—and guaranteed 100% by Olson and the manufacturer. Here is one of Olson's most sensational bargains. Believe us—you can't go wrong.

Changer can be connected to any radio or amplifier. Equipped with clever "touch-plate"—a slight press and you can reject or skip a disc and go on to the next one. Has perfect cast parts. Here's a Changer you'll be proud to demonstrate to your friends. You can sell plenty of them too. Operates on 115 Volts AC, 60 cycle. Base size 12"x12½". 5⅛" above plate and 3½" below. Take your choice of either model.

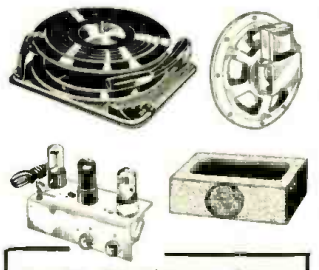
COMPLETE 3-SPEED RECORD CHANGER AMPLIFIER KIT

Easily Assemble Your Own Automatic Record Player

Stock No. AS-71 FOR ONLY **$29.99**

SEE WHAT YOU SAVE — Complete Kit	Regular List Price
3-Speed Changer	$47.50
Amplifier (Wired)	7.50
Set of 3 Tubes	4.55
5" Heavy Duty Speaker	4.00
Output Transformer	1.75
Mounting Base (Pre-Drilled)	8.50
Mounting Hardware	.55
Total List Price	$74.35

Here's an outfit that normally retails at $74.35. Save yourself a pile of money and have fun assembling your own 3-Speed Automatic Record Player. It's easy—can be assembled by anyone in just 30 minutes. All holes are drilled and all mounting hardware is provided. The Amplifier is completely wired. All you have to do is attach the Changer and Speaker wires. Shpg. wt. 20 lbs.



You Get Everything You Need to Easily Assemble Your Own 3-Speed Automatic Record Player. Kit Includes:

- GENERAL INSTRUMENT IMPERIAL DELUXE CHANGER (Model RA-69 — as described to left).
- 5" PM HEAVY-DUTY SPEAKER AND OUTPUT TRANSFORMER.
- 3-TUBE AMPLIFIER COMPLETE WITH TUBES
- MOUNTING BASE—WITH HARDWARE & INSTRUCTIONS

OLSON SMASHES KINESCOPE PRICES

Here are real bargains in Picture Tubes. Prices that would be impossible except for the fact that Olson made a cash deal on THREE SOLID RAILROAD CARS full of PICTURE TUBES. This is one of the biggest deals that we have ever made and we pass the savings on to you. We promised not to advertise the manufacturer's name, however, every tube is guaranteed, is in the original factory-sealed carton and bears the manufacturer's name. Express only. Shpg. wts.: 12LP4A—18 lbs.. 16KP4—20 lbs.. 17BP4A—22 lbs.. 19AP4B—23 lbs.. 20CP4—31 lbs.

12LP4A	Round, Dark Face, Glass Envelope. Retail Price $31.00	**$17.95**
16KP4	Or 16RP4. Rectangular Glass Envelope, Dark Face. Retail Price $37.50	**$20.95**
17BP4A	Rectangular Dark Face, Glass Envelope. Retail Price $37.50	**$20.95**
19AP4B	Round, Etched Dark Face, Metal Envelope. Retail Price $65.00	**$29.95**
20CP4	Rectangular Dark Face, Glass Envelope. Retail Price $59.00	**$29.95**

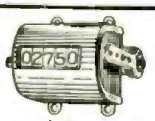
CRYSTAL MIKES

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

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

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

DELUXE COUNTER



$1.69 Stock No. X-298

We're letting these go at a fifth of Actual Cost—$8.50. Keep an accurate count up to 100,000 on transactions, traffic, production, etc. Just touch a lever and it counts. Shpg. wt. 1 lb.

FREE! OLSON'S BIG NEW BARGAIN CATALOG

Get Olson's LOWER-than-wholesale prices from this famous book. STANDARD BRANDS—FRESH STOCK. IMMEDIATE DELIVERY. Catalog is two colors—10 full pages of unbelievable bargains. A new catalog mailed Bi-Monthly—with new low bargains each mailing. Simply note on order blank or write today for your free copy from: OLSON RADIO WAREHOUSE, 275 E. MARKET ST., AKRON 8, OHIO.

WANTED! $500,000.00

WORTH OF Radio and TV Parts, Speakers, Transformers, Tubes, Picture Tubes, Condensers, Resistors, Switches, Wire, Knobs, Coils, Phono Cartridges, etc. ALSO Partially assembled or complete Radio, Amplifier and Television Chassis. ALSO Test Equipment, Record Players, Automatic Changers, Motors, Microphones, Tone Arms, Meters, Cable, Cabinets, Grille Cloth, Wire or Tape Recorders.

MANUFACTURERS and WHOLESALERS

Here's your chance to dispose of your inventory for cash.

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PHONE: JEfferson 9191 • 275 E. Market St., Akron 8, Ohio

OLSON STORES TO SERVE YOU IN:

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CHICAGO, ILLINOIS — 623 W. Randolph Street

If you live in or near either of these cities visit our Bargain Stores where you'll find these and hundreds of other Olson Buys.

OLSON HAS OVER 150,000 SATISFIED CUSTOMERS

SLOTTED SUPER SPACE LINE

LOWER LOSS 300 OHM

STOCK NO. W-115

$00 Ft. Spool Single, Ea. $7.95

Lots of 2 Spools.. **$7.75 EACH**

This slotted 300 ohm TV line is made to standard specifications in such a manner as to provide maximum air spacing while maintaining the desirable strength and durability of the usual 300 ohm twin line. Color: brown, with #22 stranded copper, bare polyethylene 35 mil web. Never offered before at such a low price. ORDER EARLY—while supply lasts. Shpg. wt. 7 lbs.

DON'T THROW AWAY OLD PICTURE TUBES

BOOST BRILLIANCE WITH THIS TV TUBE BOOSTER

$2.95 Stock No. T-100

Completely automatic. Easy to install—no tools needed. Just plug into old picture tube that is starting to dim and watch the big change. Works on any Tube—10" to 30" in all AC parallel circuits. Adds months and months of service to those old tubes. Reg. $5.95. Shpg. wt. 1 lb.

"SPORTSTER" 4-BLADE POCKET KNIFE

FREE!

Just the Knife you've always wanted. The cleverest, handiest Gift Olson has ever given away. Just price one in any store—they cost plenty—but Olson is giving you one ABSOLUTELY FREE OF CHARGE.

Knife is 4" long with handsomely colored Inlaid Handle. Contains four sturdy shiny steel blades. ● Combination Bottle Opener-Screw Driver ● Many-Purpose Punch and Reamer ● New Style Curved Whittling Blade ● Large Heavy Duty Stay Sharp Cutting Blade.

HOW TO GET YOUR KNIFE FREE

Just make out an order totaling $20 or more from these Olson Ads using the Order Blank below. We'll ship your order instantly and include the Sportster Pocket Knife FREE OF CHARGE. One Knife to a customer. **THIS OFFER EXPIRES FEBRUARY 28, 1953.**

IT'S EASY TO ORDER FROM OLSON'S

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

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

MAIL TO: OLSON RADIO WAREHOUSE
275 E. MARKET ST., AKRON 8, OHIO
WE SHIP SAME DAY WE GET YOUR ORDER

Please Minimum Order $3.00

QUANTITY	STOCK NUMBER	DESCRIPTION	PRICE EACH	TOTAL

NAME _____

ADDRESS _____

CITY _____ ZONE ___ STATE _____

RN-153

TOTAL	
ADD POSTAGE	
TOTAL AMOUNT	

OLSON RADIO WAREHOUSE • 275 E. Market St., Akron 8, Ohio

International Short-Wave
(*Continued from page 61*)

2345, 1130-1430, 0300-0430 (Fri. *only*), 0900-1000 (Fri. *only*), 0300-0400 (Sun. *only*); *English* 1230-1300 (Fri. *only*); lists channels of 9.746 (is nearer 9.737), 7.000, and 572.5 kc. (Kary, Pa.)

Angola—CR6RI, 4.770, Dundo, verified with card and letter; operates 1300-1430, also on 7.070, 100 watts. (N. Z. DX Times) *Radio Clube de Angola*, 11.862, noted to 1730 closedown. *Radio Clube de Benguela*, 9.165, heard closing with "A Portuguesa" 1500. *Radio Clube de Huila*, Sa da Bandeira, still noted near 10.048 to closedown 1530. (Pearce, England, others) CR6AA, 7.042, Lobito. *Radiodifusora do Lobito*, has recorded musical program at 1430; heard until 1530; believe closes 1600; good, clear signal in South Africa. (Ridgeway) WRH says Lobito uses 7.106 and 7.177 Sundays for *English* 1300-1400. Ridgeway, South Africa, reports *Radio Diamang*, Dundo, CR6RG, now on a *new* channel of 7.065, heard 1300-1430, good level.

Azores—Ponta Delgada is now scheduled 1500-1600 on 11.090; 1700-1900 on 4.865. (WRH)

Bechuanaland—ZNB, 8.236, Mafeking, is heard well 0600-0700, but is poor in the 1200-1430 session; relays SABC news 0615, 1200. (Ridgeway, South Africa)

Belgian Congo—OQ2AB, 11.90, Elizabethville, is scheduled Sundays *only* 0930-1100 (former schedule was 0800-1000); *Radio College*, OQ2AC, 7.198, Elizabethville, is noted daily 1130-1230; has call in *English* when closes; is parallel with 4.98. OTM4, 11.72A, Leopoldville, and OTM2, 9.382, open daily 1030 in parallel with OTM1, 6.295; close 1600. OTH, 9.211, is heard around 1230-1330 closedown. (Ridgeway, South Africa) *Radio Congo Belge*, 9.380, noted from tuning 1530 to closedown with Belgian National Anthem 1602 after closing announcements in French. Flemish; news in French 1545. (Pearce, England)

Belgium—Brussels is scheduled 0500-0700, 17.860, 21.510; 0700-0800, 21.510 (from 0715-0800 also on 15.335); 1200-1300, 9.745, 11.850; 1300-1630, 9.745, 11.850 (*English* 1515); 1630-1830, 9.745, 11.850; 1830-2000, 9.745, 9.767; 2000-2045, 9.745, 9.767 (relayed by OTC, 9.655, Leopoldville, Belgian Congo); 2045-2100, 9.745 (relayed by OTC, 9.655); 2100-2400, 9.745, 6.035 (relayed by OTC, 9.655).

Brazil—A *new* Brazilian was heard recently testing on 11.862A around 1445 to after 1600; called frequently as "Radio Clube do Estado de Bahia," and "Radio Sociedad de Bahia"; played recorded music; not heard lately, however. A Sao Paulo station is heard with strong signal on 6.022A from 2130; calls "Radiofonico Sao Paulo"; is heard until after 0000; another Sao Paulo station is being heard on 11.736

Depend on Mallory
for
Approved Precision Quality

This Service Job Will Stay "Sold"!

For good reason, too. Mallory FP capacitors were used. They are engineered to duplicate the electrical characteristics of the original part in any TV or radio set that comes into your shop. They will give performance that's equal to . . . and often better than . . . the original equipment. You can count on Mallory FP's for precision quality . . . no call-backs.

Mallory FP's are the only fabricated plate capacitors available to the replacement market. They'll give you long lasting performance at high temperatures and greater ripple currents . . . even at 185° F. (85° C.).

When you use Mallory FP capacitors for all your service work, you can be sure that every job is right the first time. It just doesn't pay to take chances on capacitor performance. Always specify *brand* as well as rating when you order . . . ask for Mallory and watch your call-backs fall away to nothing. It costs no more to be sure with Mallory.

For plastic tubular replacements, ask your distributor for Mallory Plascaps®. They will put an end to premature shorts . . . leakage . . . off center cartridges . . . and unsoldered leads.

P.R. MALLORY & CO. Inc.

MALLORY

CAPACITORS • CONTROLS • VIBRATORS • SWITCHES • RESISTORS
• RECTIFIERS • VIBRAPACK* POWER SUPPLIES • FILTERS
*Reg. U.S. Pat. Off.

APPROVED PRECISION PRODUCTS

P. R. MALLORY & CO, Inc., INDIANAPOLIS 6, INDIANA

with good signals from 1530. (Ridgeway, South Africa) PRL7, 9.72, Rio de Janeiro, leaves this channel daily 1730. (Bellington, N.Y.) PRL9, 6.147, the other *Radio Nacional* outlet, is usually good level around 2000, some QSB. (Gaylord, Wn. State)

Bulgaria—Sofia has replaced 15.330 with 9.700A; has *English* for North America 2000-2030. (Niblack, Ind., Kary, Pa., others)

British Guiana—*Radio Demerara*, ZFY, 5.980A, has been heard with news 1945; good level in Indiana. (Hord) When this was compiled the Cable and Wireless, Ltd., transmitter ZJA6, 15.075, Georgetown, was being heard throughout the world with relay of sports events (cricket, racing) from ZFY from as early as 1000 to around 1600; may have ceased these special broadcasts by now.

Burma—*Radio Rangoon*, 4.775, is good level in New Zealand 1000-1015 with *English*. (N. Z. DX Times) Noted on 9.54 from 0930 with programs in *English*, recorded music; has news 1000 by man, followed by weather report and program preview for next day; closes 1015A; calls "This is the Burma Broadcasting Service." (Ridgeway, South Africa)

Ceylon—*Radio Ceylon*, has strong signal 0100 with native vocal music; heard in *English* 0200. (Pearce, England) Still noted opening 2045 on 11.975. (Sanderson, Australia, others) This outlet normally closes 1145A but on Thursdays runs to 1215 closedown. (Fuller, R.I.) VOA relays are scheduled for 15.120 at 0730-0830 and on 11.975 at 1030-1100, both to India-Pakistan.

Chile—Punta Arenas, CE920, 9.200A, is heard with fair signal 2045; gives call 2100, closes 2200. CE1174, 11.74, Santiago, has very strong signal 2230 to close at 2400. *Radio Mineria*, 11.73, Santiago, is heard at 2300 to after 2330; gives call at 2300 and 2315; signal deteriorates after 2330. (Ridgeway, South Africa)

China—*Radio Peking*, 15.06V, noted with news 0400 and 0830, stronger 0400. (Pearce, England) Revised schedules for *English* periods from *Radio Peking* are 1730, 6.100, 7.500, 9.040, 10.260, 11.690, 15.060, 15.170; 0400, 10.260, 11.690, 15.060; 0830, 11.690, 15.060. (N. Z. DX Times)

Colombia—*Radiodifusora Nacional de Colombia en Bogota* noted moved to 6.183 from 6.203. (Stark, Texas)

Curacao—PJC2, 5.010, Willemstad, noted at fair level with *English* session on Wednesdays 2000-2030. (Croston, Pa.)

Cyprus—Asharq-al-Adna, Limassol, noted 2255 on 6.790, 6.170. (Kary, Pa.)

Czechoslovakia—Prague is heard on 9.550 with *Radio Moscow* relay 1820-1930, with own program 1930-2030, and then resuming relay from Moscow; is directed to North America. (Grenell, Ohio) Has second period for North America at 2300. (Bellington, N.Y., others)

Denmark—OZU, 7.26, relays Home Service on Mon. and Fri. 1315-1615, other days 1240-1615. OZF, 9.52, is

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Superior's New Model 770

VOLT-OHM MILLIAMMETER

Sensitivity—1000 ohms per volt

Uses latest design 2% accurate 1 Mil. D'Arsonval type meter. • Same zero adjustment holds for both resistance ranges. It is not necessary to readjust when switching from one resistance range to another. This is an important time-saving feature never before included in a V.O.M. in this price range. • Housed in round-cornered, molded case. • Beautiful black etched panel. Depressed letters filled with permanent white, insures long-life even with constant use.

Specifications:

6 A.C. VOLTAGE RANGES: 0-15/30/150/300/1500/3000 Volts.
6 D.C. VOLTAGE RANGES: 0-7.5/15/75/150/750/1500 Volts.
4 D.C. CURRENT RANGES: 0-1.5/15/150 MA. 0-1.5 Amps.
2 RESISTANCE RANGES: 0-500 Ohms 0-1 Megohm.

Model 770 is an accurate pocket-size V.O.M. Measures only 3⅛"x 5⅞"x2¼".

$14.90 NET The Model 770 comes complete with self-contained batteries, test leads and all operating instructions.

Superior's New Model TV-11

TUBE TESTER

• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. • Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover

$47.50 NET

Superior's New

JUNIOR SUPER-METER

MOST COMPLETE AND COMPACT MULTI-SERVICE INSTRUMENT EVER DESIGNED

Measures: * Voltage * Capacity * Current * Reactance * Decibels * Resistance * Inductance

Specifications: D.C. Volts: 0-7.5/75/150/750/1500 Volts. A.C. Volts: 0.15/150/300/1500/3000 Volts. Resistance: 0-10,000/100,000 ohms. 0-10 Megohms. D.C. Current: 0-7.5/75 Ma. 0-7.5 amps. Capacity: .001 Mfd.—.2 Mfd. .1 Mfd.—20 Mfd. Electrolytic Leakage: Reads quality of electrolytics at 150 Volt test potential. Decibels: —10 Db to +18 Db. + 10 Db. to + 38 Db. + 38 Db. to + 58 Db. Reactance: 15 ohms—25 K ohms 15 K ohms—2.5 Megohms. Inductance: .5 Henry—50 Henries 30 Henries—10 K Henries. Plus Good-Bad scale for checking the quality of electrolytic condensers.

Handsome round cornered molded bakelite case 3⅛" x 5⅞" x 2¼" complete with all test leads and instructions

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THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN!!

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Features.—Can be used when no stations are on the air. • Provides linear patterns to adjust vertical and horizontal linearity • Provides vertical and horizontal sweep signals • Provides signal for testing video amplifiers.

TV Bar Generator comes complete with shielded leads and detailed operating instructions ..... Only NET

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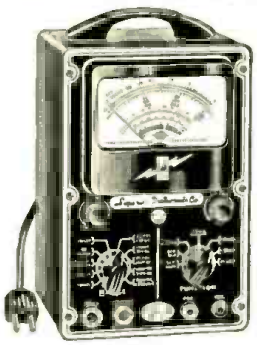
Superior's New Model 670-A

SUPER-METER

A COMBINATION VOLT-OHM MILLIAMMETER PLUS CAPACITY REACTANCE INDUCTANCE AND DECIBEL MEASUREMENTS



SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,500 Volts.
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts.
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes.
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms, 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 +38 +34 to +58

ADDED FEATURE:
The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

The Model 670-A comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 6¼"x9½" x4½".

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  $2.90 down payment. Balance $2.00 monthly for 6 months.
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  $11.50 down payment. Balance $6.00 monthly for 6 months.
- ☐ JUNIOR SUPER METER ..... Total Price $21.40
  $5.40 down payment. Balance $4.00 monthly for 4 months.
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  $9.95 down payment. Balance $5.00 monthly for 6 months.
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- ☐ Ship C.O.D. for the down payment.

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Name .....

Address .....

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

scheduled to South America, Mon., Wed., Fri. 1730-1830; to North America daily 2030-2130, 2200-2300; for Faroe Islands, Sun. *only* 0900-1000; for Danish ships Mon., Wed., Fri., 1830-1850, 2130-2150, 2300-2320, and Tue., Thur., Sat. 1200-1220. OZH4, 15.165, for Middle East, India, Burma, Malaya, Indonesia, Tue., Thur., Sat. 0900-1000, for Danish ships same days 1000-1020. OZH, 15.18, for Far East, Australia, New Zealand, Tue., Thur., Sat. 0400-0500, for Danish ships same days 0500-0520; for Africa and Near East, Mon., Fri., 1200-1300. Reports are sought. (Gade-Joergensen, Denmark)

Dutch New Guinea—Radio Omroep Neuw Guinea, 7.126, Hollandia, lists schedule of 0430-0700, Saturday also 2100-2300. (Scheiner, N.J.)

Ecuador—HCJB, 11.915, noted 2100-2130 with religious program. (Simpson, Kans.) HC4AS, 4.203, Bolivar, "La Voz de las Caras," is noted signing off weekdays 2330. (Robbins, Ind.)

El Salvador—YSASA, 11.95A, San Salvador, noted around 1830. (Bellington, N.Y.) Gives medium-wave call of YSAS; heard by 0930 and goes past 1700. (Stark, Texas) YSDR, 4.797, Santa Ana, noted with fair level signing off 2210. (Robbins, Ind.)

Ethiopia—The schedule of *Radio Addis Ababa,* 15.040AV, appears to be rather irregular; has been heard signing on in *English* 1102; on another day had a missionary program in *English* when tuned 1032; is identifying more frequently in *English* now, and some days has *English* news 1403A; sign-off varies. (Pearce, England) Was recently *measured* 15.036, but varies. Noted parallel on 6.42, latter quite good from 1230 onwards. (Ridgeway, South Africa) QRA is Box 1364, Addis Ababa, Ethiopia. (N. Z. DX Times)

Finland—OIX2, 9.555, Helsinki, heard 2345 with Finnish news and music. (Sanderson, Australia) Noted on this channel opening 2200 with news. (Annala, Oregon)

France—Paris noted signing on in French with "La Marseillaise" 0915 on 15.400 and 17.850. (Pearce, England) Paris is scheduled to Britain daily 0245 on 7.240, 6.145; 1445 on 11.970; Sundays 0800-0900 on 7.240. (Catch, England)

Fr. Equatorial Africa—Radio Chad, Brazzaville, is noted on 15.596 at 0030-0130; *Radio A.E.F.* is heard on 9.96, 15.596, 6.024 at 1200-1500. (Ridgeway, South Africa)

Fr. Morocco—Radio Maroc, 6.006, Rabat, is fair to good level around 0200-0300 with native session. (Saylor, Va.)

Fr. West Africa—Radio Francaise Africa Occidental, 9.560, Dakar, noted signing on in French after a march at 0200, then in native African talks and music; noted on 11.896 at 0230. (Pearce, England) The 11.896 outlet opens 1400 with French programs; high level to 1800 closedown. (Ridgeway, South Africa) The 9.560 outlet is heard as early as 1530 to 1730 when closes with martial tune. (Levy, N.Y., Kary, Pa., others)

Germany—Nordwestdeutscher Rundfunk, Hamburg, noted on 11.795 in parallel with 7.290 when tuned 0900, had choral concert from Hanover; was strong on 6.270 with orchestral music when tuned 0345. Berlin, 7.150, *Democratische Republic,* noted 0115 with news in German, call 0121, then dance and light music. (Pearce, England)

Greece—Kozani, 7.970, is heard in Sweden at 1335 with recorded music; CWQRM. (Malmo DX-aren, Sweden) Larissa, 6.760, relays news in Greek from *Radio Athens* 2330-2340. Athens Forces Station, 6.330, noted with recorded music 2357. (Kary, Pa.) *Radio Athens,* 7.300, heard with news 2300; on 9.607 with news (to North America) 1935-1950A. (Pelegri, N.Y.)

Guatemala—Officials list TGN, 580 kc.; TGNA, 5.9525; TGNB, 9.668, and TGNC, 11.850; say "for our *English* short-wave broadcast we use only the call TGNA." (Ferguson, N.C.)

Hong-Kong—ZBW3, 9.525, noted 0430 with "Cantonese by Radio," then musical interlude. (Sanderson, Australia) Noted 0900 at good strength relaying BBC's "Radio Newsreel." (Balbi, Calif.)

India—Latest schedules received airmail from Delhi for *All India Radio's* External Services are—To East and Southeast Asia 1930-2000, 11.850, 9.630; 2030-2200, 17.740, 15.160; 0600-0815, 17.740, 15.190; 0830-0945, 15.190, 11.780.

(*Continued on page* 136)

Oscilloscopes

(*Continued from page 34*)

instruments falls within 60 kc. to 100 kc. For most radio and TV service applications it is seldom necessary to go beyond 30 kc.

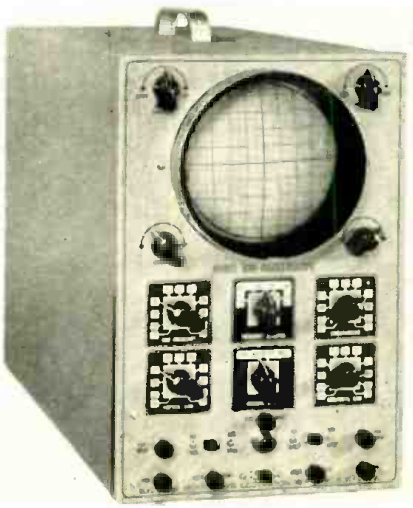
In order to work with any pattern presented on the screen, the pattern should be held stationary. With the "Range Frequency" control, it is possible with some patience to adjust the frequency of the saw-tooth generator until it exactly equals (or is an exact multiple of) the frequency of the applied vertical signal. But, unless this control is constantly adjusted, the frequency of the saw-tooth generator will change (even if only a few cycles) and the pattern will drift.

To keep the trace or pattern steady without constant adjustment of any control, a portion of the incoming signal is fed to the saw-tooth generator and serves to lock the generator in. The "Sync" control enables the operator to vary the amount of synchronizing signal fed to the sweep oscillator. The optimum position for this control is at that point where the smallest amount of sync signal causes the pattern to become stationary. Thus, you start with the "Sync" control at zero and slowly turn it to the right (clockwise) until the pattern locks-in. (It is important before using the "Sync" control to adjust the "Range Frequency" until the pattern is close to being stationary.)

The three controls just described, and especially the "Sync" control, are to be used in conjunction with the "Function" switch situated just below them. The "Function" switch is a 5-position switch which controls the power input and selects the desired horizontal deflection signal. The power is off in the "Off" position of the switch and is on in the remaining four positions. In addition, the switch makes the following connections in its 5 positions:

1. *"Off"*—Opens the circuit for the power input.

Electronic Measurement Corp.'s Model 600.



2. *"Int. Sync"*—A linear (or saw-tooth) sweep voltage is applied to the horizontal amplifier. At the same time, a portion of the "Vert. Input" signal is fed into the sweep oscillator through the "Sync" control. If the frequency of the applied (or "Vert. Input") signal is near sweep frequency, the pattern can be locked steady on the screen of the cathode-ray tube.

3. *"Line Sync"*—The saw-tooth sweep voltage is still applied to the deflection plates through the horizontal amplifier. However, now, the synchronizing voltage is not taken from the incoming signal, but from the 60-cycle power line. The 60-cycle voltage is injected into the sweep oscillator through the "Sync" control and therefore locks the saw-tooth oscillator in sync with the line frequency. This is usable for applied signals having frequencies of 20, 30, 60, 120, and 180 cycles, and for other subharmonics of 60 cycles.

4. *"Ext. Sync"*—The saw-tooth sweep voltage is still active. However, now, a synchronizing pulse can be obtained *only* from an external signal injected into the sweep circuit through the "Ext. Sync" terminal. The setting of the "Sync" control still determines how much of this sync pulse reaches the saw-tooth oscillator.

5. *"Horiz. Amp."*—In this position the saw-tooth voltage of the oscilloscope's sweep generator is disconnected from the horizontal amplifier and the beam is stationary at the center of the screen in a small, round spot. To obtain any horizontal deflection of the beam, an external signal must be applied to the "Horiz. Input" terminal at the front of the oscilloscope. This signal will be amplified by the horizontal amplifier and applied to the horizontal deflection plates of the cathode-ray tube.

The most frequent use that the TV technician will make of the "Horiz. Amp." position will be in TV or FM receiver alignment. Nearly all sweep signal generators supply their own 60-cycle deflection voltage for the oscilloscope and this should be used in preference to any 60-cycle saw-tooth or sine-wave voltage the oscilloscope may be capable of supplying. (An exception to this occurs when the oscilloscope contains specific provision, in the form of a phasing control, enabling it to develop a properly phased pattern.)

The "Function" switch is a convenience that is not universally employed. In a number of oscilloscopes, the turning on or off of the power is handled by a separate toggle switch. Another two-position switch might then govern whether the sync voltages are internally or externally obtained. Or, internal sync, external sync, and line sync might be combined in a three-position switch. There are a number of ways of handling this situation and they vary from manufacturer to manufacturer.

On either side of the "Function" switch in Fig. 1 are the gain controls for the vertical and horizontal ampli-

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fiers and their function is indicated in Fig. 1. Just beneath the "Vert. Gain" control is the "Vert. Attenuator" switch. This is a voltage divider network which limits the amount of vertical input signal reaching the first vertical amplifier. There are four switch positions labeled: .5, 5, 50, and 500 volts. These figures indicate the maximum value of input signal that should be applied with the switch in each position. Thus, with the attenuator switch in the .5 position, no signal having an amplitude greater than .5 volt r.m.s. should be applied to the "Vert. Input" terminal (and ground). Excess voltage on any range may produce a distorted pattern or may possibly cause damage. On the other hand, setting the control pointer too high—say at 500 volts for an input voltage of 30 volts—will produce a pattern which is too small. In other words, do not set the control too high or too low.

The "Vert. Attenuator" switch receives the applied signal before the "Vert. Gain" control. Hence, the attenuator switch may be considered as a rough adjustment with the gain potentiometer as its vernier.

The last remaining control on the front panel of this instrument (Fig. 1) is the "Horiz. Sens." switch. This 2-position switch is in series with the line from the "Horiz. Input" terminal to the horizontal amplifier. The "Horiz. Sens." is marked "High" for the closed switch position. At this setting the full signal is fed to the horizontal amplifier. The system is thus most sensitive with the switch in the "High" position and affords any applied signal maximum amplification (provided, of course, that the "Horiz. Gain" control is turned up, too).

The "Horiz. Sens." switch is marked "Low" for the open position of the switch and a 12-megohm resistor is placed in series with the input to the "Horiz. Gain" control.

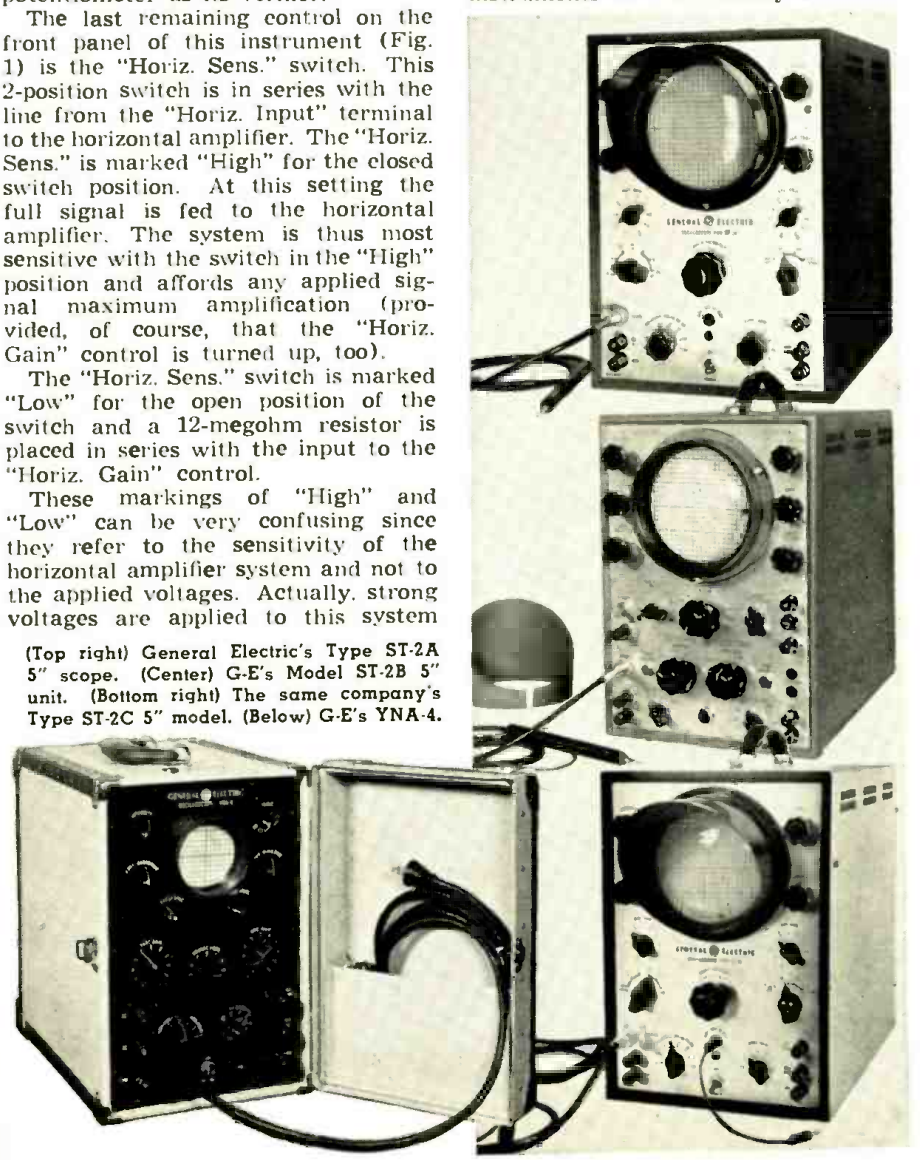
These markings of "High" and "Low" can be very confusing since they refer to the sensitivity of the horizontal amplifier system and not to the applied voltages. Actually, strong voltages are applied to this system with the switch in the "Low" position since with a strong voltage, less amplification is required. On the other hand, with a weak applied signal, the "Horiz. Sens." switch would be set "High."

Not all scopes possess attenuator controls. In some instruments the applied voltage goes directly to its respective amplifier. When using these instruments be careful not to apply too much voltage otherwise distortion and possible damage may occur. The safe maximum voltage that the oscilloscope can handle will usually be stated in the instruction manual. If it is desired to view the waveform of high voltages, reduce them first to a suitable value by the use of a resistive network such as shown in Fig. 3.

At the bottom of the oscilloscope in Fig. 1 there are six terminal posts through which connections are made to the instrument circuits. Two are for ground; the functions of the other posts are indicated in the illustration.

Alternate Control Names

The foregoing controls have all been part of one instrument. While other instruments have essentially the same



(Top right) General Electric's Type ST-2A 5" scope. (Center) G-E's Model ST-2B 5" unit. (Bottom right) The same company's Type ST-2C 5" model. (Below) G-E's YNA-4.

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0Z4G		2C34 .60	6AS5 .90	6D6 .78 1.10	6SH7		7B8 .73
1A5GT .65		2E5 .89	6AU5GT .89	6Q8G 1.15	6SH7GT .69		7C4 1.30
1A7 .69		2X2/879 .74	6AU6 .59	6E5 .69	6SJ7	59c	7C5
1B3GT .95		3LF4 1.19	6AV5GT .89	6F5GT	6SJ7GT		7C6
1B5	29c	3Q4 .69	6AV6 .59	6F6GT	6SK7GT .69		7C7
1C7G		3Q5GT 1.08	6AX4 .69	6F8G 1.15	6SL7GT .69		7E6 .69
1E7		3S4	69c	6AX6 .69	6G6G .95	6SN7GT .69	7E7 .69
1H5GT .59		3V4		6B4G	1.44	6H6GT .59	6SQ7
1J6GT .69		5T4 1.40	6B5			6J5GT .59	6SQ7GT
1L4 .69		5U4G .59	6B6G .79	6J6 1.04	6SR7GT .59	7F8 1.47	
1LA4	1.19	5V4G .87	6B8GT 1.15	6J7G .69	6SS7 .72	7G7 .69	
1LA6		5W4	59c	6BA6 .59	6J8G 1.15	6T7G 1.15	7H7 .69
1LC5 .69		5W4GT		6BA7	69c	6K5GT .59	6T8 .89
1LC6 1.19		5Y3GT .45	6BC5			6K6GT .59	6U5 .69
1LD5 .95		5Y4G .54	6BC7 .79	6K7GT .69	6U6GT	69c	
1LE5 1.19		5X4G	81c	6BD5GT .89	6K8GT .69	6U7G	
1LH4 1.19		5Z3		6BE6 .59	6L5G .95	6V3 1.29	
1LN5 1.19		6A3 1.15	6BF5 .69	6L6G	95c	6V6GT .69	
1N5GT .69		6A7 1.21	6BF6 .69	6L6GA .69		6V8 .89	
1P5GT	69c	6A8GT .69	6BQ6G 1.49	6L7 .69		6W4GT .59	
1Q5GT		6AB4 .69	6BH6	69c	6N6G 1.40	6W6 .69	
1R5		6AB7 1.15	6BJ6		6N7GT	69c	6X4
1S5	69c	6AC5GT	89c	6BK7 .98	6P5GT .69	6X5GT	59c
1T4		6AC7		6BL7 .79	6Q7GT .59	6Y6G .69	
1U4		6AG5 .69	6BN6 .89	6R7GT .69	6Z4/84 .72		
1U5 .59		6AG7 .89	6BQ6GT .85	6S4 .59	7A4 .69		
1V .88		6AH6 1.40	6BQ7 1.19	6S7GT 1.15	7A5 .89		
1X2A .89		6AK5 .89	6BZ7 1.29	6S8GT .69	7A6		
2A3 1.15		6AK6 1.08	6C4 .59	6SA7GT .69	7A7	73c	
2A5 .79		6AL5	69c	6C5GT	6SC7 .65	7A8	
2A6	89c	6AQ5		6C6	69c	6SD7GT .99	7B4
2A7		6AQ6 .81	6C8G 1.15	6SF5 .59	7B5 .73		
2B3 .89		6AR5 .74	6C86 .69	6SF5GT .59	7B6 .73		

12AV7 .89	1B3GT ea. 95c	14C5 1.07	35Z5 .55	75	69c
12AW6 .95	1X2A ea. 89c	14C7 .98	35Z6G .95	77
12AX4 .69	5U4G .59	14F7 .89	35/51 .79	78/6D6 1.10
12AX7 .69	6AB4 .69	14F8 1.30	36 1.06	80 .69
12BA6 .59	6AU6 ea. 59c	19BG6G 1.49	37 .72	83 1.45
12BA7 .69	6AY5GT .89	19T8 .89	38	84/6Z4 .72
12BE6	59c	6AX4 .69	20 1.40	39/44	88c	85 .79
12BF6		6BG6G ea. 1.49	24A .69	41 .72
12BH7 .69	6BK7 ea. 98c	25AC5GT 1.04	42 .69
12C8 1.15	6BL7 ea. 79c	25BQ6GT 1.15	43	72c
12F5GT	65c	6BQ7 ea. 1.19	25L6GT .59	45 .69
12H6		6BZ7 ea. 1.29	25W4GT .69	45Z5
12J5GT .54	6CD6G ea. 1.49	25Z5 1.04	46	89c
12K7GT	69c	6S4 ea. 85c	25Z6GT .69	47
12Q7GT		6BQ7 ea. 1.19	32L7GT 1.15	50A5 .89
12SA7GT	6CD6G ea. 1.49	26 .59	50B5
12SC7 .69	6BZ7 ea. 1.29	27 .59	50C5	69c
12SF5GT	69c	6CD6G ea. 1.49	35A5 .99	50C6G 1.04
12SF7		6S4 ea. 85c	35B5	69c	50L6 .69
12SG7 .89	6BQ7 ea. 1.19	35C5	50X6 .79
12SH7GT .69	6BZ7 ea. 1.29	35L6 .69	50Y6 .69
12SJ7GT .69	6CD6G ea. 1.49	35W4 .45	70L7
16SJ7GT .59	6S4 ea. 85c	35Y4	89c
12SK7GT .69	6BQ7 ea. 1.19	35Z3	99c	70L7GT .87
12SL7GT .69	6BZ7 ea. 1.29	35Z4 .59	71A .87
12SN7GT .99	6CD6G ea. 1.49	12SQ7	69c
12SR7GT		6S4 ea. 85c	
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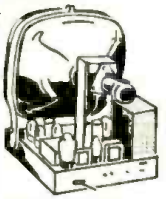

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controls, not all of them use the same names. Thus, "Range Frequency" of Fig. 1 is also known as "Fine Frequency," "Frequency Vernier" or just plain "Vernier." Alternate names for this and other controls are listed in Table 2. This is often a big stumbling block to the novice and it would help him considerably if the industry agreed on a standard name for each control.

Other Controls

In addition to the foregoing there are other controls (and their circuits) which broaden the application of the oscilloscope. The more important of these are listed below, together with a brief description of what they do.

1. *Phasing Controls.* This control, generally designated as "60 C Phasing" or "Horizontal Phasing," is brought into play when the oscilloscope is employed in conjunction with a sweep frequency generator. The sweep generator feeds its signal into one end of the system and the circuit response pattern is developed on the screen of an oscilloscope placed at the other end of the system.

In order that the observed response curve have a linear frequency base, it is necessary that the beam move in step with the changing frequency in the generator. Since the sweep oscillator is driven by a 60-cycle a.c. voltage, horizontal beam deflection should follow suit. To accomplish this, the horizontal input is switched away from its internal saw-tooth oscillator and a 60-cycle sine wave voltage is substituted. Ordinarily, the sweep generator will supply this voltage. However, some oscilloscopes have a special circuit for supplying their own.

Besides the a.c. voltage, some means must be available for bringing the beam in phase with the a.c. driving voltage used to sweep the frequencies back and forth. For this, a phasing network is employed. One of the elements of the network (a resistor usually) is made variable and this becomes the "Phasing" control. It is adjusted until a single response curve is visible on the scope screen.

2. *Vertical Polarity Reversing Switch.* This is usually a two-position switch marked "Normal" and "Reverse." When the switch is moved from one position to the other, the pattern on the screen is flipped over or reversed

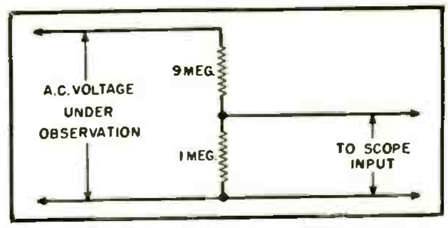

Fig. 3. Voltage divider which can be used when the applied voltage is too high.

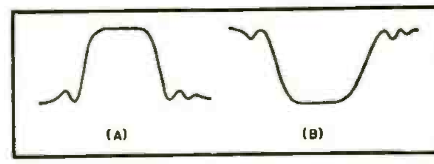

Fig. 4. Patterns for "Normal" (A) and "Reverse" (B) settings of polarity switch.

in the vertical direction. Thus, if the pattern appears as shown in Fig. 4A when the switch is in one position, it will appear as shown in Fig. 4B when the switch is turned to the other position. This is a useful device for interpreting TV video i.f. and sync or sweep waveforms, especially when the manufacturer's manual shows the pattern in one position and your scope shows it in the opposite position.

Reverse pattern on the screen is a source of confusion to many technicians. Why, for example, should the manufacturer's bulletin show the pattern pointing up when your scope has it pointing down? Does it mean that your equipment is hooked up wrong or does it indicate a defective circuit?

Actually, the answer is neither one. The polarity of the signal at various points in a television receiver is important and in general the manufacturer attempts to show the signal as it should be at each specific point. Now, this same signal, fed to your scope, may come out (at the screen) right side up or upside down, depending upon whether your scope has an *even* or an *odd* number of stages in its vertical amplifier system. Any voltage passing through an amplifier is reversed in phase by 180°. Therefore, if the signal shown in Fig. 4A is fed into the grid of an amplifier, it will appear at the plate as shown in Fig. 4B. Pass this second signal through one more stage and lo and behold, it is rightside up again.

As a general rule, two or any even number of stages will produce a sig-

Table 2. Alternate names frequently used for various oscilloscope controls. Common abbreviations, such as "Vert." for "Vertical," have been omitted from listing.

NAME OF CONTROL	ALTERNATE NAMES
Vertical Centering	Vertical Position, V Center, Y Position
Horizontal Centering	Horizontal Position, H Center, X Position
Vertical Gain	V Gain, V Vernier, Y Amplitude, Vertical Amplifier
Horizontal Gain	H Gain, H Vernier, X Amplitude, Horizontal Amplifier
Sync	Sync Amp., Sync Lock, Locking, Sync Signal, Sync Gain, Sync Control
60-Cycle Phasing	Horizontal Phasing, Phase
Horizontal Attenuator	Horizontal Sensitivity, Horizontal Input Control
Vertical Attenuator	Vertical Sensitivity, Vertical Input Control
Fine Frequency	Frequency Vernier, Vernier, Sweep Vernier, Range Frequency
Sweep Frequency	Sweep, Sweep Range Coarse Frequency, Steps, Saw-Tooth Sweep Frequency Range

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An open letter to young men of ambition from a pioneer in the field of radio-TV education

by

E. H. RIETZKE, *Founder and President of*
CAPITOL RADIO ENGINEERING INSTITUTE

IF YOU HAD TRAVELED with me on my recent trip across the United States and Canada, you would have seen with me the proud, grateful, earnest faces of CREI graduates and students. Proud that they had converted ambition into success. Grateful for what CREI had given them. Earnest in their plea to you to study for success.

Personnel Directors and Chief Engineers thanked me for personnel we had sent them—and bombarded me with requests for more.

I received the same reaction in every electronics installation, TV and radio station and factory I visited. I was proud that the professional school which I founded could point to such a fine record of accomplishment.

But I realized that our job has just begun. The growth of the electronics industry thus far is just a trickle compared to the future.

There are already 111 television stations. The FCC, by its "unfreezing" action, makes way for 2000 more stations. Over 18,000,000 TV sets are in use—that is 5,000,000 more than experts predicted there would be in 1954. There are over 100,000,000 radios in operation—in 95% of America's homes—and served by over 2500 radio stations.

Billions in electronics contracts have been awarded in the defense build-up. By 1960, it is estimated that the radio-electronics industry should do no less than $10,000,000,000 per year, not counting military orders.

This is but a fraction of the picture of expansion.

There is already a gaping shortage of trained men to accept the thousands of openings in development, research, design, production, testing, inspection, manufacture, broadcasting, telecasting and servicing. The best jobs, the highest rewards, the posts of leadership are going to the trained men. And the better the training—the better the results.

If you are a beginner, CREI is not the school for you. There are other schools equipped to do much more for you. In a year or two, they can bring you to the point where you can profitably enroll at CREI.

If, however, you are a graduate of one of these other schools—or if you have been gainfully employed in the Radio-TV-Electronics industry for one year, or more, CREI can help change your life.

I founded CREI more than 25 years ago to provide professional level advanced training for men in the field. 98% of all our students were employed in electronics at the time they enrolled.

I can safely say that we have more contracts with leading companies for group training—than all other radio educational institutions combined. Let me mention just a few: United Air Lines, Columbia Broadcasting System, Canadian Broadcasting Corporation, Trans-Canada Air Lines, Bendix Products Division, All-American Cables & Radio, Inc., RCA-Victor Division, the Machlett Laboratories—all have chosen CREI technical courses for group training of their own electronic personnel.

In CREI's Home Study Course you will receive authentic and complete courses, prepared by recognized experts, in a practical, easily-understood manner. You will learn under the supervision of a staff instructor. Your work will be graded by your instructor, not by machine. Return letters will indicate where you can improve. Your CREI diploma will be your key to success.

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The best way to find out about CREI is the way I am now going to suggest. Talk to your supervisor, to the chief engineer of your local radio or television stations, to CREI graduates, to the officials of any radio school—anywhere. I, with every member of the distinguished CREI faculty, am ready to stand on whatever answer they give you.

We have prepared a booklet called "Your Future in the New World of Electronics." In it you can find the breath-taking future of the industry, translated into *your* future. It contains an outline of the CREI curriculum that can transform your life from one of placid, plodding, ordinariness—to a full, happy, successful life of leadership in the fastest growing industry in the world.

Having expressed my pride in the past of the educational system and institution I represent, I make this pledge:

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Precise Development Corp.'s Model 300 oscilloscope incorporates such features as 7" tube, sweep magnifier, complete push-pull vertical from input through output, blanking amplifier, internal square-wave calibrator, gated output with cathode follower, reversible polarity, driven and non-driven sweep, astigmatism circuit, and illuminated scale, to mention just a few.

nal at the output which has the same phase (approximately) as the input signal. By the same token, pass a signal through one or any odd number of amplifiers and its phase will be reversed.

3. *Intensity Modulation.* This is a binding post on the front panel which is electrically connected to the grid (or cathode) of the cathode-ray tube. Its purpose is to permit a voltage to be applied to the cathode-ray tube so that portions of the trace may be made brighter or darker, as the case may be. This process of varying the beam intensity is known as intensity modulation and many oscilloscopes contain some provision for achieving it. Ordinarily the television technician has little need for this facility; however, it is employed in using the oscilloscope for frequency comparisons.

An application that several oscilloscopes have made of intensity modulation that can be of use to the television technician is the addition of a control known as the "Blanking Phase" control. This control, when turned from its "Off" position, applies a sine wave of voltage to the control grid of the cathode-ray tube. This has the effect of intensifying the trace during a portion of the sine wave cycle and of blanking it out during its most negative portion. The most useful application of this function is the elimination of one of the dual patterns obtained in the sweep alignment of TV and FM receivers. The 60-cycle sine wave applied to the grid of the CRT is so phased, by means of the "Blanking Phase" control, that when the second pattern should be traced out, the beam is blanked out. This results in one pattern, which is much easier to work with.

In working with oscilloscopes or in reading the instruction manuals that

accompany them, it will be found that the horizontal input terminals are sometimes called the "*X*" axis. This terminology was borrowed from mathematics where it is customary to refer to all horizontal axes as "X" axes. By the same token, the vertical input terminals are referred to as the "Y" axis. And, to complete the analogy, the intensity modulation terminal is known as the "Z" axis.

4. *Self-Measurement of Peak-to-Peak Voltages.* In servicing a television receiver, it is important not only to observe whether the wave possesses the proper shape but frequently also whether its amplitude is correct. The latter is especially critical in horizontal and vertical sweep systems. Inclusion of some means for measuring the peak-to-peak values of a wave is becoming increasingly popular in oscilloscopes. In its simplest form the manufacturer provides a terminal on the front panel which is internally connected to one of the windings of the power transformer. Usually this is the 6.3-volt winding. When this voltage is connected to the vertical input terminal, by means of a short jumper, the sine wave produced on the screen has a peak-to-peak value of 17.64 volts. This is because 6.3 is the r.m.s. value. When this is multiplied by 2.8 it becomes peak-to-peak.

For convenience, the height of the 17.64-volt wave is adjusted (by means of the vertical gain control) until it occupies one inch vertically on a ruled screen mask. Then the reference voltage is removed and the unknown voltage applied in its place to the vertical input terminal. The height of this wave is then compared to the height of the 17.64-volt wave and by means of a simple proportion, its peak-to-peak value is determined.

Reference voltage values of 1 volt, 3 volts, and 10 volts are also popular in place of 6.3 volts. Sometimes the values are given as r.m.s. and sometimes as peak-to-peak. If in doubt check the instruction manual before using.

Other oscilloscopes have more elaborate measuring systems, some using a selector switch with a series of different voltages available and some going so far as to include a voltmeter on the front panel. Generally, the more reference voltages there are, the more accurate the measurement of the unknown voltage.

When a scope does not contain provision for the self measurement of peak-to-peak voltages, there are voltage calibrators available. These are instruments providing reference voltages which are first placed on the scope screen to calibrate the instrument and then removed while the unknown voltage is exhibited on the screen. Since these units are specifically designed for this purpose, they are frequently simpler to use than the scope system.

5. *Probes.* Television receivers contain many circuits in which only r.f. signals are present. If it is desired to

observe the signal waveforms in these circuits, then an r.f. probe must be employed between the scope and the receiver. The probe contains a germanium crystal or a miniature diode which detects the received signal and then applies the low-frequency modulation of the signal to the vertical input terminals of the scope for screen presentation.

A second type of probe which is finding increasing favor is the low-capacity probe. This probe permits the proper observation of waveforms in circuits that are capacity sensitive and where use of normal test leads would result in a distorted pattern on the screen.

Both probes are auxiliary pieces of equipment and are usually not included with the price listed for the oscilloscopes in Table 1. However, they do serve useful purposes and are recommended. When purchasing these units, obtain those specifically designed for your instrument. This is especially important in the case of the low-capacity probe.

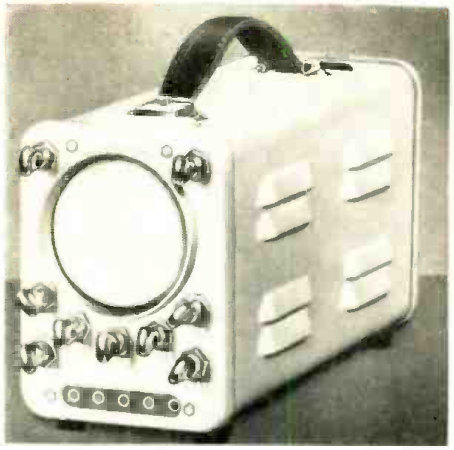
Bandpass vs. Sensitivity

The function of the vertical amplifiers in an oscilloscope is to amplify applied signals in order that they may be sufficiently powerful by the time they reach the deflection plates to produce a sizable pattern on the screen. The greater the amplification available in this system, the smaller the input signal needed to produce a given vertical deflection. In other words, the oscilloscope becomes more sensitive as a measuring device.

Of importance, too, in the vertical system is its bandpass or its ability to amplify a range of frequencies. The signals whose waveshapes are portrayed on the oscilloscope screen are those found in television receivers, *i.e.*, square waves, saw-tooth waves, and video signals, to mention the more common ones. Each of these waves contain a number of frequencies and to accurately depict their waveshapes, every frequency contained in the wave should be passed by the vertical amplifier system. For accurate television signal observation, this can mean a 4-mc. (or more) bandpass.

The objectives, then, in designing an amplifier for use in the vertical system of an oscilloscope are wide bandpass and high amplification. Unfortunately, for any given circuit, bandwidth × gain is a constant which means that if we increase the bandpass by a certain amount, we decrease its gain by the same factor. Thus, one works against the other and if we desire a wide bandpass, we must make up for the resultant gain reduction by adding more amplifier stages. This, in turn, raises the cost of the instrument.

Most manufacturers of moderately priced equipment resolve this conflict by designing the vertical system amplifiers to possess a nominal bandpass (top limit from 250,000 cycles to 1,000,000 cycles). A few manufactur-



A. C. Cossor Ltd., parent company of Beam Instruments Corporation of New York, offers the Model 1039B for the American market.

ers give the instrument user a choice between high sensitivity and wide bandpass by providing a suitable switching arrangement. This, for example, is true of the *Jackson* Model CRO-2 oscilloscope. The "Vertical Input" control has three positions where the vertical system possesses a wide bandpass (response uniform within 10% from 20 cycles to 4.5 mc.) with a fair amount of gain and three positions where the bandpass is reduced (uniform within 10% to 100 kc.), but the gain is up. For each of these positions, attenuation ratios of 100:1, 10:1, and 1:1 are available.

In the *Triplett* oscilloscope, there is a switch at the rear by means of which the bandwidth of the vertical system can be widened from its normal value of 2 mc. to a special value of 4 mc. However, in the 4 mc. position, the system gain is cut in half.

This matter of bandpass is a source of confusion to many technicians. Just how wide should the vertical system bandpass be for suitable application to TV receiver servicing? The answer to this can be found by analyzing where (and how) the oscilloscope is employed. Broadly speaking, the scope is used in conjunction with a sweep generator to depict the response curve of a circuit or it is used for servicing to show whether or not a signal is present at a certain point in a circuit and, if so, what its shape is.

Oscilloscope use with a sweep generator requires that it be capable of depicting a waveform having a repetition frequency of 60 cycles—this being the rate at which the response pattern is swept out. Hence, the vertical system bandpass should extend down below 60 cycles, preferably 30 cycles or less. The lower this limit, the more linear the response will be at 60 cycles.

For servicing, the oscilloscope finds its greatest application in checking voltage waveforms in stages located beyond the video second detector. These include the video amplifiers, sync separator stages, and the vertical and horizontal sweep systems. In all but the video amplifier stages, the fundamental frequencies are low (either

60 cycles for the vertical sweep system or 15,750 cycles for the horizontal sweep system). The rectangular pulse or saw-tooth waveforms in both systems have components that extend to the fifteenth harmonic (or so) and taking this into consideration only requires that the bandpass be uniform to a maximum of 240,000 cycles.

In the video amplifier stages, the full 4.0 mc. video signal is present, but in everyday servicing you are interested primarily in determining whether the video signal is present rather than accurately depicting its waveshape. Hence, any oscilloscope which possesses a uniform vertical frequency response in excess of 240,000 cycles will be quite suitable for television receiver servicing.

What about those scopes where the vertical response is less than 240,000 cycles? These units can still be used for TV servicing but, of course, the narrower their bandpass, the less accurate will be the reproduction of steep-sided waveforms. Frequently a compensating factor here is lowered cost and this can be very important to the man of limited means. The author has seen scopes with a bandpass of 100 kc. successfully used, but for the beginner the wider bandpass will lead to less confusion.

Oscilloscopes are not the simplest of instruments and individual eccentricities have a lot to do with the one best suited for you. Your best bet is to try to work with as many different scopes as possible and then buy the unit you find easiest to use. —30—

S-38B IMPROVEMENT

By R. E. FRANKLIN, W2EUF

A number of the popular Hallicrafters S-38B receivers are known to suffer a serious volume loss and frequency shift when switched from AM to c.w. These sets use regeneration in the i.f. stage to produce beat-frequency oscillation. Reducing the feedback voltage as follows will decrease the frequency shift and the c.w. volume will be stepped up tremendously.

Originally, the regeneration was obtained from an insulated wire wrapped around pin 4 of the 12SK7 i.f. amplifier tube. By cutting off about an inch of this wire and bringing it within an eighth-inch of pin 4 a point can be found, by trial and error, that will produce the desired results. This will take some care as the hand must be withdrawn each time the wire is moved to avoid body-capacity effects. The wire should be affixed in the correct spot with a generous amount of cement.

In one conversion, one end of a piece of 300-ohm ribbon about three inches long was suspended between pin 4 and a terminal strip anchored by the lug of the i.f. can. The "wrap-around lead" was brought to this terminal and soldered. There will be capacity between the two wires of the ribbon as between the plates of a condenser, and the feedback condenser thus formed can be adjusted to a suitable value by snipping off small pieces of the 300-ohm ribbon. Do not cut the ribbon until power is removed from the set. —30—

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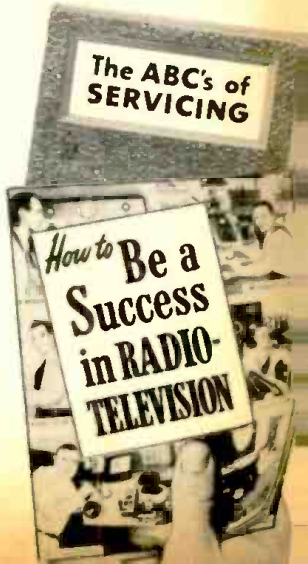


Train at Home to Jump Your Pay as a RADIO-TV Technician

J. E. Smith, *President*
National Radio Institute

The men whose letters are published below were not born successful. At one time they were doing exactly as you are doing now . . . reading my ad! But they acted. They decided they would know more . . . so they could earn more! They acted! Mail the card now for my 2 books FREE.

There's a Bright Future for You in America's Fast Growing Industry

Do you want good pay, a job with a bright future, security? Would you like to have a profitable business of your own? If so, find out how you can realize your ambition in the fast growing RADIO-TELEVISION industry. Even without Television, the industry is bigger than ever before. 105 million home and auto radios, 2900 Radio Broadcasting Stations, 108 TV Stations with 1800 more now authorized. Expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc., are making opportunities for Servicing and Communications Technicians and FCC Licensed Operators.

NRI Training Can Lead to Jobs Like These in RADIO-TELEVISION

BROADCASTING
Chief Technician
Chief Operator
Power Monitor
Recording Operator
Remote Control Operator

SERVICING
Home and Auto Radios
P.A. Systems
Television Receivers
Electronic Controls
FM Radios

IN RADIO PLANTS
Design Assistant
Transmitter Design Technician
Service Manager
Tester
Serviceman
Research Assistant

SHIP AND HARBOR RADIO
Chief Operator
Assistant Operator
Radiotelephone Operator

GOVERNMENT RADIO
Operator in Army, Navy, Marine Corps, Coast Guard
Forestry Service Dispatcher
Airways Radio Operator

AVIATION RADIO
Plane Radio Operator
Transmitter Technician
Receiver Technician
Airport Transmitter Operator

TELEVISION
Pick-up Operator
Voice Transmitter Operator
Television Technician
Remote Control Operator
Service and Maintenance Technician

POLICE RADIO
Transmitter Operator
Receiver Serviceman

You Learn by Practicing with Kits I Furnish

With both my Servicing Course and my NEW Communications Course I send you many Valuable Kits of Parts. They "bring to life" theory you learn in my illustrated texts. Mail card for my big 64-page book. It shows photos of equipment you build from kits I send.

My Training Includes Television

Both my Servicing and Communications Courses include lessons on TV principles. You get practical experience by working on circuits common to both Radio and Television. My graduates are filling jobs, making good money in both Radio and Television. Remember, the way to a successful career in Television is through experience in Radio.

Send NOW for 2 Books FREE
Mail the Postage-Free Card NOW!

What will YOU be doing one year from today . . . will you be on your way toward a good job of your own in a Radio and Television service shop or business? Decide now that you are going to know more and earn more! ACT NOW! Take the important first step to a career and security. Send the postage-free card now for my FREE DOUBLE OFFER. You get Actual Servicing Lesson. Also my 64-page book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning; see equipment you practice with at home. Mail card now. J. E. SMITH, President, National Radio Institute, Washington 9, D.C. Our 39th year.

I TRAINED THESE MEN

Handicapped but Successful
"I am now Chief Engineer at WHAW. My left hand is off at the wrist. A man can do if he wants to." R. J. Bailey, Weston, W. Va.

$10 a Week In Spare Time
"Before finishing, I earned as much as $10 a week in Radio servicing, in my spare time. I recommend NRI". S. J. Petruff, Miami, Fla.

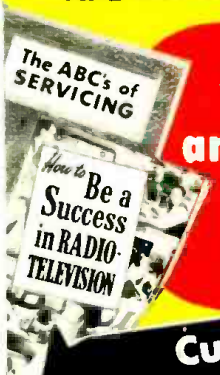
Control Operator, Station WEAN
"I received my license and worked on ships. Now with WEAN as control operator. NRI course is complete." R. Arnold, Rumford, R. I.

Trained Men Make Money in TV
"I am now servicing Television. Your course enabled me to repair TV receivers without any trouble." R. Currier, Fair Haven, Vt.

Has Growing Business
"Am becoming expert Teletrician as well as Radiotrician. Without your course this would be impossible." P. Brogan, Louisville, Ky.

Got First Job Thru NRI
"My first job was with KDLR. Now Chief Engr. of Radio Equipment for Police and Fire Dept." T. Norton, Hamilton, Ohio.

Find Out What RADIO-TV Offers You



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Washington 9, D. C.

Make Extra Money While Learning

Keep your job while training. Many NRI students make $5, $10 and more a week extra fixing neighbors' Radios in spare time while learning. I start sending you special booklets that show you how to service sets the day you enroll. Multi-tester you build with parts I furnish helps discover and correct Radio troubles.

Want Your Own Business?

Many N.R.I. trained men start their own business with capital earned in spare time. Let me show you how you can be your own boss . . . Robert Dohmen, New Prague, Minn., (whose store is shown at right) says, "Am now tied in with two television outfits and do warranty work for dealers. Often fall back to N.R.I. textbooks for information on installing Television sets."

Mac's Service Shop

(*Continued from page* 60)

to meet competitive prices and for not having limitless time at their disposal for working out every last bug from a new model. You do not seem to realize that you are second-guessing all of these errors. They might prove to be a lot harder to see if you were depending upon foresight instead of hindsight.

"And this prod is for your doing all your yelling where it will do no good. If you see a mistake has been made in the design of a chassis or a record-changer, why don't you sit down and write a courteous letter—not one of the smart aleck, how-can-you-be-so-dumb type—to the manufacturer telling him what you have found and making suggestions for correcting the trouble? You may be surprised at the apprecation he will show, and you can be certain he will not repeat the mistake in future models.

"I might suggest, too, O Bumptious One, that sometimes you are guilty of trying to blame your own lack of service skill and enterprise on to the set-maker. Time after time I have seen your kind try to persuade yourself that a poorly-operating set never did work any better, that it was *made* that way; consequently, nothing could be done about it. How you can make yourself believe anyone would pay his good money for a new receiver in that condition I'll never know. If you would concentrate more on improving your own knowledge and technique instead of always being so alert to catch the manufacturer off base, you'd be a better technician for it."

"Hey, lemme see that technician-doll of yours," Barney demanded as he grabbed it from Mac's hand. "Uh huh, it's just as I thought. Did you *have* to make him with red hair?" he asked plaintively.

"You know," he went on reflectively, "I'm beginning to think there is something in this voodoo stuff after all. I could have sworn that I actually felt some of those jabs you gave this little feller."

"Imagination—and a guilty conscience—can play strange tricks." Mac commented; "but let's get away from all this hocus-pocus and talk a little sense. I ran across something yesterday I think may interest you. A fellow came in with the complaint that his radio-controlled garage door had suddenly become very erratic in its behavior. It opened and closed of its own accord while the car that had the controlling transmitter was miles away and the transmitter was shut off.

"I went over and checked the thing over carefully, but I couldn't find a thing wrong with it: a good healthy signal from the transmitter was required to trip the pilot relay; there were no gassy tubes to cause trouble; running the line voltage up and down made no difference. First thought of mine was that possibly a harmonic of a ham transmitter was getting into the receiver and making the relay trip, for I have read of that; but since Ten went dead none of the local gang are working the high-frequency bands; so I decided to look for something else. I asked the man if any new electronic equipment had been installed in the neighborhood lately, and after I explained what 'electronic equipment' was, he said all he could think of was a new TV set in the house across the street that had been in for a couple of weeks.

"Playing a hunch, I went over and asked the folks if they would mind turning on their TV receiver for a few minutes. As I stood in front of the receiver I could see the closed garage doors; and when I turned the channel selector to Channel 10, the doors opened up. I tried it two or three times, and every time the set was tuned to Channel 10, the doors worked. With the i.f. used in that set, the oscillator was on about 219 megacycles when the receiver was tuned to Channel 10, and that is squarely inside the 210-250 megacycle band in which the door-opener works. Fortunately, provision had been made for using any one of six different frequencies in the garage-door setup; so I just moved the transmitter to a different frequency and peaked up the receiver on that. When this was done the TV set could be switched to any channel without affecting the doors."

"That is one for the book," Barney said; "and it just goes to show you what a hefty signal is radiated from the oscillator of some of the TV receivers. No wonder we hams get the blame for a lot of blanking out and herringbone patterns that are caused by a neighbor's TV set tuned to a lower channel!" —30—

Within the Industry

(*Continued from page* 26)

Transicoil Corp. has appointed **DWIGHT W. BLOSER** to the post of chief engineer in the manufacture of control motors, induction generators, gear trains, and servo amplifiers.

* * *

DR. JOHN RUZE has been appointed director of research of *The Gabriel Laboratories, Division of The Gabriel Company.*

He joins the company from the Air Force Cambridge Research Laboratories, where he was assistant chief of the antenna laboratory. During the war he headed the antenna design section at the Signal Corps Engineering Laboratories.

A native of New York, Dr. Ruze received his doctorate from the Massachusetts Institute of Technology after completing his work for his MS degree at Columbia. —30—

McGEE'S $250,000 PUBLIC ADDRESS SYSTEM SALE!

FEATURING 3-SPEED PHONO AND TWIN 12" ALNICO V SPEAKERS

IMMEDIATE SHIPMENT AT UP TO 60% SAVINGS!

5 Trailer loads—over $250,000 worth of underwriters lab. approved public address systems on sale at McGee for a fraction of the original price. Purchased from one of the largest mail order companies in the United States. These amplifiers are made of the finest material to U. L. standards for 105 to 125 volt 60 cycle operation. Compare their weight with other amps and you can see for yourself. Follow our ordering instructions for immediate delivery.

HOW TO ORDER: Send full remittance and you save the added C.O.D. collection fee, or if you wish include a 25% deposit and the shipment will be made C.O.D. for the balance. All prices F.O.B. Kansas City, Missouri. Specify whether you wish shipment to be made by Express or Truck. Amplifiers are not mailable.

28 WATT $150.00 LIST PORTABLE P. A. ON SALE $69.95

3-SPEED PHONO TOP—TWO 12-INCH SPEAKERS
7-TUBES PUSH PULL 6L6'S HEAVY LEATHERETTE COVERED PLYWOOD PORTABLE CASES
CRYSTAL MIKE $8.95 EXTRA

STOCK No. AP-28X. Portable 28 watt public address system. You get a 7 tube heavy duty push pull 6L6 amplifier with inputs for 2 mikes either crystal or dynamic with separate mixing volume controls. One phono input. Fully variable tone control high fidelity, wide range frequency response. The heavy duty output transformer has taps for 4, 8, 16, 125, 250 and 500 ohm speaker connections. Two heavy duty 12 inch alnico V P.M. speakers, each with 25 feet of speaker cable. Each speaker is mounted in separate carrying cases. Each case has a snap on back and is large enough to give good speaker baffling. Each case is 21 x 16 x 13 inches. One is used to carry the amplifier. A 3 speed phono motor and pick up is mounted in the top of the amplifier to play 33⅓, 45 and 78 RPM records.
This portable P A system will put out 20 watts all day long and 28 to 30 watts peak audio. McGee offers you this $150.00 list portable P A system at a terrific saving.
STOCK NO. AP-28X complete portable PA system with 3 speed phono and speakers as pictured (less mike) ship. wt. 71 lbs. **$69.95.**
Electro Voice model 910 $28.50 list crystal mike with 20 feet of cable and desk stand **$8.95** extra.
Floor type mike stand instead of desk stand **$4.95** extra.
(SEE OFFERING TO THE RIGHT FOR WALL SPEAKERS INSTEAD OF THE PORTABLE SPEAKERS.)

28-WATT AMPLIFIER WITH 12-INCH WALL SPEAKERS

The 28 watt amplifier shown to the left is also offered without the portable speakers. In their place we will ship two Seeburg walnut wall baffles with two heavy duty 12 inch alnico V magnet PM Speakers and 500 ohm line matching trans. Stock No. SS-28H 28 watt amplifier with 3 speed phono top with two 12 inch wall speakers. **$69.95.** Extra 12 inch wall speakers **$11.95.** Model 910 Electro Voice mike **$8.95** extra. Floor stand **$4.95** extra.

50 WATT $250.00 LIST PORTABLE P. A. ON SALE $99.95

3-SPEED PHONO TOP—TWO 12-INCH SPEAKERS
10 Tubes — 4 6L6's
Heavy Plywood Tan Leatherette Covered Cases

DYNAMIC MIKE $11.95 EXTRA

STOCK No. AP-60X. Portable 50 watt public address system. You get a 10 tube amp with (4-6L6) push pull parallel 6L6 output tubes. Inputs for two mikes either crystal or dynamic, with separate mixing type volume controls. One phono input. Twin tone controls one for bass the other for treble high fidelity wide range frequency response. The heavy duty output trans. has taps for 4, 8, 16, 125, 250 and 500 ohm speaker connections. Two super heavy duty 12 inch 20 oz. alnico V magnet PM speakers with 25 foot cables and plugs. Each speaker is mounted in large separate cases, one is used to carry the amp. Each case is 21 x 21 x 13 inches with removable snap on backs. Twice the ordinary size to give proper speaker baffling. This is the most powerful portable PA system we have ever offered. Most 4-6L6 amps of this size and weight are rated 60 watts. This amp will put out 40 watts all day long and 50 to 60 watts with ease. Equipped with a 3 speed phono motor and pick up to play all records, 33⅓, 45, 78 rpm. A **$250.00** list value. Ship. wt. 100 lbs.
Stock No. AP-60X portable PA system as pictured less mike. Sale price **$99.95.** Reg. **$45.00** list Electro voice model 610 dynamic mike with 20 feet of cable and desk stand **$11.95** extra.
If floor stand is desired instead of the desk stand add **$4.95.**
(SEE OFFERING TO THE RIGHT FOR WALL SPEAKERS INSTEAD OF THE PORTABLE SPEAKERS.)

50-WATT AMPLIFIER WITH 12-INCH WALL SPEAKERS

The 50 watt amplifier shown to the left is also offered without the portable speakers. In the place we will ship two Seeburg walnut wall baffles with two super heavy duty 12 inch alnico V pm speakers with 500 ohm line trans.
STOCK No. SS-60X 50 watt amplifier with 3 speed Phono and 2 12 inch wall speakers. **$99.95.** Electrovoice 610 dynamic mike **$11.95** extra. Floor stand instead of desk stand **$4.95** extra.
Extra 12 inch speakers and wall baffles **$14.95.**

10 WATT $90.00 LIST PORTABLE P. A. ON SALE $42.95

STOCK NO. AP-11X. A 5 tube 10 watt (14 watts peak) push pull 7C5 U. L. approved amplifier with wide range frequency response. Inputs for one mike and one phono. Separate mixing volume controls. Fully variable tone control. Heavy plywood leatherette covered case is equipped with a heavy duty 10 inch Alnico V magnet PM speaker. The amp fits inside the speaker case. Case size 21 x 16 x 13 inches has removable snap on back. (note, this portable system has only one speaker whereas the 28 and 50 watt models shown above have two). The top of the amplifier is equipped with a 3-speed phono motor and pick up for all records, 33⅓, 45, 78 rpm—this portable PA system has a list value of **$90.00.** Offered by McGee at a terrific saving.
STOCK NO. AP-11X. 10 watt portable PA system with 3-speed phono. Ship wt. 41 lbs. Sale price as pictured less mike **$42.95.** Crystal mike with non removable desk stand **$3.95** extra.

3-Speed Phono Top—Heavy Plywood, Tan Leatherette Case
10" Alnico PM Speaker—Crystal Mike $3.95 Extra

The 10 watt portable PA system shown on the left is offered less the phono top. Specify stock No. AP-11NO. Sale price **$34.95** less mike. Crystal mike with non removable desk stand **$3.95** extra.

McGEE'S $62.50 LIST 15" COAXIAL SPEAKER, $21.95

21 OZ. ALNICO V MAGNET—5" TWEETER

This is the finest 15" coaxial PM speaker value that we have ever offered. New 1952 production, of a famous manufacturer of fine speakers. The 15" speaker has a 21⅛ oz. Alnico V magnet; equal to 68 oz. of the Alnico 3 type magnet. The cone is free floating, of one piece construction, will reproduce low frequencies down to 20 cps. The 5" tweeter is coaxially suspended and has a ridged cone to reproduce only the high frequencies. It will respond up to 17,500 cps. The high-pass filter is concealed under the pot cover, leaving only two wires to connect both the tweeter and woofer to any 8 ohm output transformer of a radio, or high fidelity music lover's amplifier. Stock No. P15-CIC, shipping weight 13 lbs. Net price **$21.95.**

12" COAXIAL SPEAKER, $12.95

McGee offers the new 1952 model 12" coaxial PM speaker. Quality you would put in your finest sets if you were a manufacturer. 12" woofer has 6.8 oz. Alnico V magnet. Tweeter is coaxially suspended and has a metal diffuser. High pass filter is under pot cover. Only two wires to connect to your radio or audio amplifier. 8 ohm with 18 watt peak and 10 watt average. Shipping weight 8 lbs. Response from 30 to 17,500 cps. Stock No. CU-14Y. Sale price **$12.95** each; 2 for **$25.00.**

12" JENSEN PM, $15.95

Another McGee Scoop! Jensen Concert 12" 14½ oz. Alnico V magnet PM speaker, 8 ohm voice coil. Will take 25 watt audio. You save dollars on this speaker. Just 100 to sell. Shipping weight 8 lbs. Stock No. P-12P. Sale price **$15.95**; 2 for **$30.00.**

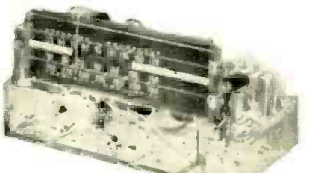
G.I. 3-SPEED CHANGER WITH G.E. VARIABLE RELUCTANCE TURN-ABOUT CARTRIDGE $22.95

Another tremendous McGee Scoop! Brand new General Instrument 3-speed automatic record changers. Complete with RPX-050 G.E. variable reluctance cartridge with turn-about stylus. Plays all 3 speeds automatically: 7", 10" or 12" records. Has reject button. Repeats last record. Base size, 12"x12⅝". Shipping weight 14 lbs. Stock No. 700-GE. Scoop price. $22.95.

GI 3-speed changer same as above, but with Webster flip-over twin needle cartridge. Stock No. GI-700. Sale price, **$21.95** each.

ESPEY 12-TUBE FM-AM CHASSIS, $59.95

- ★ BUILT-IN PRE-AMP FOR G.E. VARIABLE RELUCTANCE PICK-UP
- ★ WIDE RANGE AUDIO
- ★ WHY NOT ORDER WITH A COAXIAL SPEAKER AND A RECORD CHANGER? SEE OUR SPECIAL OFFERING



McGee's new 1952 model 12-tube FM-AM chassis. Latest design with phono inputs for all types of record players, crystal or G.E. variable reluctance. Receives standard broadcast 550 to 1700 kc and FM 88 to 108 mc. Wide range audio response (push-pull 6V6 output) and bass boost tone control. Loop antenna for broadcast and 300 ohm line type FM antenna may be stapled in cabinet. Attractive lighted slide rule dial. Chassis size, 13½" x 9" high and 9" deep. Complete with tubes: 6BE6, 6BA6, 6BA6, 12AT7, 6SH7, 6AL5, 6SQ7, 6SQ7, 12AT7, 2—6V6GT and 5Y3GT rectifier. Shipping weight 20 lbs. Stock No. 7C-X Espey 12-tube FM-AM chassis. Sale price, **$59.95,** less speaker. Output matches voice coil of our 12" or 15" coaxial speakers.

ESPEY DEAL (1), $99.95

Espey 7-C chassis complete with 12" coaxial PM speaker CU-14Y and VM-950 G.E. 3-speed changer equipped with a G.E. turnabout variable reluctance cartridge. A better home music system than ordinarily available. Espey Deal #1. Sale price **$99.95.** With 15" coaxial PM speaker P15-CIC instead of CU-14Y, **$10.00** extra.

ESPEY DEAL (2), $118.95

Espey 7-C chassis complete with 12" coaxial PM speaker CU-14Y and the English Garrard 3-speed changer equipped with a G.E. variable reluctance turnabout cartridge. Our best home music system. Espey Deal #2. Sale price **$118.95.** With 15" coaxial PM speaker P15-CIC instead of CU-14Y, **$10.00** extra.

ESPEY DEAL (3) $138.95

Espey 7-C chassis complete with THREE 12" coaxial PM speakers CU-14Y (these three 12" coaxial speakers give a cone area equal to an 18" speaker) and a Garrard 3-speed changer with G.E. variable reluctance turnabout cartridge, Espey Deal #3. Sale price **$138.95.**

McGEE RADIO COMPANY

Prices F.O.B. K.C. Send 25% Deposit with Order, Balance Sent C.O.D. With Parcel Post Orders, Include Postage

TELEPHONE VICTOR 9045. WRITE FOR FLYER 1422 GRAND AVE., KANSAS CITY, MISSOURI

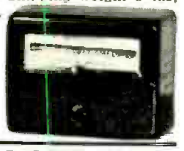
LOOK TO McGEE FOR ALL RADIO AND TELEVISION MATERIAL

GENUINE STANDARD COIL T.V. BOOSTER $11.95

Not Surplus, But Right From the Factory

Latest Model B-51 Standard Coil Television Booster. McGee makes another lucky purchase and as usual, passes the saving on to you. The famous Model B-51, 12 Channel Standard Coil TV booster, which lists for $35.00, is offered to you for only $11.95 each. Brand new, factory cartoned and fully guaranteed by McGee. This top quality single stage booster utilizes printed high frequency circuits, for improved performance on all channels. Uses 6AK5 tube. Average gain, 6 to 7 volts on low channels and 5 or 6 on high channels. No distorting of picture or sound. Has extremely low noise factor. Continuous one-knob tuning and channel selector control switch for off-on and by-passing 300 ohm lead-in to set. Modern design, dark brown plastic cabi. net, 8"x4¼"x4½". Made for 110 volt, 60 cycle AC operation. Shipping weight 5 lbs. Model B-51, Sale price, $11.95 each, or buy 2 for only $22.00.

McMURDO SILVER BOOSTER $10.95



Sensational value. Continuously variable inductance type tuner, from channel 2, including the FM band, through channel 13. This booster is self powered for 110 volts AC operation. Incorporates a 6J6 tube. Input for 300 ohm TV line and 300 ohm output to the TV set. Single knob tuning. Attractive plastic case. McMurdo-Silver Super Sonic TV-FM booster, Stock No. G11-6B. Shipping weight 5 lbs. McGee's terrific sale price, $10.95 each, two for $20.00.

1952 MODEL ASTATIC $19.10

New Astatic "Seanafar" TV booster with improvements to match the newer model TV receivers. Minimum noise with maximum gain. Balanced cascoded circuit with 6J6 and 6BQ7. Input and output for both 72 and 300 ohm. Mahogany finished metal cabinet 6½x4⅞x4¾" high. Model CT-1. Net price $19.10.

1952 MODEL REGENCY $19.10

New Regency DB-520 TV booster with exclusive circuit stabilizer and newly designed cabinet only 4½x6x4½". Improved circuit with push-pull 6J6 is equal to the best cascode circuits and has higher gain. Matches 72 or 300 ohm. Net price $19.10.

14-17-20 INCH CONV. KITS AT SCOOP PRICES

20 IN. CONV. KIT $29.95

Our 20" conversion kit includes a 6-month guaranteed 20HP4, 20" rectangular blackface picture tube, plus a 14,000 volt G.E. built high voltage flyback transformer, plus a matched 70° cosine yoke, plus a 20" rectangular gold trimmed plexiglas mask and suggested diagram. The picture tube is the latest electro-static focus type that requires no focus coil. Shipped via express or truck only. Ship. weight, 40 lbs. Stock No. 20-TP. net price, $29.95.

14-INCH CONVERSION KIT $19.95

Our 14" conversion kit includes an RCA 14CP4, 14" rectangular blackface tube, plus a 14,000 volt G.E. built flyback, plus a 70° cosine yoke, plus a 14" plexiglas gold trimmed mask. Offered at the very low price of only $19.95. Suggested diagram furnished. Ship. weight, 20 lbs. Via express or truck only. Stock No. RC-14X, net price, $19.95.

17-INCH CONVERSION KIT $24.95

Our 17" conversion kit includes a 6-month guaranteed 17HP4 blackface rectangular picture tube, plus a G.E. built 14,000 volt flyback, plus a matched 70° cosine yoke, plus a gold trimmed 17" plexiglas mask, and suggested diagram. The 17HP4 is the latest electro-static focus tube that requires no focus coil. Shipped via express or truck only. Stock No. 17-TP4. Net price, $24.95.

RED HOT INTERCOM VALUE!

3-STATION INTERCOM MASTER, $14.95

USE UP TO 3-SUB STATIONS, $4.49 EACH

A red-hot intercom master value. A full 3 tube, 110 volt AC-DC master, with 3 station selector switch and easy accessible volume control. Small compact size, 5"x9"x6½" high. Makes an attractive intercom installation. May be used with from one to three of our G-4T substations described below. Intercom master is quiet at all times, except when press-to-talk switch or call-back switch at one of the subs is pressed. Shipping wt. 5 lbs. Stock No. KA-3, master station, less subs. Net $14.95. Stock No. G-4T, brown plastic substation, with 4" PM speaker and call-back switch. May be purchased with or without master station. Shipping weight 2 lbs. Net $4.49 ea. 3 wire plastic intercom cable. 100 ft. $1.95; 500 ft. $8.95.

TERRIFIC VALUES IN SPEAKERS AND BAFFLES

8" PM AND LEATHERETTE BAFFLE, $4.95

LOTS OF 10, $4.75

The finest Leatherette Baffle we have ever offered. New, self-supporting plastic grill material, baffle is covered tan with matching grill. Offered with a good heavy duty 8" Alnico V PM speaker with 3.2 ohm voice coil. Stock No. 8-18. Speaker and Baffle, $4.95 ea.; lots of 10, $4.75. 8". Baffle only. Stock No. NV-8, $2.29 ea.; 10 for $19.95.

12" PM AND WALNUT BAFFLE, $9.95

LOTS OF 3, $8.95

The finest built 12" Walnut plywood wall baffle we know of. Factory cost of the famous juke box manufacturer exceeds $7.00, we offer with a 12" PM for little more. You pay only $9.95 in single lots, or $8.95 in 3 lots for both a 12" Alnico V PM with 3.2 ohm voice coil and the beautiful wall baffle. 12" Speaker Baffle combination, Stock No. HS-120, $9.95 ea.; lots of 3, $8.95 ea. 12" Baffle only, SEG-12, $4.95 each.

RCA 201E1 T.V. TUNER $7.95

Terrific buy on this RCA tuner. We have a limited quantity of the famous original 201E1, 13 channel completely wired and tested TV front end tuners. Ready to connect to your TV video I.F. strip. Offered at a sacrifice. Price was $41.00. Now only $7.95 each, with tubes. Each tuner in good condition but has been repaired. Stock No. RCA-13P, TV front end tuner. Convertor coil type for separate sound as used in the famous 630 chassis. Complete with 3—6J6 tubes, $7.95. Specify shaft length desired, either 2" or 4".

RCA 201E-1 T.V. TUNER

Same as pictured above only new—with tubes. Stock No. 2Z01. Sale Price, $11.95.

3-TUBE SARKES-TARZIAN T.V. TUNER $9.95

This popular Sarkes-Tarzian Type 3 tuner is widely used. 13 channel rotary type switch with individually tuned coils. Price is complete with diagram and three tubes: 6C4 osc., 6BH6 R.F. and 6AG5 mixer. Regular factory cost is twice our price. Each tuner is wired ready to hook up to a video and sound IF strip. May be used with either inter-carrier or separate sound IF circuits. Has built-on convertor coil, built in fine frequency control. Sarkes-Tarzian TV tuner, with 3 tubes. Net price, $9.95 each. Specify shaft length, either 27/8" or 43/4".

RCA PRINTED CIRCUIT T.V. TUNER $14.95

RCA Printed Circuit T.V. Tuner with 6J6 and 6CB6 tubes. Similar mechanically to the standard coil (same knobs fit). Snap-in channel segments. Has 6½" shaft. Used on late Hallicrafters T.V. sets. Stock No. RC-A12. 12 Channel Tuner with Tubes. New, $14.95. Knobs, 59c.

T.V. TUNER FOR EMERSON $12.95

STOCK NO. SC-947E

For Emerson 650D ETC. Has 2½" insulated shaft and tubes 6BC5—filaments in series—shunted to .6 amps. Stock No. SC-947E. Sale Price, $12.95. Knobs, 59c.

T.V.-RADIO NEWS SPECIAL $9.95

3 Flybacks and 3 Deflection Yokes for $9.95. You get 3 deflection yokes, 2—70° yokes, and 1—53° yoke, and 3 horizontal flyback transformers. 2 General Electric 14,000 volt ceramic core 70°, and 1 early model Philco. The G.E. flyback cost regularly more than our price for the complete deal. Stock No. 31YK, ship. weight, 5 lbs. Radio News Special, only $9.95.

T.V. COMPONENT DEAL #CGE $12.95

Here is a terrific TV parts deal for those who repair TV or for the builder and experimenter. You get a Meissner 12-channel TV tuner, a Crosley 5-tube video IF strip, a 14 KV G.E. horizontal output transformer, plus a standard 4-wire vertical output transformer, plus a 70° cosine deflection yoke (no tubes included). It's worth $20.00. Our sale price, only $12.95.

TERRIFIC COMBINATION CABINET SALE

29.95

Originally intended for an Admiral 14" TV combination. Made of walnut veneer, 32" wide, 35⅛" high and 20" deep. Offered at less than the factory production cost. Upper left door is made to swing down, opening record changer compartment, 14½" x 13¾" x 20" deep. Upper right door swings open for the TV compartment. (Note: the TV chassis area is only 14½" wide and 15½" high, 20" deep, limiting the size of TV chassis to a 14" set.) Panel is cut for the 14" Admiral. Up to a 12" speaker may be mounted in the lower right section. Lower left section has hinged door and is for record storage. Brass hardware and matching grill cloth. Shipping weight 60 lbs. Stock No. A-430 mahogany TV combination cabinet. Special Price. $29.95. Blank panel overlay for cut out TV panel, $3.95 extra.

CAPEHART CABINET FOR 1000 SET—ONLY $99.95

EITHER WALNUT OR MAHOGANY

99.95

Beautiful, finest quality walnut combination radio-phono cabinet, 42" high, 42" wide and 22" deep. Made for Capehart's finest combination, selling for $900 and up. Cabinet cost manufacturer over $200.00. Has highly polished matched walnut panels. Made of ¾" material. Top 1½" solid stock. This cabinet weighs approximately 175 lbs. The changer radio and speaker grill all have hinged doors. Radio compartment on right hand side is 14" high and 11½" wide. Made to mount chassis vertically. Changer compartment is 14" high by 26½" wide. Large enough to hold any record changer or recorder mechanism. Front 10" of top over the changer compartment is hinged to fold back for easy access to the changer. Both radio and changer compartments come with unet blank panels. Speaker baffle is cut for a 12" speaker and the speaker compartment is completely enclosed. Shipping weight, 275 lbs. Stock No. K-275 Capehart combination cabinet. Net price $99.95. SPECIFY, when ordering, whether you want Walnut or Mahogany.

COMPLETE RADIO, TELEVISION AND AMPLIFIER KITS AT McGEE

3-WAY PORTABLE KIT

$15.95

A NEW '52 MODEL

New 1952 Model 3-way personal portable radio kit. Operates on 110 Volts AC-DC or 67½ B plus 1½ volt self-contained batteries. Leatherette covered case size, 5½x8¾x8". Receives broadcast & 550 to 1650 KC. A conventional 2-gang superhet circuit with 456 KC iron core IF's. Incorporates the new super gain stick loop antenna. All plated chassis. Lab. approved circuit—matched parts. Price includes all parts, tubes, diagram, Alnico V PM speaker. A factory quality kit. Stock No. PN-4T. shipping weight 12 lbs. The complete kit. Less batteries, $15.95. 67½V. B. $1.59; 1½V. A. 39c extra.

Build Your Own Phono-Mike Broadcaster $7.95

Kit Model DE-6R. With this simple kit, you can build a 3-tube phono oscillator that also has a mike input. Will broadcast over any radio, within your home, (about 75 feet) from 1000 to 1500 kc. Inputs for crystal mike or crystal phono pickup. Fader control fades from mike to record. Ideal for a home P.A. system, baby listener and home entertainment. A complete kit of parts including tubes. Kit Model DE-6R. Net price, $7.95. DE-6RWT, wired and tested. Net price, $9.95. Crystal mike and desk stand, $4.95 extra. Concealed microphone unit, only 1" in diameter and ¼" thick. Specify hidden mike when ordering. Stock No. T-001. Net, $3.95 extra.

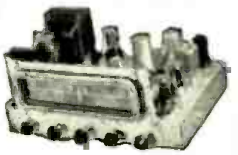
8-Tube Hi-Fi Amplifier Kit $29.95

A complete kit, including tubes: 3-7E5, 2-7F7, 2-6A3, plus rectifier diagram and photos. Inputs for radio tuner and any kind of phono pickup (crystal or G.E. variable reluctance) and either crystal or dynamic mike. Output matches 8 ohm voice coil. Two electronic bass and treble tone controls with range selector switch for either juke box quality with heavy bass response or brilliant symphonic range. Response 18 to 20,000 cps. 8 tube all triode amplifier kit, complete with tubes. Shipping weight 25 lbs. Model 7X5. Net $29.95.

10-Watt Hi-Fi Amplifier Kit $14.95

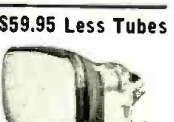
A complete kit of parts including tubes 12AX7, 12AU7, 2-5QL6, plus rectifier, diagram and instructions to build a high fidelity twin tone control audio amplifier with bass and treble boost. Inputs for radio tuner, crystal mike and crystal phono pickup. Output matches 8 ohms. Response from 50 to 15,000 cps. Chassis ready punched. Ventilated cover. Straight forward circuit with twin triode gain stages and 2-5QL6 tubes in push-pull. Size, 5¼" x 10" x 5⅝" high. Model AP-10R, ship. wt. 8 lbs. Sale price $14.95.

10-TUBE RADIO KIT $29.95



10 tube broadcast radio chassis kit, complete with tubes: 2-6SK7, 6SA7, 6H6, 6SQ7, 2-12AX7, 2-6V6 plus rectifier, diagram and instructions. 3 gang superhet with 8" slide rule dial. Chassis size, 12½"x10"x6½" high. Features push-pull 6V6 high fidelity audio. Output matches 3 to 8 ohm voice coil speakers. Inputs for G.E. variable reluctance or crystal phono pickup and crystal mike. Heavy duty power transformer. Model BK-R10 kit less speaker, shipping weight 18 lbs. Net $29.95.

17, 20" T.V. Kit $59.95 Less Tubes



A complete kit of parts to build an AC transformer operated television chassis for use with a 16", 17" or 20" rectangular picture tube. The 12 channel Sarkes-Tarzian tuner is ready wired, as is the 4 tube video IF strip. Circuit is of the conventional design. Do not buy this unless you understand Television. It is difficult to wire. We furnish schematic. Kit model WH-20. Ship. wt. 40 lbs. less all tubes. Net $59.95. Kit of 22 tubes, less picture tube $16.95. 17" 17BP4A, $19.95, 20IP4, $25.00.

6-TUBE 2-BAND KIT $14.95

Popular with schools and colleges for training, 6 tube AC-DC, 2 band radio kit with plastic cabinet. Receives broadcast and 16 mc shortwave. Full 2 gang superhet with 5" speaker and slide rule dial. A complete kit with tubes: 12SK7, 12SK8, 12SK7, 12SQ7, 35L6 and 35Z5, diagram and instructions. Factory quality. Cabinet size 12"x6¾"x8¼". Shipping weight 12 lbs. Model ME6-2. Net $14.95.

5-TUBE AC-DC KIT $12.95

Model RS-5. A 5 tube AC-DC straight broadcast kit, housed in the same cabinet as ME6-2 above. Complete with tubes. Shipping weight 10 lbs.. Net $12.95.

AC POWERED BROADCAST TUNER KIT $12.95

A self-powered, 3-gang superhet tuner kit with R.F. stage. This complete kit is furnished with a diagram, photos and tubes. 6AU6 R.F., 6BE6 oscillator R.F., 6AU6 I.F. detector, 6AL5 diode. AVC. plus rectifier. Connect to any audio amplifier. Ideal for use with our S-2020 or 7x5 amplifier kits. Chassis size, 9½x4x4½" high. Shipping weight, 7 lbs. Broadcast tuner kit Model BT-38X. Net price, $12.95.

$20.00 Amplifier

(Continued from page 45)

The critical point here is that excessive feedback cannot be used, due to the phase shift of the circuits and the transformer, dependent on the instantaneous frequency. The attenuating resistance in the loop has been chosen to develop optimum feedback within the limits of the transformer.

Power was taken from an existing supply, but could as easily have been drawn from a radio or other source. Power supplies are all similar, and any discussion here would be redundant. All that is needed is 350-400 volts at 110-120 ma. The entire circuit is stable, as regards frequency response, and will operate as well with 350 volts as 400, with hardly noticeable loss of power under normal demands.

The cost of all the parts in this amplifier is $20.00 or less.[3] This sum can be flexible since almost endless variation is possible in the actual construction, limited only by the needs and ingenuity of the constructor.

Preamplifier

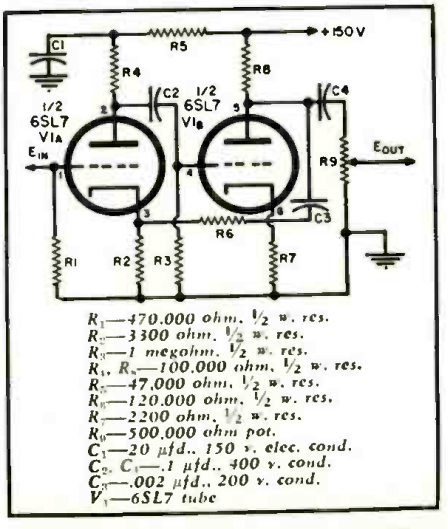
Because six different preamplifiers tried in the past year have been unsatisfactory, the circuit shown in Fig. 6 was built for use with the amplifier. The preamplifier is quite simple, and without complications. Immediately apparent is the absence of tone controls. Distortion created by tone controls is apparent to most listeners only when all tone controls are bypassed, and the sound is heard through a familiar system. The circuit is designed to develop sufficient voltage to drive the amplifier to peak undistorted power when used with a *G-E* RPX-040, or similar type, variable reluctance cartridge.

REFERENCES

1. *Tele-Tech, January 1952, pages 90-94.*
2. *Audio Engineering: "An Ultra Linear Amplifier," November, 1951.*
3. *Allied Radio Corporation: Catalogue No. 127.*

—30—

Fig. 6. Diagram of preamplifier designed to be used with the author's amplifier unit.



R_1—470,000 ohm, ½ w. res.
R_2—3300 ohm, ½ w. res.
R_3—1 megohm, ½ w. res.
R_4, R_5—100,000 ohm, ½ w. res.
R_6—47,000 ohm, ½ w. res.
R_7—120,000 ohm, ½ w. res.
R—2200 ohm, ½ w. res.
R_9—500,000 ohm pot.
C_1—20 μfd., 150 v. elec. cond.
C_2, C_3—.1 μfd., 400 v. cond.
C_4—.002 μfd., 200 v. cond.
V_1—6SL7 tube

It's New! It's Better! Here's Proof!

Now, we have finally found the answer in your V8 antenna. Servicemen tell us its the best antenna we have ever had. It really does the job because it pulls in stations we could not get before.

Here's How the new RADIART TELEVISION V*8 ANTENNA Solved Mr. Hartong's Fringe Area Headaches

SEE FOR YOURSELF
Try One On Your Toughest Location

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October 7, 1952

Mr. William Schoneberger
Jobber Sales Manager
Radiart Corporation
3455 Vega Avenue
Cleveland, Ohio

Dear Bill,

Just a word to let you know how we feel about your new V8 antenna.

As you know, our reception problem down here is difficult because of the fringe area position. Believe me, when I tell you almost everything that has come along has been tried.

Now, we have finally found the answer in your V8 antenna. Servicemen tell us its the best antenna we have ever had. It really does the job because it pulls in stations we could not get before.

Attached is another reorder, please keep them coming.

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MANUFACTURERS' LITERATURE

Readers are asked to write directly to the manufacturer for the literature. By mentioning RADIO & TELEVISION NEWS, the issue and page, and enclosing the proper amount, when indicated, delay will be prevented.

UTC TRANSFORMERS

United Transformer Company, 150 Varick Street, New York 13, New York, has released a new catalogue which lists over 600 stock items covering the entire scope of electronic transformer applications.

The new publication is fully indexed, giving complete technical descriptions of all items. In addition, a center insert gives circuit details for high-fidelity amplifier equipment.

Transformers for high-fidelity systems, hermetically sealed units for military applications, special transformers for hams, and a replacement line are covered along with listings of high "Q" filter coils and complete audio filters.

CRYSTAL CATALOGUE

James Knights Company of Sandwich, Illinois, has issued a completely new catalogue covering its line of stabilized quartz crystals.

The catalogue lists 45 different crystals for use in communications equipment, laboratory instruments, medical and industrial equipment, etc.

Development engineers and others will find the new catalogue of interest. Copies may be obtained by writing the company direct.

SOUND SYSTEMS

Mark Simpson Manufacturing Co., Inc., 32-28 49th Street, Long Island City 3, New York, has issued its new general catalogue of 1952, revising its catalogue No. 50.

A complete line of school and institutional sound systems using control amplifiers with microphone, radio, and phonograph inputs for up to 40 locations is only one of the many groups of modern equipment featured.

Other items listed include high-power amplifiers, high-fidelity amplifiers, transcription equipment, mobile, and preamplification equipment.

ALLIED'S 1953 CATALOGUE

Allied Radio Corporation, 833 W. Jackson Boulevard, Chicago 7, Illinois, has released its 1953 general catalogue which contains 236 pages—the largest catalogue in the company's history.

Among the 18,000 items listed in the new publication are sound systems, television chassis, boosters, rotators and u.h.f. converters, table model and portable radio sets, professional and home recording equipment, public address amplifiers and complete systems, amateur receivers, ham transmitters and other gear, industrial v.h.f. radio and radiotelephone equipment, as well as tools, books, hardware, kits, and other supplies.

The high-fidelity section has been expanded to include many units for custom installation: amplifiers, tuners, changers, speakers, preamps, and cabinets.

Copies of the new catalogue No. 131 are available on request to the company.

SOUND EQUIPMENT

A new eight-page, two-color catalogue illustrating and describing the fifteen 1953 models of *Califone* phonographs, transcription players, and sound systems has just been released by *Califone Corporation,* 1041 North Sycamore Avenue, Hollywood 38, California.

Accompanying the catalogue is a combined specification and price sheet for easy selection of equipment to fit the customer's requirements.

Copies of the new publication are available from the company direct.

ANNIVERSARY CATALOGUE

Burstein-Applebee Co., 1012-14 McGee Street, Kansas City, Missouri, is currently distributing copies of its 25th Anniversary catalogue, No. 531.

This 148-page catalogue lists thousands of parts and equipment items for dealers, technicians, schools, broadcasters, public utilities, experimenters, factories, engineers, laboratories, and hams.

A comprehensive index has been included to facilitate locating the part or unit desired.

Copies of the new catalogue are available without charge on request.

TRADE-IN GUIDE

Publication of the first television set trade-in guide, the "1953 NARDA TV Blue Book," has been announced by the *National Appliance Guide Company.* 2132 Fordem Avenue, Madison 1, Wisconsin.

The manual provides authentic, detailed, up-to-the-minute information on all popular TV sets of over 30 leading manufacturers and covers models produced from 1947 through 1952. The annual guide tells the dealer how to evaluate trade-ins, how to service them, and how to resell them to his and his customer's satisfaction.

Details on how copies of this manual can be obtained will be supplied by the company on request.

RADIO SHACK CATALOGUE

Copies of *Radio Shack Corporation's* 30th Anniversary Catalogue are now

New RADIO COURSE *only* $2.50

MADE MONEY FIRST WEEK

"You should get more money for your Course. The first week I studied it, I made $10.00 repairing sets. I built my own test outfit from details given in this course. I have repaired 100 radios to date. . . ."

Signed: *Robert C. Hammel*, 120 W. 13th, Davenport, Iowa.

COMPLETED IN 8 WEEKS

"I am very satisfied with the course. When I was at the twelfth lesson I started repairing radios. It took me two months to master your course." From a letter written by *Roger Langlois*, 1679 Poupart St., Montreal, Canada.

MODERN, UP-TO-DATE

"Your course is modern and up-to-date. There is not one page in the whole course which anyone can afford to miss. Your course started me on the road to a well paid job and has repaid me many times." *Charles Alspach*, 433 Elm St., Reading, Pa.

AMAZING BARGAIN OFFER

Here is a practical home-study course that will teach you how to repair all radio sets faster and better. These newly reprinted 22 lessons cover all topics just like other correspondence courses selling for over $150.00. Our amazing offer permits you to obtain the course complete for only $2.50, nothing else to pay. Easy-to-follow, well illustrated sections on test equipment, circuit tracing, alignment, F.M., use of oscilloscope, amplifiers, and every other topic needed to be an expert in radio repairing. Trouble-shooting hints, circuits, short cuts, service suggestions, new developments. Send coupon today, and use the complete course at our risk. Satisfaction guaranteed. All 22 lessons, in large manual form, + self-testing questions, complete, your cost only..... **$2.50**

INTRODUCTION TO TELEVISION

These practical lessons making up this course-book are easy to follow and apply to actual radio jobs. Use this training to get ahead in radio and as an introduction to television. Hundreds of radio facts that puzzled you will be quickly cleared up. You will find yourself doing radio repairs in minutes instead of hours — quickly finding faults or making needed adjustments. Every new radio development of importance and thousands of time-saving radio facts are packed into this complete course-manual. For example, there is a large lesson on servicing F.M. sets and another full lesson on audio amplifiers. Use coupon below to order **Course** for 10-day examination in your own home. Look over the material, read a few lessons, apply some of the hints. Then decide to keep the lessons at the bargain price of $2.50 (full price), or return the material and get a cash refund. *(Offer may be withdrawn at any time.)*

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With Hi Gain CASCODE Tuner, RCA Hi-Fi 12" Speaker, all knobs and hwre..... $146.50

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1B3GT..$.63	6BQ6..$.76	6V6GT..$.46	12SL7..$.57
1U4....48	6BQ7...86	6V8....83	12SN7...54
1U5....48	6CB6...48	6W4....44	12SQ7...42
1X2....68	6F6GT...49	6W6....52	19T8....64
5W4GT..46	6J6....79	6X4....34	25BQ6...77
5Y3GT...29	6L6G...89	7X7....62	25W4....48
6A7....62	6SA7...52	12AT6...48	25L6....48
6AG5...59	6SG7GT..49	12AU6...48	25Z6....42
6AK5...1.14	6SK7...49	12AU7...56	35C5....57
6BC5...58	6SL7...52	12AV6...52	35L6....48
6BE6...48	6SN7...54	12AZ7...94	35Z5....33
6BG6...1.21	6SQ7...42	12BA6...47	50L6....48
6BH6...62	6T8....74	12SA7...52	80.....38
6BJ6....53	6U6....57	12SK7...49	

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ready for distribution, according to word received from the company.

The new 1953 listing describes and illustrates over 30,000 products. This 224-page edition is the largest in the company's history and includes a new 32-page rotogravure section devoted to the components of high-fidelity custom music systems.

Although primarily designed for the industrial and laboratory user of electronic parts, the new catalogue includes sections on public address systems, amateur radio gear, hand tools, books, intercoms, kits, and emergency communications equipment.

The new catalogue is available from the company at 167 Washington Street, Boston 8, Massachusetts.

WRL CATALOGUE

World Radio Laboratories, Inc., 744 West Broadway, Council Bluffs, Iowa, has announced the issuance of a new catalogue covering electronic components.

Comprising 130 pages, the new *WRL* catalogue lists many new items of interest to the purchasers of all types of amateur and other electronic equipment and components. Copies are available on request.

AUDIO CATALOGUE

Harvey Radio Company, Inc., 103 West 43rd Street, New York 36, New York, has issued a new catalogue devoted exclusively to high-fidelity audio equipment.

Designated as Catalogue No. 54, this new 36-page publication lists hundreds of items for the audiophile. Included are AM-FM chassis and tuners, amplifiers, baffles, cabinets, cartridges, changers, disc recorders, equalizer-preamps, high-fidelity speakers, pick-ups, phonographs, tape units, etc.

In order to insure maximum usability, the company has not only listed and illustrated each piece of equipment but provided technical data and performance information.

MAGNETIC DOOR LATCH

A catalogue sheet which describes all of the features of its new magnetic door latch is now available from *Heppmer Sales Company*, Round Lake, Illinois.

The product described in the sheet is suitable for either wood or metal doors, retains its magnetic properties, and since it incorporates no working parts, will last indefinitely.

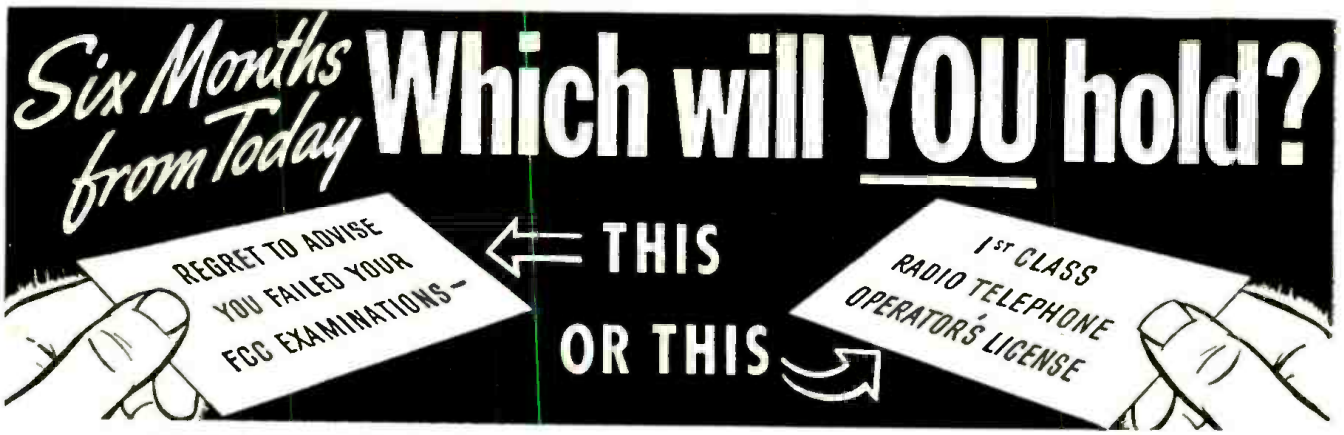
HAM BOOKLET

The *Allied Radio Corporation*, 833 West Jackson Boulevard, Chicago 7, Illinois, in cooperation with the ARRL, is distributing a free booklet to radio clubs, radio classes, and all other groups of radio or electronic students or hobbyists.

The booklet, "You Can Be There," is a dramatic story of the romance of amateur radio and the thrills that come with the hobby of operating a ham station.

Instructors of radio classes, officers

Six Months from Today Which will YOU hold?



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If you fail to pass your Commercial License exam after completing our course, we guarantee to continue your training without additional cost of any kind, until you successfully obtain your Commercial license, provided you first sit for this examination within 90 days after completing your course.

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Letter from Chief Engineer, Broadcast Station, North Carolina. "Need men with radiotelephone 1st class licenses, no experience necessary. Will learn more than at average station for we are equipped with Diesel Electric power, transmitting and studio equipment."

Telegram from Chief Engineer, Broadcast Station, Wyoming. "Please send latest list available first class operators. Have November 10th opening for two combo men."

These are just a few samples of the job offers that come to our office periodically. Some licensed radioman filled each of these jobs . . . it might have been you!

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Clifford E. Vogt, Box 1016, Dania, Florida	1st Phone	20
Francis X. Foerch, 38 Beucler Pl., Bergenfield, New Jersey	1st Phone	38
S/Sgt. Ben H. Davis, 317 North Roosevelt, Lebanon, Illinois	1st Phone	38
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TRANSFORMER CATALOGUE

Milwaukee Transformer Company, 5231 North Hopkins Street, Milwaukee 9, Wisconsin, has just released a new, 16-page catalogue to the electronic trade.

Designated as catalogue MTR-1, the new publication describes a varied line of transformers, reactors, filter networks, and similar components which have been specially engineered to the rigid requirements of commercial and government agencies.

-30-

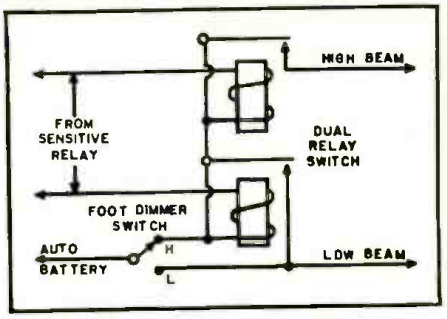
Headlight Dimmer

(Continued from page 35)

second stage because without heater excitation no plate current can flow. The current drain on all the batteries is very low and they should provide almost shelf life. The circuit could be designed to use the auto battery as one of the bias cells as well as for heater power but this is not advisable because the grid voltages are quite critical and the 6 volt system in an automobile varies considerably with engine speed.

A 0.01 μfd. condenser is connected from grid to cathode of each stage to prevent any a.c. voltages from appearing at those points. If this precaution were not taken, the circuit might oscillate and would surely pick up ignition noise and possibly even r.f. It is the combination of C_1 and R_1 in the first stage that gives the circuit the slow reaction to changes of light intensity. This reaction can be slowed even more by increasing the value of C_1.

The sensitive relay in the plate circuit of the second stage of the amplifier has a 10,000 ohm coil and can be adjusted to close at about 2 milliamperes. The contacts form a single-pole, double-throw switch. The armature of the relay is grounded. The normally-closed contact goes to the relay switch operating the "high" lights and the normally open contact goes to the relay operating the "low" lights.



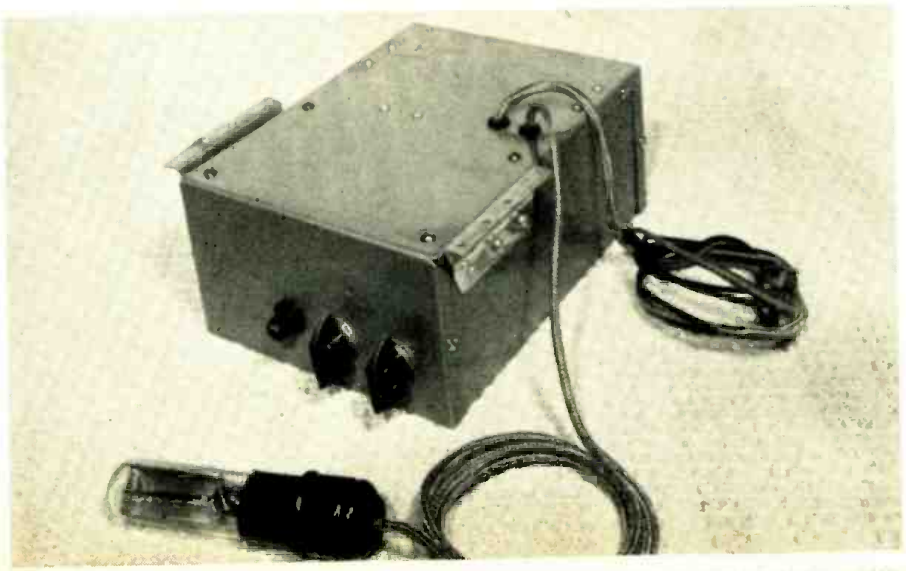
Wiring diagram for a conventional auto headlight system. See text for details.

The unit was constructed in a small aluminum box 8" x 6" x 4". Care must be taken to mount the sensitive relay in a horizontal position so the vibration of the auto cannot interrupt its operation. Also, the resistance between the grid and cathode of the first stage of the amplifier should be kept as high as possible because a resistance of less than 10 megohms will cause considerable loss of sensitivity. Four wires are brought out of the box—one for filament power, two for the headlight relay switches, and one for the phototube. The wire for the phototube is shielded to prevent any stray pickup. The entire unit is mounted on two aluminum flanges beneath the dash panel of the automobile. The phototube can be mounted behind the windshield in any convenient place.

This unit was installed on a 1946 *Chevrolet* and a dual headlight relay had to be installed on that car. The wiring of the headlight control system would have to be adapted to the particular car, of course. In any case, the foot dimmer switch should be wired to override the photoelectric dimmer as a safety precaution.

-30-

Over-all view of the complete photoelectric headlight dimmer unit.



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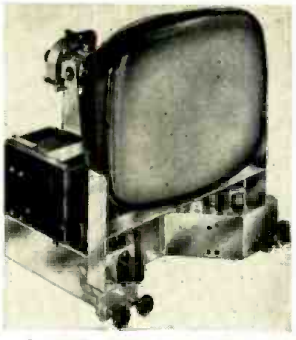

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TV Signal Tracing

(*Continued from page* 51)

of the horizontal-output tube, its effect can be reduced to an insignificant level by both direct contact of the probe tip to the tube cap and manipulation of the probe body for minimum capacitance pickup. Actually, direct contact lowers the probe input impedance, making it less sensitive to the crosstalk field.

The small short ripple, which follows the pulse in Fig. 2B but is not apparent in Fig. 2A, is a characteristic found at the deflection voltage level. It is referred to by design engineers as the "Spook". (The spook may be noticed on television screens as a fine vertical line very close to the left edge of the raster.)

Hum

Hum also presents a continuous but not too serious problem in high-voltage signal tracing in that it spreads the horizontal lines of a high-voltage waveform vertically, as shown in Fig. 3. Very little hum interference comes through the probe-tip contact because a rather high ratio of high voltage to hum voltage exists at that point. Hum introduced near the handle of the probe, however, mixes with the high-voltage signal after the signal level is reduced by the probe resistor. Fig. 3 shows amplitude expansion of horizontal lines due to hum voltage originating in the field of a *Variac* placed near the probe handle. If the source of hum cannot be removed, movement of the probe to a different angle of approach will usually reduce the hum effect to an insignificant level. As a matter of note, strong video signals or vertical-deflection signals, or either of these mixed with hum, will cause distortion similar to hum alone.

Effect of Reduced Voltages

Low supply voltage (low line voltage, low "B+" voltage, or low boosted "B+" voltage) is another possible cause of waveform distortion, particularly because it affects pulse shape and amplitude. The three exposures in Fig. 5 are expanded trace views showing how pulse amplitude diminishes with decreasing supply voltage. These pictures, obtained by probe contact at the plate of horizontal output tube, show a simultaneous reduction of the wavetrain following the pulse.

Reduction of heater voltage at the damper tube may also cause reduced pulse amplitude along with distortion in the wavetrain as shown in Fig. 6. Reduced cathode emission within the damper tube produces a similar effect.

The use of a d.c. oscilloscope for examination of these waveshapes has one special advantage; three standard conditions of "B" voltage can be rechecked conveniently when desired. The triple exposure in Fig. 4, made with probe contact at the damper-

tube cathode, shows zero voltage at the base or lower line, the "B+" voltage above it, and boosted "B+" voltage and pulse waveshape at the top. The "B+" voltage alone remains when anything happens to eliminate the high-voltage pulse.

Typical Waveforms

As previously mentioned, deviation from the normal waveform at the plate of the horizontal output tube indicates failure of components in the high-voltage section of a TV receiver. The series of examples that follows is typical of modern high-voltage circuits. An *RCA* 17T153 television receiver chassis was employed during waveform photography. In receivers with different circuits, some modification of waveforms can be expected.

Although the normal waveform in Fig. 7A is not entirely clear of crosstalk, it is typical of waveforms found to be satisfactory as a reference for signal tracing. Subsequent illustrations each show singular changes from this normal state. The testing arrangement employed to obtain the normal signal indication of Fig. 7A was retained for all other pictures in the group.

Baseline Distortion

Figs. 7B and 7C illustrate the bent baseline caused by reduced damper-tube emission. In the previous exhibit of this condition in Fig. 6, the general bend in base line is lost because of trace expansion. It can be seen, therefore, that it is advantageous to examine at least a complete cycle of the waveform, digressing only temporarily to observe detail by trace expansion.

Fig. 8 indicates loss of pulse amplitude due to damper tube heater-to-cathode leakage. Usually such leakage is quickly checked by tube replacement but may even be traced to paths external to the tube.

Short-circuited or leaky components place undue loading on the entire deflection circuit and result in loss of pulse amplitude and base-line warping. Various degrees of such conditions are illustrated in Figs. 7B, 7C, 8, 10, 12, 13A, and 14.

Distortion of Pulse Shape

Analysis of the cause of a distorted waveform should also include inspection of the pulse shape. The shape of the pulse is closely related to the proper performance of the deflection output components, such as the horizontal output transformer, the yoke, or the damper tube. The pulse-forming circuit which includes these components has a resonant frequency of approximately 65 kilocycles and there-

Fig. 12. Waveform at plate of horizontal output tube. This pattern is obtained when there is a shorted condenser between "B+" and boosted "B+" circuit.

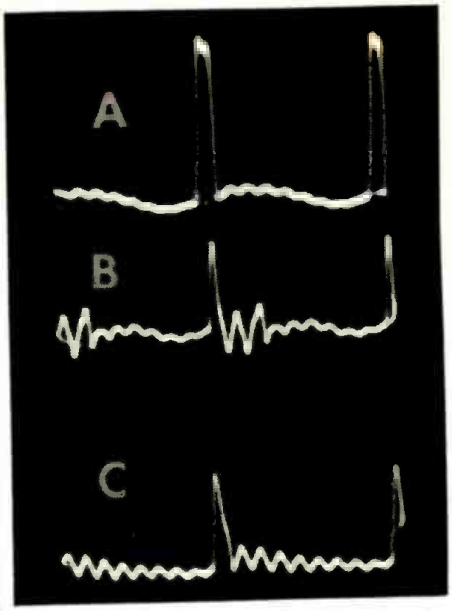


Fig. 13. Waveform at plate of horizontal output tube. Short between horizontal and vertical yoke windings. (A) Low side "H" to "Center V." (B) High side "V" to "Center H" and (C) Low side "V" to "Center H."

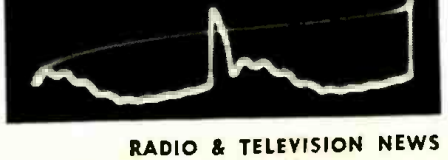
by controls the return trace or flyback time. The repetition rate of the pulse is determined by the 15,750 cycle horizontal-oscillator frequency.

Weaknesses in pulse forming circuits, such as open yoke windings, cause the pulse to become broad at the base and round at the top, as shown in Fig. 9B. Pulses having little change in base width but showing deformed peaks indicate trouble in the resonant pulse-forming circuit. Because the tuning of this circuit depends on the proper operation of a number of components, a change in any one of them, or a change in their distributed capacitance, can be responsible for pulse-peak distortion.

Defects in the yoke, the output transformer, the width control, the high-voltage condenser, the horizontal-output tube, the damper tube, or the high-voltage rectifier tube, or even in the associated leads, can individually be the cause of detuning the pulse-forming circuit. With such defects, the pulse shape suffers as shown in Figs. 9A, 11, 13B, 13C, and 14.

Short circuits between horizontal and vertical yoke windings produce different reactions depending upon the sections involved. Fig. 13A shows little change in pulse shape due to a short at the low end of the horizontal winding. When half of the horizontal yoke is involved, however, rapid pulse decay occurs as pictured in Figs. 9A, 13B, 13C, and 14.

Fig. 14. Waveform at plate of horizontal output tube. Condenser shorted and series resistor across half of horizontal yoke winding subsequently was burned.



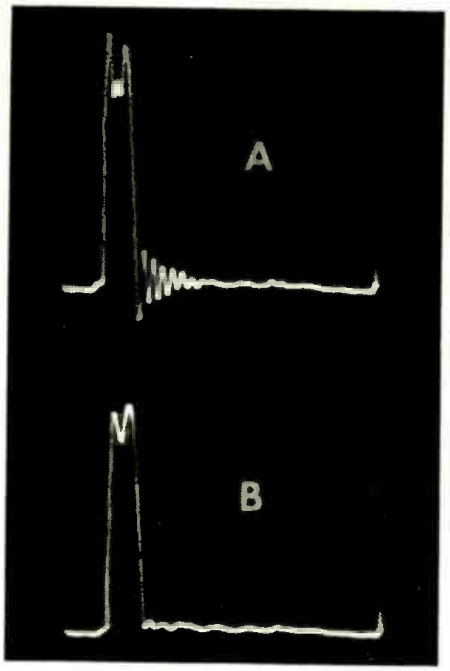


Fig. 15. Horizontal pulse as seen with high-voltage probe at high side of yoke connection. (A) Additional damped wave due to open condenser across half of yoke. (B) Normal waveform with new condenser.

Fig. 14 depicts the waveform associated with a common cause of trouble in the yoke circuits, a shorted neutralizing condenser, and subsequent burnt series resistor across half of the horizontal windings of the yoke. Three principal signs of distortion are evident. 1. The pulse, severely reduced in amplitude, indicates excessive loading of the horizontal deflecting system. 2. The bent baseline is associated with reduced damper-tube conduction, which is concurrent with insufficient pulse power. 3. The rapid decay in pulse shape agrees with other examples of excessive loading across part of the horizontal yoke winding.

If the yoke-neutralizing condenser is open-circuited instead of shorted, it causes no noticeable change in the waveform at the plate of the horizontal-output tube. Open yoke condensers, however, are known to cause "ringing," which is a condition easily recognized by the presence of a series of vertical bars at the left half of the raster. Fig. 15A shows a waveform distinctly associated with this condition. This waveform exhibits the ringing as a damped wavetrain immediately following the pulse. Connection for this test was made by probe contact at the yoke terminal connected to the high side of the horizontal winding.

Although waveforms may differ somewhat with various makes of TV receivers and detailed symptoms may not agree because of circuit or component design differences, high-voltage signal tracing can be universally applied to horizontal-deflection, pulse-type, high-voltage power supplies.

The author wishes to extend a note of appreciation to Mr. B. V. Vonderschmitt for his helpful suggestions.

WHAT'S *New in Radio*

For additional information on any of the items described herein, readers are asked to write direct to the manufacturer. By mentioning RADIO & TELEVISION NEWS, the page and the issue number, delay will be avoided.

RC OSCILLATORS

Hewlett-Packard Company, 395 Page Mill Road, Palo Alto, California, is currently introducing two new wide-range *RC* oscillators which are small in size and simple to operate.

The new instruments, Models 200AB

and 200CD, have high stability and quickly resettable tuning circuits. Operation is simplified and only three front panel controls are used. They are small in size, lightweight, and are mounted in an aluminum case with carrying strap for maximum portability.

The Model 200AB, for general audio tests, offers a frequency range of 20 cps to 40 kc. and a full watt output. The Model 200CD, for wide-range measurements at lower power levels, provides constant voltage output from 5 cps to 600 kc.

The company will supply additional details on request.

OIL-FILLED TUBULARS

A complete line of easy-mounting, single-stud tubular oil-filled condensers is now being offered by the *Industrial Condenser Corp.,* 3243 N. California Ave., Chicago 18, Illinois.

The new units are oil-impregnated and filled with *Indco* Oil "A." *Pyroteen* filled units are also available. Standard capacity tolerance is +20% −10%. The temperature range with the *Indco* Oil is −40 degrees to +70 degrees C. and with *Pyroteen* −70 degrees to +90 degrees C. Power factor is .4% with the *Indco* Oil and .2% with *Pyroteen.*

A four-page illustrated catalogue, containing complete data on the new G and H types, is now available from the company.

PUSH-BUTTON SWITCH

Grayhill, 4524 West Madison Street, Chicago 24, Illinois, has developed a new push-button switch which measures only 1.047 inches from the end of the plunger to the end of the terminal tips. It is ½" in diameter at the widest point.

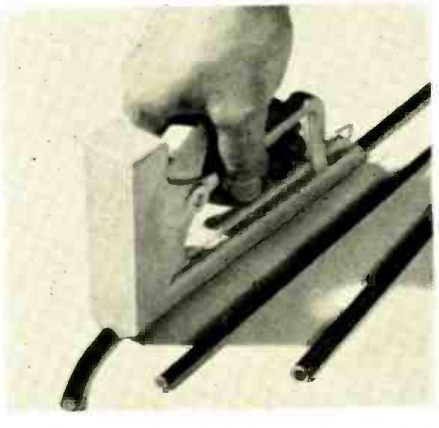
Designated as the Catalogue No. 23-1, the new switch is normally open and has a s.p.s.t. momentary contact arrangement. It is rated at ¼ amp., 117 volts, noninductive. The bushing, providing single hole panel mounting, has a 5/16-32 thread.

Complete information on this new push-button switch is available from the company. Address letters to Mr. B. Doran.

FASTENING GUN

Of interest to service technicians is the newly-developed, hand-held automatic fastening gun which has been introduced by *The Heller Stapler Company,* 2153-E Superior Avenue, Cleveland 14, Ohio.

This compact unit is operated by just one hand, leaving the other hand free to guide the cable or hollow tube lines being installed. The force of the machine will drive bands around cables and tubes into hard or soft woods, plaster walls, flooring, joists,



and even mortar joints and cinder or mineralite building blocks.

An extra-size band, with leg lengths varying from 3/16" to ½", is used with the new fastening gun.

BASS REFLEX CABINET

Argos Products Co., 310 Main Street, Genoa, Illinois, is now offering a new bass reflex cabinet to the trade.

Featuring a solid mahogany front and matching leatherette top and sides, the new cabinet has a single grille cloth covering the entire front panel, thus concealing the two separate sound openings and giving a more modern appearance.

Known as the "Deluxe Model DBR-15," the new cabinet is designed to accommodate either a 12" or 15" speak-

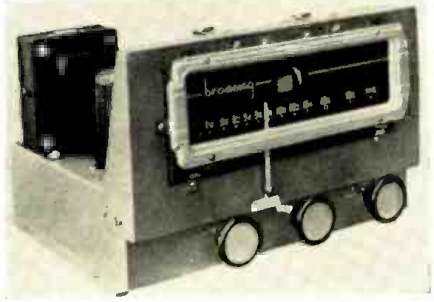
er. The cabinet measures 23⅞" wide, 30" high, and 14⅞" deep. It is available in either blonde or mahogany finishes. All the necessary mounting hardware is included, along with a mounting board for 12" speakers.

A data sheet on these new bass reflex cabinets is available from the company on request.

FM TUNER

Browning Laboratories, Inc., of Winchester, Mass., has recently introduced a new FM tuner which has been designated as the Model RV-31.

The new tuner features an all-triode r.f. section and follows the *Armstrong* receiving method with dual cascade limiters for most effective noise quieting. Input signals of 3 microvolts will



produce 20 db of quieting. An a.f.c. circuit locks the local oscillator into correct tuning but may be switched off if desired. A selector switch permits FM, phono, TV, or recorder playback to be fed through the tuner volume control to the main amplifier.

The RV-31 is suitable for custom installations where space is limited since it measures 11" wide, 9⅜" deep, and 6½" high. Knobs and dial escutcheon are furnished in black and silver to complement the black dial background.

EXTENSION SPEAKER

Auto radio sales and service technicians will be interested in a recent announcement from *Lowell Manufacturing Company*, 3030 Laclede Station Road, St. Louis, Missouri that it is now in production on an easily-installed rear-seat auto extension speaker baffle kit.

This "extra profit" item comes complete. It includes a 9" x 7" stamped metal louvre plate with tamperproof screening, a three-way switch, screws for mounting dial plate to car dashboard, complete mounting hardware, and detailed instructions.

The company will supply additional details on request.

VARNISH REMOVER

A non-inflammable, impregnating varnish remover that rapidly strips all types of impregnating varnish from baskets, jigs, etc. has been announced by *London Chemical Company*, 325 W. 32nd Street, Chicago 16, Illinois.

The new "*Lonco*" remover is designed for fast stripping, at room temperature, of all types of varnishes used in the electrical field. The only equipment necessary is a covered tank large

enough to accommodate the piece to be stripped.

Attack on the coating begins immediately and parts are normally stripped clean in ½ to 4 hours. Overnight immersion will remove heavy coats up to 3" in thickness.

Further information and a free sample are available from the company.

TAPE RECORDER

Allied Radio Corporation, 833 W. Jackson Boulevard, Chicago 7, Illinois is currently offering a low-priced tape recorder which incorporates many new features for a variety of applications.

The *"Knight"* 96-485 has "automatic keyboard" control. Five piano-key type push-buttons permit the quick and easy selection of the operating functions including "fast forward," "playback," "stop," "record," and "fast reverse." The "fast forward" speed enables the user to locate that portion of the recorded tape desired for playback.

Two speeds and a dual-track recording head provide four recording times. At the speed of 3.75" per second, a 7" (1200 foot) reel records continuously for one hour, or two hours by recording on the second half of the tape width. At the 7.5" speed, the recording times are one-half hour continuously and one hour over-all. Frequency response is flat from 70 to 8500 cps at 7.5" and 90 to 6000 cps at 3.75".

The unit is housed in a sturdy, two-tone green, luggage-type case which measures 14" x 12" x 7". It weighs less than 22 pounds. Ready for operation

from any 105-120 volt, 60-cycle a.c. outlet, the unit comes complete with crystal microphone. 8 feet of mike cable, a 600-foot reel of type "A" tape, a 5" take-up reel, and all tubes.

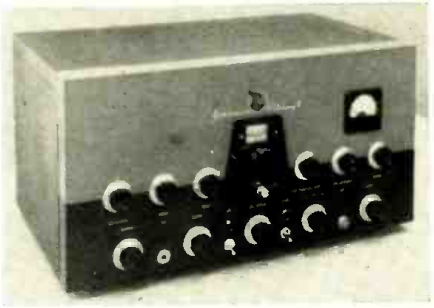
HAM XMTR. KIT

E. F. Johnson Company of Waseca, Minnesota, is now in production on a new ham transmitter kit known as the "Viking II".

Rated at 130 watts c.w. output, 100 watts phone, the new transmitter has been designed for operation on every amateur band from 10 to 160 meters, including the recently-assigned 15-meter band. The pi-network amplifier matches a wide variety of antenna impedances. A crystal selector assem-

bly permits the selection of any one of 10 crystal frequencies from the front panel, with an 11th position provided for use with an external v.f.o.

All stages are metered and dual power supplies are designed for econ-



omy and operating convenience. For novice operation, the final amplifier input may be reduced to 75 watts without transmitter modification.

The transmitter, TVI suppressed, is enclosed in a heavily copper-plated steel cabinet. The lid is bonded with silver-plated, phosphor bronze contact fingers. Special shields are included for the meter, dial window, and v.f.o. power socket.

A free bulletin, No. 714, giving complete specifications on the new transmitter kit, is available on request.

COMPACT CONVERTER

The Terado Company, 1068 Raymond Ave., Saint Paul 8, Minnesota has introduced a compact d.c. to a.c. converter, the "Trav-Electric Super," Model No. 6-71160.

This unit converts 6 volts d.c. (car battery) to 110 volts, 60 cycle a.c. Capacity is 60 watts continuous and 75 watts intermittent. Suggested uses for the new unit include the operation of wire recorders, dictating machines, portable phonographs, radio receivers, small electric drills, hand vacuum cleaners, electric shavers, lights, and test equipment.

A catalogue sheet describing this and other converters in the company's line is available on request.

SOLDERING MACHINE

Sunrise Products Company, P. O. Box 173, Hawthorne, New Jersey, is currently featuring a new soldering unit, the Model XK-72.

This compactly-designed resistance soldering unit incorporates a sensitive interval timer (1/5 to 90 seconds) and an adjustable heat controller to per-

mit fast, precision soldering without overheating or warping of the parts to be soldered.

The electrode holder, L-14, measures 6" long and weighs just 3½ ounces.

Three tips, 1/8", 1/4", and 5/16" diameter, are available for use with this unit.

A brochure describing the Model XK-72 and other units in the company's line is available without charge upon request.

H.V. TEST JACK

Alden Products Company, 117 North Main Street, Brockton, Massachusetts has introduced a new, skirted test point jack, the 110BCSH, which permits safe circuit voltage readings up to 3000 volts a.c. peak from the front of equipment panels.

Its high collar protects the operator from flashover during high voltage checks. Actual flashover breakdown-to-chassis occurs at 7-8000 volts a.c. (r.m.s.).

This new miniature test point jack has a beryllium copper contact, made to critical accuracy in progressive dies to insure resilient, long-life contact action. Its pre-tinned soldering tab is suitable for use with up to 14 gauge wire.

For complete information on this new product, address requests for additional data to Mr. Nelson Hearn at the company's address.

AUTOFORMER

Halldorson Transformer Company, 4500 Ravenswood Avenue, Chicago 40, Illinois, has announced the availability of a new "Varivolt Autoformer" which permits the adjustment of line voltages of 65, 75, 90, 100, 115, 130 and 145 volts to 115 volts, or to other voltage levels within the unit's range.

Voltage is set by means of a seven-

step rotary switch and indicated by a voltmeter having a red-line marker at 115 on its 0-150 volt scale. Each unit is equipped with a conventional six-foot plug-in line cord and a standard output receptacle.

The line is currently available in four wattages (resistive load rating): 150, 350, 500, and 750.

UNIDIRECTIONAL MIKE

The Astatic Corporation, Conneaut, Ohio, has announced the addition of a unidirectional dynamic model to its line of microphones.

Known as the "Dynabar" Model DR-11, the new microphone employs the company's exclusive sintered metal method of acoustic phase shifting. This accomplishes a front-to-back

pickup differential of approximately 15 db, which makes the microphone, for all practical purposes, dead to extraneous noise and drone, according to the company.

The internal dynamic element is floated in rubber to help insure stability. An impedance selector switch provides operating impedance of 50, 200, 500, and high impedance. The switch is located at the back of the microphone housing, flush with the surrounding grillework to prevent accidental turning. It has a center slot for easy turning with coin edge or screwdriver.

Output level is –54 db (1 volt-per-microbar) and the range is 40 to 10,000 cps. Standard equipment includes an *Amphenol* cable connector and 18 feet of two-conductor shielded cable.

PROGRAM EQUALIZER

Production on a new program equalizer, the Type 4031-B, has started at the Burbank, California plant of *Cinema Engineering Co.*

The new instrument has wide applications in sound and electronic laboratories for research and control; broadcasting, recording, and motion picture

uses include providing corrections for frequency response in audio equipment, sound pickup, and transmission lines.

Easy operation of two control knobs allows wide range of over 395 available curve combinations. Controls provide for independent adjustment of the high and low frequencies in 2 db steps. Input level minimum is —70 dbm and maximum +20 dbm.

The equalizer uses standard RTMA rack mounting and is available either from the company's New York representative, *Audio & Video Products,* 730 Fifth Avenue, or from the manufacturer direct. -30-

RCA SHOWS EXPERIMENTAL TRANSISTOR GEAR

RCA recently demonstrated a series of electronic gear in which a wide range of transistor applications useful to radio, television, and the industry were incorporated.

Each development was in the form of a laboratory model which, it was emphasized, is still in the preliminary and experimental stage. None of the units is commercially available at the present time.

Among the equipment demonstrated at the David Sarnoff Research Center of RCA in Princeton, N. J., was a portable public address system, a personal radio which was transistorized except for one tube, an all-transistor personal radio, a portable FM receiver, a transistor portable phonograph, a wireless phono jack, a roving microphone, a toy piano, a transistor ukelele, and a portable television receiver.

Ten types of RCA developmental and experimental transistors, three of the point-contact variety and seven of the junction transistor family, were used in the equipment. The three point-contact types and one of the junction types are to be offered on a limited sampling basis for engineering advanced development to industry representatives. The other six junction-type transistors are still classed as experimental.

Among the experimental items which attracted considerable attention was a portable, battery-operated television receiver, tubeless except for the picture tube. In another approach transistors were introduced in part of the circuits of a standard television receiver. Transistors were also employed in circuits of industrial TV equipment and the "Walkie-Lookie" portable TV camera equipment to point up savings in weight, size, etc.

In summarizing the demonstration, Dr. E. W. Engstrom, vice-president in charge of RCA Laboratories Division, said:

"These demonstrations highlight the fact that transistors are today no longer entirely a research concern. They are, in the fields of radio and television, an immediate problem for advanced development by industry engineers who can learn how to put them to work in evolving more versatile, smaller, sturdier, and eventually lower cost equipment for industry and the public." -30-

D. D. Holmes, staff member of the David Sarnoff Research Center of RCA at Princeton, N. J., demonstrates the simple replacement of a junction-type transistor in an auto receiver operating solely from 11 developmental and experimental transistors instead of the customary electron tubes. The use of transistors makes it possible to eliminate the usual high-voltage power supply. The transistors operate directly from the car's 6-volt storage battery so that the receiver has only 10 per-cent of the usual drain on the automobile battery.

power supply shown be adopted as all parts are standard and the over-all cost is low.

The theory of tuned *RC* nets has too many ramifications to be discussed here; those interested are referred to the bibliography at the end of this article. However, a brief description of oscillatory action in this circuit will be given. As stated before, the circuit is essentially a two-stage *RC*-coupled amplifier, with the output of the second stage brought back to the input of the first. There are three necessary components for oscillation: a gain-producing element, a phase-controlling element, and a frequency-selective element. The two-stage amplifier represents the gain-producing element. However, the output is fed back negatively through the lamp in the cathode circuit of the first stage, which limits the gain of the amplifier to slightly more than three times. Simultaneously, positive feedback is coupled through the *RC* net to the grid. This net is frequency selective due to its transfer-phase shift characteristic. At some frequency, depending upon the values of *R* and *C*, the voltage at the grid will be in-phase with the voltage impressed across the entire net and equal to ⅓ of the impressed voltage. At any other frequency, for the same *RC* values, the grid voltage will either lead or lag the impressed voltage by some angle. Thus for only one frequency will the second stage output and the first stage input be in phase. At this frequency the grid and cathode voltage are in phase, and the negative feedback voltage developed across the lamp must be just slightly less than the voltage developed between grid and ground, *i.e.*, a slight net positive signal, for oscillation to occur at this frequency. At all other frequencies the negative feedback voltage is greater than the positive feedback voltage; hence oscillation will occur at one and only one frequency.

Although single-frequency oscillation is assured with sufficient positive feedback, good waveform is not. It is with the greatest of ease that this circuit can and will produce almost any desired waveform. Continuous sine waves are only one of a great variety, and are the result of critical damping, to borrow a mathematical term. Over-damping produces a damped wave train, usually sinusoidal in form; under-damping is multivibrator action. For continuous sine waves, the negative feedback must be adjusted so that an over-all gain of unity results. This is the condition where the energy fed back positively just cancels the circuit losses. While it is relatively easy to make this adjustment for one frequency, to do so for a wide range of frequencies requires another variable element.

Preferably this element should act automatically, for adjustment of *two* controls when changing frequency is to be frowned upon. This function can be obtained in a number of ways, all of which resolve into an impedance element that varies with voltage or current. In other words, it does not follow Ohm's Law. Such an element may be as complex as the a.v.c. circuit in a receiver; thermistors, or a diode also exhibit the nonlinear characteristic; so does an iron wire, such as a pilot lamp. This is a convenient form, and relatively inexpensive. The 3-watt, 117-volt lamp is almost universal in this application.

The action of the lamp in automatically adjusting its magnitude or resistance to maintain the amplitude of oscillations at a constant level may be seen by the characteristic curve of such a lamp, shown in Fig. 2. In this curve resistance is plotted as a function of impressed voltage, and clearly shows the nonlinear nature of this function. The dashed vertical line indicates the approximate limit of voltage that may be applied to obtain regulator action. Don't expect any light from the lamp—even the faintest red glow of the filament indicates improper adjustment. The characteristic that permits the use of a lamp for regulation is that the voltage developed across it increases more rapidly than the current sent through it. It is the slope of the curve, that is, the incremental resistance, at any point rather than the resistance value at that point that governs the action (Fig. 4). An amplifier with such an element as the negative feedback resistance becomes a very nonlinear device. No matter what magnitude of signal is applied, the output is nearly constant. The range of input is, however, limited by the range of the nonlinear element.

Calibration of the dial involves a known frequency (from a standard oscillator, or the 60 cps power line) and a CRO. With the oscillator feeding the vertical amplifier and the reference signal feeding the horizontal amplifier, Lissajous figures will be produced. Any stationary pattern indicates an integral relationship between the two frequencies. The ratio may be calculated by counting the number of tangent points to a rectangle enclosing the figure. Let the number of tangent points along the top be H; similarly, the number of tangent points along one side is V. Then H/V is the frequency ratio, and H/V multiplied by the reference frequency gives the frequency of the oscillator. In this manner 10 cps division marks can be made on the lowest band using the 60 cps power line for reference. If the condenser decading is within 1%, no further calibration is necessary up to 200 kc.

A method of checking distortion content of any waveform was mentioned. This requires a CRO and an oscillator with very low distortion. A Lissajous figure of unity ratio is formed. Of

course, the possibility of two signal sources maintaining a precise phase relationship for more than a few seconds is remote. Therefore the figure will apparently rotate, changing from a circle to an ellipse, to a straight line, and back again. It is the straight line that provides the desired criterion: any harmonic distortion greater than 1% will appear as a bump or loop in the straight-line pattern.

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Modernizing the SCR-274/N

(Continued from page 59)

for the final. The use of a stand-off insulator-type r.f. choke makes this easy, using the existing hole between the 1625's for the mount, and the existing plate "B-plus" feedthrough mica insulator for power connections.

Connect the parallel-feed as shown in the top chassis photo and the diagram, forming a conventional pi-type network system, after soldering the top of the coil to the top-chassis left-hand condenser, and the bottom of the coil to the top-chassis right-hand condenser. (Positions as viewed from front of panel.) Use bits of the former tank coil wire for all this, since that silver is hard to beat for r.f.

The hole in the lower right-hand side of the front panel, due to the removal of the dial assembly, etc., is an ideal spot for the midget closed circuit jack J_1, to which is wired a lead from the final amplifier cathodes, for keying the rig.

A ⅝ in. punched hole, to the right of the meter, provides for a coaxial fitting, to carry the pi-tank output to the antenna, which can be almost anything, from a short whip to a fancy array. (With some type of antennas, it may be necessary to solder a .0001 μfd., 2500 volt mica condenser in parallel with the loading condenser, RH pi-net condenser, to get proper and adequate loading.) In our case, we can load to a hundred-and-fifty mils, with approximately 450 volts on the final, which was considered good enough.

The former neutralizing condenser, shown on the chassis lip in the under chassis photo, was not used in our case: it can be left disconnected.

Power for the rig is from a typical junk-box job, using a husky 500 volt,

200 ma. power transformer, dual chokes, and two 8 μfd., 600 volt condensers, with a VR-150 (0D3) for the regulated 150 volts to the oscillator. A recommended supply is shown in the diagram, with pin connections shown as used by the author. A five-wire cable handles things nicely, and we simply soldered the wires directly to the socket on the rear chassis drop, using a *Cinch* plug for the power supply chassis end of the cable.

If any difficulty is encountered in resonating the final with your particular antenna set-up and loading condenser capacity used, short out approximately five turns of the pi-net tank coil. The final resonating condenser will then work nicely. To those not familiar with this type tuning net, a review of the pertinent chapter in current "Handbooks" is recommended. Briefly, the input condenser is the resonating one, by which the plate current of the 1625's is dipped, and the output condenser is the loading one, by which the current drawn from the 1625's is placed at a desired value. It is a simple, efficient means of power transfer, and has the happy faculty of giving a wide range of impedance matching.

It has been found in practice that almost any setting of the final pi-net will deliver an almost constant power to the antenna, with a wide frequency range covered on the oscillator tuning condenser, giving virtually one dial control, but allowing any loading desired on the final—a desirable condition.

The rig packs quite a wallop, the rule-of-thumb light bulb test showing a full 40 watts going into the antenna, which can make quite a noise. We feel the equivalent rig, if built from scratch by the ham, would entail a considerably larger monetary outlay, and much more work. So all in all the SCR-274, in its modern garb, has proven to be, for us, the answer to a long-felt problem. For a small auxiliary rig it is ideal, and for the beginner or confirmed low-power c.w. man we feel it is pretty hard to beat.

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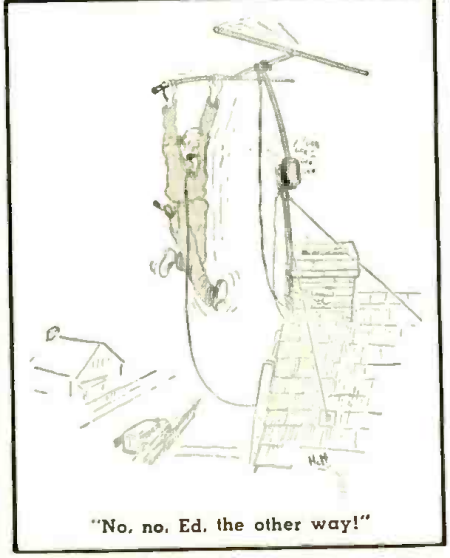


"No, no, Ed, the other way!"

nected as shown in Fig. 8A to the end of a transmission line and power is fed to these stubs by the line, very little radiated signal is obtained. This is due to the fact that currents of opposite phase flow in the stubs (as indicated by the arrows) and their fields effectively cancel each other. Only in the small end sections (labeled *Y*) are currents in-phase and these radiate. However, the lengths of these end wires are small and very little effective radiated power is obtained.

It has been found, however, that if a half-wave slot is cut out of a metal sheet, as shown in Fig. 8B, that the non-cancelling currents in the *Y* ends of the slot circulate about the entire plate and now we have a fairly efficient radiator. With a horizontal slot we get a vertically polarized wave. Since television has standardized on horizontal polarization, a vertical slot would be required.

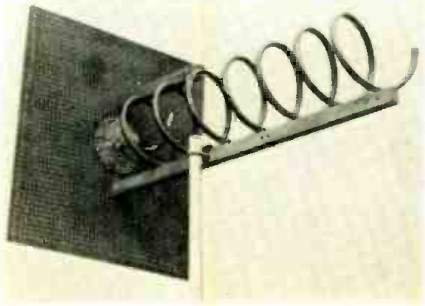
While the discussion has centered about the slot as a radiator, identical results will be obtained when it is employed as a receiving antenna.

The impedance across the center of the slot is on the order of 500 ohms. This gradually decreases to zero at either end. Hence to properly match a 300-ohm twin-lead line to the slot, it would have to be attached to the slot by connecting one wire to one edge of the slot and the other conductor to the other edge. One conductor may be bonded to the metal sheet, if desired.

The radiation pattern of the slot is similar to a dipole antenna. However, if the slot is cut out of the side of a cylinder, as in Fig. 8C, rather than out of a plate, the radiation pattern tends to become non-directional.

B. Helical Antennas. The helical antenna, Fig. 13, may be looked upon as a form of loop antenna. In fact, Kraus points out that it is related to the straight wire (or linear) antenna on the one hand and to the loop antenna on the other. If the helical antenna were employed for signal transmission, the energy fed in at one end would be "fired" out at the other end. This is shown by the radiation pattern in Fig. 14. The energy is brought to the antenna by a coaxial cable, with the center conductor connecting to the

Fig. 13. A helical television antenna.



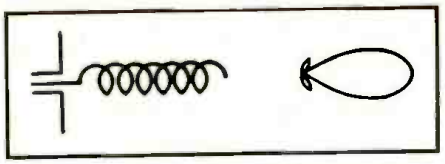


Fig. 14. Helical antenna radiation pattern.

end of the coiled helix and the outer conductor attaching to a reflecting screen. For reception the same type of response curve obtains.

Helical antennas can also be center fed with a balanced transmission line, and now the radiation pattern extends in more than one direction. As might be expected, the number of turns in the helix, the distance between turns (*i.e.*, the pitch of the helix) and the circumference of each turn all will affect the response pattern of the antenna. In general, increasing the number of turns causes the beam width to become narrower; increasing the pitch or increasing the turn circumference will have the same effect, within limits.

The response pattern for a helical antenna shown in Fig. 14 holds true when the circumference of the helix turns are on the order of 1 wavelength at the operating frequency. If the helical antenna becomes small and compressed, the radiation pattern closely approaches that of a half-wave dipole. This latter application is not desired for TV reception.

The helical antenna has a broadband characteristic, enabling it to be used over a 2 to 1 frequency range. By the same token, the input impedance remains fairly constant over the same range.

It might be of interest to note in passing that when the helical antenna is used for transmitting, it radiates a circularly polarized wave. Now most technicians are familiar with vertically polarized waves and horizontally polarized waves. In the former the electric lines of force extend up and down and in the latter they extend in a horizontal direction, or from side to side. In a circularly polarized wave, electrical lines of force may be considered as existing vertically, horizontally, and at all angles in between. This can be readily demonstrated by taking a dipole antenna, holding it in front of a transmitting helical antenna, and then slowly rotating the dipole. The amount of signal picked up will remain constant as the dipole is rotated through a complete revolution of 360°.

For reception, a helical antenna will receive any signal, no matter what its polarization. (There are several exceptions to this but they are not of interest in commercial television.) This is frequently advantageous because while television signals are radiated with horizontal polarization, this may change before the antenna is reached. A strictly horizontally or vertically polarized antenna might therefore not adequately receive all the available signal. A helical antenna, however, will.

(To be continued)

Vibration Pickup

(*Continued from page 49*)

been completed, the unit may be tried by holding it against a safe or piece of machinery. Power should be on, and volume turned up.

Any noises within the equipment should be readily heard in the earphones (as the combination lock is manipulated, or as machinery is operated). The tone control is manipulated for easiest interpretation of the vibrational sounds heard. The ability to interpret the various sounds heard and to properly adjust the *"Volume"* and *"Tone"* controls will be gained with practice in using the instrument.

If the instrument seems to be weak, first check the batteries. Also check tubes and all connections for possible errors.

Check the operation of the amplifier alone by disconnecting the pickup cartridge and holding your finger on the input grid. Hum, clicks, and other noises should be heard in the earphones.

If the amplifier is operating properly, but the unit still seems to be weak, check the condition of the cartridge used. Also experiment with the exact location of the probe along the case of the crystal—sometimes the sensitivity may be doubled by taking care in locating the probe position with respect to the cartridge. There are no general rules for selecting the best location—this will vary with the type of cartridge used, and must be determined experimentally by trial and error.

When the unit is used to listen to vibrational sounds, it is often possible to select the particular sounds desired by experimenting with the way the probe is held against the machinery being checked. In some cases better results are obtained when the probe is held at right angles to the machinery housing; in other cases, holding the side of the probe against the housing will give better pickup. The pressure exerted in holding the probe will also affect the pickup. Again, experience and practice will best enable the user to develop the proper techniques.

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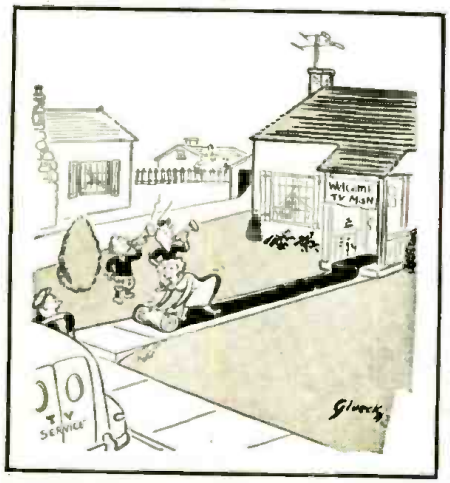


NEW TV PRODUCTS on the Market

SYLVANIA 1953 TV

Among the new receivers being introduced by *Sylvania Electric Products Inc.*, is "The Lexington", a 21" deluxe combination, AM and FM radio, and 3-speed phonograph.

Designated as the Model 178, the new console features "HaloLight" and the company's "Stratopower 508" chassis. The cabinet is of hand-rubbed mahogany veneer with rosewood grained doors. The model is available with built-in all-channel u.h.f. reception.

Two wood finishes are offered, with the mahogany finish being designated as the Model 178M while the blonde finish is known as the Model 178B.

"PICBOOST"

C-B-C Electronics Co., Inc., P. O. Box 1556, Philadelphia 5, Pa., has introduced a new series of picture tube brighteners which have been tradenamed the "Picboost Pacemaker".

The new unit is said to restore new tube brilliance, for periods up to several years, to any size or type picture tube. Other models in the series will permanently relieve heater-to-cathode shorts, thereby restoring brightness control, according to the company.

The "Pacemaker" can be installed within a few minutes, just by plugging in. No soldering is necessary and no 117 volt a.c. lines are used.

The four models currently available include the Models 1F and 2F, which

restore brightness to dim picture tubes in parallel and series circuits respectively, and the Models 3F and 4F to relieve heater-to-cathode shorts only, in parallel and series circuits respectively.

STANCOR TUBE BOOSTER

Standard Transformer Corporation, 3580 Elston Avenue, Chicago 18, Illinois, is in production on a CR tube booster, a compact, self-contained device designed to add months to the useful life of a television picture tube.

The tube booster, P-8192, can be used with all electromagnetic picture tubes irrespective of size, where dimming is due to low cathode emission.

Easy to install, the new booster measures only 3½" high and 1½" in diameter. It does not require a.c. line connection and is equipped with a "high-low" switch providing two levels of brilliance. Of autoformer construction, it has 18-inch leads between the booster and connector plug, allowing the booster to be placed anywhere in the set.

U.H.F. ANTENNAS

Technical Appliance Corporation of Sherburne, New York, has announced the availability of a complete u.h.f. antenna line.

Designed to meet the specific needs of various localities, the new line includes parabolic-reflector types, yagis, modified "X", and "V" type antennas. With the exception of the modified "X" design, all are of the sharp directivity type. The modified "X" will be marketed in areas where reception from channels in opposite directions is required. Tuning of all antennas is such that all operating u.h.f. channels will be within the antenna's bandwidth.

Catalogue 83 covering this new line of u.h.f. antennas is available on request.

"SUPER AUTOBOOSTER"

Production of a new four-stage "Super Autobooster" has been announced by *Industrial Television, Inc.*, 369 Lexington Avenue, Clifton, New Jersey.

The Model IT-102A utilizes the new 6BK7A dual-triode in a multiple resonant circuit which provides a uniform 18 db gain over both bands.

Designed for general booster applications requiring uniform high gain at moderate cost, the new unit has a low noise factor resulting in high usable gain even with the new "low noise" TV receivers.

The wideband booster has automatic "on-off", heavy-duty transformer-type power supply, and a metal cabinet. It is operated by a thermal "on-off" switch.

CR TUBE ANALYZER

The Jackson Electrical Instrument Company, 18-46 S. Patterson Blvd., Dayton 2, Ohio, has introduced a new test unit, the Model 707 dynamic cathode-ray tube analyzer.

The new instrument is designed to completely and accurately test all TV

picture tubes, both magnetic and electrostatic deflection types. It will also analyze oscilloscope, radar, and other special purpose CR tubes without removal from the chassis or carton.

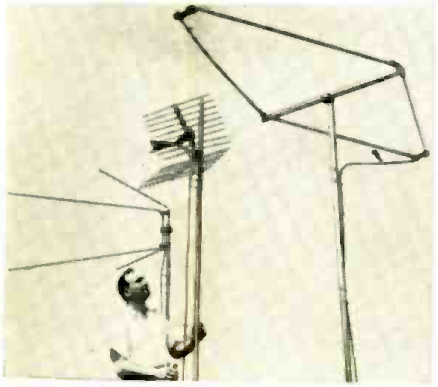
Four classes of tests are made with the analyzer. The beam current test is made to the final anode rather than to the grid or any other element. The beam current scale of the meter not only indicates sufficient or insufficient beam current, but also gives an accurate forecast of remaining tube life.

A grid test, a gas test, and interelement leakage test are also performed by the unit.

Full data on this new Model 707 is available from the company.

JFD ANTENNA LINE

JFD Manufacturing Company, Inc., 6101 16th Avenue, Brooklyn 4, New York, has developed a complete line of antennas for u.h.f. television reception.



Included in the new line are rhombics, single and stacked "V's", corner reflectors, and a combination "JcTenna-u.h.f." antenna.

This latter unit, the Jet 283, is designed for areas where both u.h.f. and v.h.f. stations will be in operation. It combines the features of the company's "fan-front" unit with a broadband triangular dipole u.h.f. antenna. A single lead-in wire delivers signals to the set through use of the company's unique coupling device.

Literature on the Jet 283 and other u.h.f. antennas produced by the company can be obtained by writing direct to Mr. Edward Finkel, sales manager of the firm.

TV COVERAGE CALCULATOR

Pioneer Electronic Supply Company, 2135 Prospect Avenue, Cleveland 15, Ohio, is now offering a new television signal-range calculator to the trade.

Designed as an easy-to-use slide rule, the new unit will quickly show the approximate grade "A", grade "B", and city coverage for all v.h.f. and u.h.f. television channels. Practical design permits coverage radius to be read directly on the scale, with one rule setting, for stations operating with effective radiated powers from 10 kw. to 1000 kw., and for antenna heights up to 3000 feet.

While useful to television transmitter engineers, the rule was designed especially as a handy TV service and

installation aid. With this calculator any TV service technician can quickly estimate signal strength from 5 to 100 miles and have a good "customer-convincing" basis for recommending a particular antenna installation.

Complete information on the calculator is available from Mr. Phil Jeffries, the general sales manager of the firm.

IMPEDANCE MATCHER

Rytel Electronics Mfg. Co., Inglewood, California, is now in production on a new unit which is engineered to balance the impedance between any antenna and the lead-in with which it is used.

Tradenamed "AIM", the new unit takes care of the impedance matching automatically. According to the company, the new unit will increase signal strength to the receiver on all channels (2 through 84), it will help eliminate snow and provide clear, sharp pictures in any reception area, it will give 3 to 7 additional db gain on all channels, and will prevent standing waves on the line.

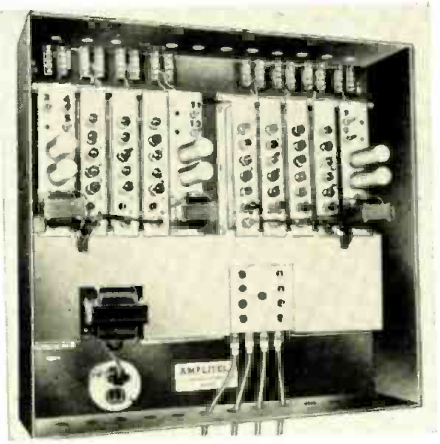
The junction box measures 2⅝" x 1⅜" x 1". It weighs 8 ounces complete with the U-clamp and approximately 47" of wire.

Full details on this new product are available from the company at 9820 Irwin Avenue in Inglewood.

AMPLIFIED SYSTEM

Amplitel, Inc., 360 W. 57th Street, New York 19, New York, is currently offering a new master amplifier TV antenna system which has been designed especially for large apartment buildings, hotels, hospitals, institutions, television dealers, etc.

The new unit is an amplifier system, designed to produce peak reception on each channel in an area—on every television set in the building regardless of location. According to the



company, there is no interference between sets and no cross-modulation between channels.

Complete technical specifications on this new antenna system are available upon request to the company.

TUNER CLEANER

Conrac, Inc., 649 W. Foothill Blvd., Glendora, California, has introduced a

new device which perpetually cleans both rotating and stationary contact points on all standard television tuners.

Tradenamed "Tuner Kleen'r", the new product consists of a plastic back covered by nylon which, in turn, is impregnated with a special cleaning agent. Produced to close tolerances, the unit is installed in the tuner by removing a pair of the unused tuner strips and substituting the cleaner device.

—30—

Spot Radio News

(*Continued from page 18*)

charged the normal calm of Commissionland. For his arrival is expected to cause some broad changes, particularly in the chairmanship of the group and the nomination of a new Commissioner to replace the recess appointee, Eugene Hyde Merrill, former director of the Materials Branch in the Defense Production Administration, who succeeded Robert Jones.

The naming of a new chairman may not be possible until June 30, when Walker's term expires. Actually, the present headman is serving on a special appointment from the President, having been asked to take the chair even though he had passed the retirement age; the late President Franklin Roosevelt had named Walker as a Commissioner in 1934. According to the established mode of procedure, the chairman is expected to be of the same political party as the President. Accordingly, two members of the Commission have appeared as possibilities for the appointment: Rosel Hyde, now serving as vice chairman, and George Sterling, both Republicans.

The appointment of Merrill was quite a surprise and was made public during an address by President Truman at Brigham Young University in Salt Lake City. Said the President: "This morning I signed a paper appointing to the FCC a distinguished resident of your state, Eugene H. Merrill. I thought you might be interested in that, because I understand that Mr. Merrill's father was a member of the board of this university. Of course, that was a good recommendation for him, as far I was concerned . . ."

Merrill's tenure, technically, will expire when Congress convenes in '53; his name must then be submitted to the Senate committee for confirmation. It is believed that the name of another candidate for the post, a Republican, will probably be sent to the Senate for such confirmation.

THEATER TV, shelved and reshelved on a dozen occasions, received a brief airing a short time ago during a special hearing in Washington which featured testimony by the Motion Picture Association of America and the National Exhibitors Theatre Television Committee.

Among the subjects included on the agenda were the technical requirements and standards for theater TV, involving the video signal (bandwidth, signal-to-noise ratio, linearity of electrical transducers and standards); audio signal; and the radio-frequency transmission of the video signal (r.f. bandwidth per channel, allocation principles for co-channel and adjacent channel operation, number of channels required per system, summary of standards, technical limitations on choice of frequencies, and possible location of theater TV service in spectrum). Also up for review were the possible systems of microwave distribution which might be used for intercity relay, intercity multiple address and intracity distribution. Methods which might be employed for projection were also up for analysis, kinescope projection, film storage, and *Eidophor*. Costs were also debated.

Quite a slice of the spectrum was asked for by the motion picture interests; a 360-mc. band in the 5925-6875 megacycle range, a band now allocated for fixed common carrier services. To assure quality transmission of 35-mm film, film engineers said that the FCC should provide 10-mc. wide video channels, radio-frequency channels 30-mc. wide, two-channels for a single system, and room for six systems for competitive reasons. It was also noted that an additional 60-mc. would be required for mobile pickup services. The Commission was told that if the channel initially requested could not be set aside, then there were two alternatives. Theater TV could be reclassified as an industrial service and be allowed to operate in the 6575-6875-mc. band, with the band being widened to accommodate the necessary 360 megacycles, which would mean that the industrial service band would have to be extended down to 6425-mc. The second possibility lay in the allocation of the band at 10,700-11,700 megacycles, now also assigned to fixed carrier circuits. If this microwave band were used, then radio-frequency channels of 55 megacycles would be required, instead of 30-mc. stated in the original specifications.

Theater TV may require an entirely new set of standards, it was disclosed at the meeting. Recommended for such a new engineering setup were a scanning rate of 735 lines; a signal-to-noise ratio of 46 db for black and white, and 42 db for color; a frequency-modulated video signal, an 8-kc. wide audio signal, multiplexed on the carrier, and a linearity not to exceed 10 per cent variation between the black and white levels.

The cost of building an intercity and intracity microwave net covering nine cities and about 1500 theaters between New York and Washington was estimated at between fifty- to sixty-million dollars, while operational expenses would run to about $2-million.

The fear that theater TV would deprive home viewers of top-flight pro-

grams was discounted by spokesmen for the film exhibitors and producers. Only special presentations, prepared for theater audiences and particularly adapted to large-screen reproduction, would be offered, the film moguls declared.

Complete briefs on behalf of others who will be involved in this new form of videocasting will be offered during the first weeks of the new year, and an extensive cross-examination period will follow. In view of the complexities of the issues involved in theater TV, many believe that there'll be no final decision from the Commission for quite awhile.

LOUDSPEAKER MANUFACTURERS have been cautioned by the NPA against a quick return to the production of electromagnetic speakers, in view of the present uncertainties in the copper supply situation.

The steel situation, disturbed by the recent strike, was also posed as a current difficulty by the government. Both issues were presented at a special meeting in Washington. In reply, an industry committee reported that speaker manufacturers are faced with a problem of seasonality and tie-in with radio and TV production. Declaring that loudspeaker steel allotments for the fourth quarter of '52 and advance allotments for the first quarter of '53 have been inadequate, manufacturers stressed that these quarters are the period of highest demand for their products. It was pointed out that speakers are the last component to be incorporated in chassis, and thus set makers do not order far in advance of their peak selling season. Therefore, it was noted, the speaker industry loses civilian business if it does not have a concentration of production material in the fourth and first quarters.

NPA officials stated their awareness of the situation and desire to alleviate the problem as soon as defense needs for steel are met.

Among those who attended the conclave in the nation's capital were H. S. Morris (Altec Lansing), George Cromartie, Jr. (Best), Austin Ellmore (Crescent Industries), Russel S. Fenton (Permoflux), Matt Little (Quam-Nichols), Stuart W. Bell (Quincy), A. I. Abrahams (Racon) and Laurence A. King (Rola).

THE SIZZLING AM-BAND EXTENSION debate has finally come to an end. A few weeks ago the Commision issued a finalized rule approving the use of the 540-kilocycle band. The AM broadcast band now extends from 535 to 1605 kc, instead of from 550 to 1600. The extension of the band had been approved at the Atlantic City conference in '47, and on December 1 of this year the extension had been officially supplemented by a Geneva agreement.

For years, broadcasters have been trying to win approval of this band, but were told that this channel was

too close to frequencies used by the government and marine services. However, the marine services have now arranged for the adoption of higher standards for auto-alarms* on shipboard, and the interference difficulty which prevailed earlier will no longer be a problem.

Canada has been using 540 kc. as a clear channel for many years, and XEWA, San Luis Potosi, in Mexico, is also operating on this band, with a power of over 100 kilowatts.

The first American station to use the new frequency may be KMBC, at Concordia, Missouri, who has been seeking that channel for years.

COMPATIBLE COLOR TV, as developed by the National Television Systems Committee, is expected to be ready for submission to the Commission next summer, according to Art Loughren, vice prexy of Hazeltine and chairman of the color video standards committee of NTSC.

The forecast was made during a meeting of the Society of Motion Picture-TV Engineers in Washington recently.

Before the FCC receives the petition to review the new color system, industry will be asked to review carefully, during a series of tests, all of the aspects of the system on the receiving as well as transmitting fronts. Then, one company will enter a plea for a hearing; NTSC will not be able to request the hearing since it represents most of industry and its views would probably be judged as biased, and thus not admissible before the Commission.

A FLEET OF 26 aircraft, operated by the Swiss Air Lines, will soon have complete visual omni-range very-high facilities for communications. The system features the use of instrument-panel navigation and is said to be useful on any course up to 200 miles to or from an airport.

* Auto-alarms serve to sound a call when a signal is received on 500 kc.

The airlines, operating out of Zurich, Switzerland, serve principal European points, the Near East, and provide transatlantic flights to New York City.

THE COUNTRY lost one of its foremost broadcasting legislators during the late fall, when Harold A. Lafount, member of the former Federal Radio Commission, died.

As a crusading Commissioner, he sought means to improve reception through the use of higher power for key outlets. Over twenty years ago he studied the possibilities of TV development.

The nation will miss the talents of this pioneer whose mature wisdom played so vital a role in creating the sturdy base on which modern broadcasting is built today. . . . . L.W.

International Short-Wave

(*Continued from page* 86)

To Central Europe, United Kingdom 0230-0330, 17.705, 15.160; 0345-0415, 17.850, 15.160; 1000-1030, 11.780, 7.250. To East, Southeast Africa, Mauritius 2300-0010, 17.705, 15.130, 11.870; 1045-1215, 15.290, 11.780. To Burma 1945-1955, 9.720, 7.170; 0615-0700, 17.850, 15.160. To China 0430-0545 (to *only* 0530 Sat., Sun.), 17.850, 15.160; 0530-0600 (Sat., Sun. *only*), 17.850, 15.160. To Indonesia 1745-1800, 7.125, 5.960; 0700-0730, 17.850, 15.160. To Fiji 0200-0320, 21.700, 15.190. To West Indies 1830-1930, 11.850, 9.630, 7.170, 5.980. To Pakistan 2245-2320, 9.630, 7.125, 5.970; 0745-0815, 5.990, 3.945; 0815-0915, 7.170; 0945-1000, 3.945. To Afghanistan and adjacent areas 2215-2230, 7.125, 5.960; 0845-0930, 3.945. To Afghanistan 0030-0130 (Fri. *only*), 9.670, 7.170; 1130-1230, 7.170, 5.980, 4.940, 3.945. To Persia, Afghanistan 1230-1330, 7.170, 5.980, 4.940, 3.945. To Saudi-Arabia, Egypt, Lebanon, Syria, North Africa, Jordan, Sudan 2330-0030, 11.760, 9.720; 1230-1430, 7.125, 5.960. To Europe, United Kingdom 1445-1545, 11.780, 9.565, 7.115.

To W. Europe, N. Africa, and the Levant 1445-1530, 5.960, 7.125. The *English* news service is 1500, 11.780, 9.565, 7.115; 1930, 11.850, 9.630; 2310, 17.705, 15.130, 11.870; 0300, 17.705, 15.160; 0830, 15.190, 11.780; 1045, 15.290, 11.780.

Indo-China (Vietnam)—Radio France-Asie, 9.954AV, Saigon, noted ending *English* session with "Knightsbridge March" 1754. (Pearce, England) This one is at fair level some days around 0740. (Stark, Texas) Heard on 15.430 with *English* session 0500. (Sanderson, Australia) "Voice of Vietnam" is noted on 7.2882 and 9.620 with English 0930-1000 closedown; schedule is 1800-1930, 2215-0030, 0500-1000. *Radio Hue*, 7.205, is now scheduled 1830-1900, 2300-0015, 0500-0800. *Radio Dalat*, 7.265, broadcasts 0530-0630 (Sat. 0630-0700) in French. *Radio Hanoi* is now on 9.670 at 1800-1900, 2230-0015, 0500-0830. *Radio Hirondelle (Swallow Radio)*, "Voice of the French Army in Indo-China," broadcasts on 7.408 from Hanoi at 2300-0130, 0530-1000, all-French. *Radio Laos*, 7.215, broadcasts news in French 0800-0815. *Radio Cambodia* relays French from Saigon 1815-1845 on 6.090, has its own news in French 0700. (Wada, Japan)

Israel—Tel-Aviv, 9.009A, now has news 1515; has *English* session ("Voice of Zion," relayed from Jerusalem) now 1615-1700 closedown. Announces news for 0645 over 6.830, 9.000 (actually 9.009A); has "Voice of Zion" session in French 1530. (Pearce, England; Martin, R.I.)

Italy—Rome, 9.630, noted opening 1245 and announcing for 9.63, 11.81; had news for Great Britain. (Ferguson, N.C.)

Jamaica — Radio Jamaica, 4.950, Kingston, noted opening 0600. (Ferguson, N.C.) And closing 2300 on 3.360. (West, Va.)

Japan—JKI4, 11.800, Tokyo, relaying Home Service, is strong level in New Zealand 0400; before 0345 has bad QRM. (N. Z. DX Times) JBD4, 15.235, noted 0400 with program in Japanese and Western music; is "N.H.K." outlet JK16, 11.825, noted 0400 with world and local news, then music. (Sanderson, Australia) JKL, 4.860, noted 0850 with popular music; JKI, 4.910, heard 0830 in Japanese, along with JKM, 4.940. (Flynn, Calif.) AFRS, 4.860, is noted in *English* to 1000 sign-off. (Gaylord, Wn. State) *Radio Japan* now uses JOA3, 9.675, and JOB, 6.069, to North America 0000-0100; the 0600-0700 beam to North China is radiated over JOA2, 7.180, and JOB, 6.069. Other transmissions are unchanged. (Kary, Pa.)

Kenya Colony—VQ7LO, 4.852, Nairobi, is now on this *measured* frequency, heard from 1200 to close 1500; the South African Broadcasting Corporation says Nairobi is also using 6.060 in parallel. (Ridgeway, South Africa) Forces Broadcasting Service, East Africa Command, 7.265, Nairobi, noted with music 2248; has BBC news relay 2300. (Ferguson, N.C.)

Lebanon—Beirut, 8.036A, has *Eng-*

lish daily 1000-1100A. (Pearce, England) Noted signing off 1631. (Kary, Pa.)

Liberia — ELBC, 6.022, Monrovia, noted 1830 to 1845 sign-off; announced would be back 1025. (Ferguson, N.C.)

Madagascar — Tananarive, 9.515, noted opening 2230 with "La Marseillaise." (Bellington, N.Y.; Kary, Pa.)

Malaya—Radio Malaya's Blue Network, 7.200, Singapore, noted signing off 1030 with "God Save the Queen;" on a Saturday was noted to 1100 closedown. (Pearce, England) Kuala Lumpur, 6.025, is heard well from 0900 with programs in *English*; has dance music 1000-1030 closedown. (Ridgeway, South Africa)

Manchuria—Mukden, 7.660, has been noted 0500-0855. (WRH)

Martinique — Nattugglan, Sweden, says FNRI, *Radio Martinique,* Fort-de-France, has been heard on 9.680 at 1935-2000; *not confirmed;* may have been confused with Paris on 9.685 which runs to 2000 closedown.

Monaco—Radio Monte Carlo, 6.035. 9.785, has *English* program, "Hour of Decision," Thursdays 1730-1800A sign-off, and "Back to the Bible" 1730-1800A sign-off Fridays. (Bellington, N.Y., others)

Mozambique—The *English* commercial service of Lourenco Marques is now using 11.742 instead of 11.765 as formerly. The Portuguese service is now using 6.14 at 0400-0630, and also 1030. (Ridgeway, South Africa) Heard signing off 1515 on 15.285A with "A Portuguesa"; fair to good level in N.Y. (Bellington) CR7BE, 9.810A, noted 0030 in Portuguese session. (Patterson, Ga.) Is heard 0000-0100. (Rosenauer, Calif.)

New Zealand — Revised schedules have just been received via airmail from *Radio New Zealand*—to Australia 1300-1515. ZL2, 9.540; 1530-0145, ZL10, 15.220; 0200-0545. ZL2. 9.540. To Pacific Islands 1300-1515. ZL9, 11.810; 1530.0145, ZL4, 15.280; 0200-0545, ZL3, 11.780.

Nigeria — Nigerian Broadcasting Service, 32 Marina. Lagos. Nigeria, verified reception of "7.083," stating frequency is actually 7.079; this is a 250-watt regional transmitter at Enugu in the Eastern Provinces; another regional station—low powered—is at Kaduna in the Northern Provinces on 4.925 during "hours of darkness" and 7.165 during "daylight hours" (local time). Officials said Lagos operates on 9.650, 7.5 kw., 0100-0215, 0530-0800, 1200-1500; channels of 6.100 and 7.255. low-powered, broadcast 0100-1700 with one break 0345-0530. Relays many BBC programs. Has been heard on 9.655A by Bellington, N.Y., and Kary, Pa., however, as late as 1700 closedown.

North Korea—Radio Pyongyang, the Korean Central Broadcasting Service, now broadcasts in Japanese on 4.400, 6.250 at 0800-0900. (Japanese Short-Wave Club)

Pakistan—Radio Pakistan is now on regular transmission (after completing

tests) to Turkey at 1430-1515 and to the United Kingdom 1515-1600 closedown on 7.010, 9.484. (Pearce, England, others) Heard with news 0330-0340 near 17.715. Noted with strong signal in program for Indonesia 0630-0715 on 17.835; announced 15.270 in parallel. (Pearce, England) Heard on 15.335 at 1915 with program for home listeners. (Sanderson, Australia) Is noted daily on 6.285A around 0700-1000, all-native; identifies often. (Wada, Japan) Now uses 9.762 instead of 11.844 for news 1015; heard on 6.23 with native programs 1115-1200. (Ridgeway, South Africa)

Panama—HO50, 5.996, noted in Australia 0145 with Spanish program of music and news. (Sanderson) HOJA, 9.645, noted 2140 with commercials in Spanish. (Pelegri, N.Y.)

Paraguay—Radio Encarnacion, ZPA5, 11.945, noted at good level from 1500 onwards. ZPA1, 6.278, Asuncion, is high level 2100 to close at 2200; features dance music 2100-2200. (Ridgeway, South Africa)

Peru—Radio Central, Lima, has moved from 9.522 (*listed* 9.545) to 9.550; weak level; uses call of OAX4K and Andalusian Spanish. (Stark, Tex.)

Philippines—Radio Free Asia, 6.11 Manila, noted closing 0920 when announced channels of 11.94 and 6.11 for Manila, 9.49 for Guam. (Balbi, Calif.) DZH4, 6.000, Manila, noted in *English* 0900, CWQRM. (Flynn, Calif.)

The Far East Broadcasting Co., Manila, has brought into use a 16-m. channel of *measured* 17.805; is reported opening 0300; has been heard by Sanderson, Australia, also around 2300 when signal strength was especially good in Melbourne, also with news 0500; call is DZ16. The 16-m. outlet is heard by Ridgeway, South Africa, at good strength in parallel with 9.73, 11.855, 15.300, and from 0900 on 6.030; heard from around 0800 to closedown 1200, *English* from 1000. DZI6 has been heard in Sweden by Engberg 0500-0600.

Poland—Warsaw lists *English* (presumably for Europe) as 0130-0200, 6.140, 7.155, 5.995; 1200-1230, 7.175, 9.555; 1230-1300, 6.115, 9.555, 7.145; 1400-1430, 6.115, 9.555, 7.145; 1430-1455, 6.140, 7.155, 5.975; 1730-1800, 6.140, 7.155, 5.975. (Pearce, England)

Portugal—Lisbon, 6.360, noted 1754-1800 when signed off with "A Portuguesa." (Machajewski, N.Y.)

Portuguese Guinea—CQM sent QSL card and mentioned *only* 5.838 at 1630-1800. (Pearce, England)

Portuguese India—Radio Goa, 9.61, heard in Hindi 0930, in Portuguese 1000; in *English* 1030 (Mondays has "Old Fashioned Revival Hour" transcription); has guitar interval signal; is in foreign language 1130 and closes 1230, good level in South Africa. (Ridgeway)

Reunion—Radio St. Denis, 7.168, has strong signal in South Africa opening 0915 with announcements in French; 0930 light music, French songs; calls "Ici Reunion, Radiodiffusion Francaise" by man; woman also an-

nounces; 1100 gives news in French; 1115 dance music; a Soviet transmitter swamps the station around 1125. (Ridgeway)

Sao Tome—CR5SB, 17.677.5, noted Sundays 0750 when tuned with dance music; at 0757 had call, guitar music, details of next program and closing announcements in Portuguese; left air 0800A after "A Portuguesa." (Pearce, England; Ferguson, N.C.) CR5SC, 4.809, is good level opening 1430, light musical programs to closedown 1600; gives call frequently (by man). (Ridgeway, South Africa)

Saudi-Arabia — Djeddah is noted opening around 2215 on 6.177A and 7.245A with usual interval signal; uses Arabic; closes around 2304A. (Bellington, N.Y., others)

Somalia—Mogadishu, 7.383, is heard from 0915 in Arabic to 1200, when goes into Italian until 1300 closedown. (Ridgeway, South Africa)

South Korea—HLKA, 7.935A, Pusan noted 0630 with Western music and Korean news. (Sanderson, Australia) Wada, Japan, says is now operating on 7.935 and 9.555 at 1600-1800, 2130-0030, 0330-0900, all in Korean. Flynn, Calif., reports HLKA on 4.4785 at 0845, S6, in oriental language, much QRM.

Spain—Radio Mediterraneo, Valencia, is noted now near 6.995 from audibility around 1425. *Radio Juventud le Murcia* has been moving around, noted more recently on 7.105A with dance music 1655; gave call in Spanish 1700, and was soon buried by sign-on of a *Radio Free Europe* station. A Spanish Nationalist outlet has been heard on 7.420, but it is *not Radio Menorca;* signs on 1500 with singing of march and signs off with similar number 1705; call sounds like "Transmite Radio Cartagena." (Pearce, England) FET1, 7.006, noted 1630 with Spanish program of news, music. (Sanderson, Australia) Malaga, 7.012A, is still noted with Spanish Home Programs around 1515 onwards, fairly good level. (Ridgeway, South Africa)

Sweden — Radio Sweden, 11.705, noted with news 2300, then music. (Sanderson, Australia) Heard on 15.155 with news around 1000, fair level. (Scheiner, N.J.) Noted on 9.535 at excellent strength 1900-2000. (Deem, W. Va.)

Switzerland — Damascus, 17.865, heard 0945-1045 to India-Pakistan. (Pearce, England) On 11.913A with news 1720-1730 closedown. (Black, Pa.)

Tahiti—Radio Tahiti, 6.135, Papeete, is heard around 0000; signs off 0130. (Kary, Pa.)

Taiwan — BEC26, 10.060A, noted from 0910 tune-in with Chinese session to 1000 closedown. (Pearce, England) Taipeh, 15.235, heard with news 2200 to North America. (Annala, Oregon) BEC32, 9.775A, Taipeh, noted 0700 with *English* commentary and Western music; asked for reports. (Sanderson, Australia) A Taiwan outlet is noted on 7.045A around 0500-1030 closedown; call seems BEC22, BEC32, or BEC34; is not parallel with 9.855 which is heard quite irregularly; another Taiwan station is noted on 7.340A to 1030 or 1100. (Wada, Japan)

Tangiers—Radio Africa is on a *new* channel of 7.192 as early as 1015, and as late as 1745. (Pearce, England; Kary, Pa.) *Radio International,* 6.110A, noted with news in Spanish 1700. (Pearce, England) *Pan-American Radio,* 7.300, is heard with clock chimes (12) at 1900 and multi-lingual announcements to 1904 sign-off. (Kary, Pa.)

Thailand — Bangkok, 11.910, has *English* session 0500-0630, fair level; announces also 15.630, 7.140 (is nearer 7.105—K.R.B.), 6.240. (N. Z. DX Times)

Uruguay—Radio Electrica, CXA10, has extremely good signal from around 1130 with classical music; call is given every half hour by man; has QRM from *Radio Dakar* at 1400. *Radio Ariel,* CXA3, 6.075, is noted at good strength from around 2030 to closing 2200, man gives call in Spanish. (Ridgeway, South Africa) Niblack, Ind., notes CXA10, 11.900, at good level 1800 and closing 2210.

USI (Indonesia)—A station believed Djakarta is heard with strong signal mornings to 1030 closedown on 9.865; at times location sounds like "Jogjakarta," however. (Stark, Texas; Kary, Pa., others) Noted on 9.585 from around 0800-1030 closedown. (Balbi, Rosenauer, Calif.)

USSR— Radio Tashkent, 6.825, is noted with *English* for India-Pakistan 1000-1030, 1115-1130 (some days *English* begins 1030, however). (Pearce, England) Moscow is noted on 11.68A with *English* (review of Moscow press) and music 0500-0530 fade-out. (Jones, France) Frequencies used by Moscow for the 1820-0100 period to North America are 15.330, 15.250, 15.230, 15.110, 11.910, 11.830, 11.810, 11.710, 9.670, 9.650, 9.550, and 7.240 (some of these are actually relays by satellite countries); the 0800-0830 transmission to North America is over 17.830, 15.440, 15.360, 15.180, 15.120, 11.910. (Kary, Pa.)

Vatican—HVJ, 5.968, noted 1545 with chimes and then news in Italian. (Sanderson, Australia) Noted on 11.74 with news 1000, fair level; also heard on this channel with *English* 1315. (Scheiner, N.J.) Noted with *English* period 1315 also on 9.550. (Kary, Pa.) According to NNRC, HVJ has news Wednesdays, *only* 0930-0940 on 17.775 for Near East.

Venezuela—Radio Rumbos has *English* session Mon.- Fri. 1800-1900 over 4.970, presented by Jay Farr; first 45 minutes is disc jockey session called "Supper Club" and last 15 minutes (1845-1900) consists of a roundup of latest world and local news. (West, Va.) YVKB, 4.8903, noted S5 at 0612; YVMM, 4.9096, was S5 at 0615; YVKM, 5.0294, noted S5 at 0619, CWQRM. (Oskay, N.J.)

Yugoslavia—Belgrade, 6.100, noted signing on 2330; has *English* 0130 and then is heard parallel on 9.505. (Bellington, N. Y.) *English* is now sched-

duled 0130 on 6.100, 9.505; 1100-1115, 6.100, 7.200; 1315-1330, 6.100, 6.150; 1645-1700, 6.100, 6.150 (WRH)

* * *

Press Time Flashes

When this was compiled, a station on 4.950, identifying (in *English*) as "the Broadcasting Service of Radio Belize" was being heard around 1830-1904 closedown. (West, Va.) Good level in West Virginia but with CWQRM and aircraft phone QRM. Is British Honduras.

The *Radio Clube de Angola*, Luanda, Angola, is now using a *new* channel of 4.873 in parallel with 9.632, 11.865; heard from around 1330. (Ridgeway, South Africa)

The Central Broadcasting Station, Lusaka, 4.826, North Rhodesia, is noted around 1210 with dance records; with talk in *English* 1230, BBC news relay 1300; probably signs off 1400. (Pearce, England) Ridgeway, South Africa, lists ZQP at 0700-0900 on 7.220; 0900-1100 on 7.220 and 4.826; 1100-1230 on 7.220, 4.826, and 3.275; 1230-1400 closedown on 4.826. 3.275.

The Japanese Communist station *Radio Free Japan* broadcasts on 10.180, 11.896 at 1500-1600, 2200-2300, 0500-0600, 0730-0830; uses Japanese *only;* is probably located in Communist China. (Japanese Short-Wave Club)

Legge, New York, notes *Radio Free Europe* afternoons (*EST*) on 11.855, 11.725, 9.717, 9.695, 9.607; fair signals around 0600 on 11.745, 11.675. (NNRC)

An Arabic-speaker reported some months ago by Cushen, N.Z., heard on 5.000, has been identified by Bert Bluman, Israel, as located at Kuwait in the Persian Gulf; operates 1130-1400 and identifies *only* at sign-on; programs are all-Arabic. (Radio Australia) (Al Kuwait is a sultanate in Arabia, south of Iraq, on the northwestern coast of the Persian Gulf; it is a British protectorate with a population estimated at 50,000.—K.R.B.)

Latest schedules for the *COURIER*, the *Voice of America's* "Truthship," are 1200-1615 to Near East and 1730-1900 to Caucasian USSR on 6.015; 1730-1900 on 7.200 to Caucasian USSR. VOA is now sending out QSL cards for reports on reception when the *COURIER* was testing from the Panama Canal Zone some months ago.

By this time, the 1953 edition of *WORLD RADIO HANDBOOK*, compiled in Copenhagen, Denmark, by O. Lund Johansen, should be available from Ben E. Wilbur, 1000 Connecticut Ave., N.W., Washington, D.C. It is written in *English*.

"Australian DX-ers Calling" is now aired each Saturday 2300 on 15.200; each Sunday 0030 on 15.200, at 0300 on 9.580, 11.760, 17.840, and at 0902 on 9.580, 11.840, 15.320.

The Korean Broadcasting System operates a network of 15 stations, two of which are short-wave—HLKA on 2.510, 7.935, each 1 kw., and located in Pusan. A *new* short-wave station will open shortly in Seoul, using 10 kw. QRA is Hahn Ki Syan, Chief Engineer,

Korean Broadcasting System, Office of Public Information, Pusan, Republic of Korea. Schedule is 1600-1830, 2100-2400, 0300-1030. (Cushen, N.Z.)

A station noted on 9.310A around 1710-1847 sign-off in Danish and Greenlandic is believed to be Godthaab, Greenland. Has bad QRM at times. (Bellington, N.Y.; Kary, Pa.)

A *new* outlet in Sao Paulo, Brazil, is noted on 11.855 around 1830. (Niblack, Ind., others)

ISWC, London, says "The Voice of Zion," Israel, has an experimental transmission to South Africa on Sundays 0630-0730 over 15.550 (frequency may be varied).

YVMG, *Radio Popular,* 4.810, Maracaibo, sent QSL card; listed YVMG, 4.810, 2 kw.; YVMH, 1250 kc., 2 kw. QRA is Apartado Postal No. 347, Maracaibo, Estado Zulia, Venezuela. Says is affiliated with *BBC, NBC, United Nations Network of Peace,* as well as *Radio Programas de Mexico.* (Patterson, Ga.)

Schedules of *Radio Tirana,* Albania, on 6.560, 500 watts, and 7.850A, 3 kw., are 2300-0100, 1100-1130, 1215-1700; *English* is listed for 2345, 1600. (Radio Sweden)

Bellington, N. Y., notes the clandestine *Yugoslav Emigrant Station* on 6.887A parallel with an outlet on 7.500A around 1750; has man and woman alternating in European language.

British Honduras is to have a better short-wave service soon; a 5 kw. short-wave station is expected to be in operation at Belize by next March. (Catch, England)

Radio France-Asie, Saigon, Indo-China (Vietnam), has been noted back on its old 11.83 channel from 11.924A, signing off 1125. (Balbi, Calif.)

Sanderson, Australia, notes a much improved signal from the Chinese Air Force Station, Taipeh, Taiwan, on 9.750A at 0700 when has *English* session. May have installed a new and more powerful transmitter?

Radio Free Europe noted on 10.300A when tuned 1000; melody followed by call, then program in Hungarian; news in Czech 1015. (Pearce, England)

The Free Greek Radio appears to be on about 6.970; intercepted at 2255 when had Greek language session running past the hour. Signal was gone when retuned 2315. (Kary, Pa.)

A clandestine station announcing as *"Freidomsender"* is heard in Sweden on 7.700 at 0230-0245.

EDV10, *Estacion Escuela Radio S.E.U.,* Madrid, sent usual QSL card; said is on 7.170 but enclosed schedule for Esperanto transmission (at 1430) which gave channel as 42.33 m. or 7.088. (Pearce, England)

When this was compiled, the BBC's programs for the Western Hemisphere were listed—*North American Service*—To Canada, USA, Mexico, 1000-1215, 17.715; 1300-1545, 11.930 (Mon.-Fri.); 1500-1545, 9.825 (Mon.-Fri.); 1545-1700, 9.825, 6.195. *Special Programs*—For Falkland Islands, Sun. *only,* 1130-1200, 17.810; for West Indies, 1815-1845, 9.580, 6.035. *General Overseas Service*—To West Indies, Central America, South America (north of Amazon), 1500-1700, 11.750; 1700-1815, 9.580, 6.035; 1845-2200, 6.035. To South America (south of Amazon), 1500-1700, 11.820; 1700-2200, 9.410, 6.110. To Canada, USA, Mexico, 1700-1845, 9.825; 1700-2200, 6.195; 2300-0115, 6.110.

* * *

Acknowledgment

Many thanks for the splendid cooperation during 1952. May 1953 bring you the best in SWL'g. Sorry that space limitations would not permit the use of more of your fine reports this month. Please continue to send your *best tips* to Kenneth R. Boord, 948 Stewartstown Road, Morgantown, West Virginia, USA. Thanks!—K.R.B.

Two-Meter Master

(*Continued from page 41*)

The filter network, R_8-C_{13}-C_{14}, helps to isolate stray r.f. from the modulation transformer. The r.f. chokes RFC_2 and RFC_3 are identical, wound on a short ¼" diameter polystyrene or ceramic dowel. 24 turns of #28 enameled wire provide adequate choking at 144 mc.

All tube heaters are wired so that the "B-" ground return serves as half of the heaters return; at the final amplifier, the 832A heaters bypasses to ground through C_{18}.

Cross neutralization of the final shows lengths of solid hookup wire connected from the grids, across the back of the tube socket, and out through small holes in the socket mounting bracket. The holes support feedthrough bushings, which rigidly support the neutralizing wires running parallel to the plates outside the glass envelope of the tube. When neutralizing the amplifier, start with wire lengths adjacent to the tube's plates extending about ¾" from the feedthrough bushings. Clip off about a sixteenth inch at a time until the amplifier stabilizes. Do not try to operate the amplifier without neutralization; at these frequencies, its use becomes mandatory unless one was born under a *very* lucky star!

The r.f. section requires 300 to 325 volts d.c. at a current of 175 ma. Any power supply meeting these requirements may be used, and most junk boxes may provide enough parts to run 20 watts input. Separate power supplies are employed for the r.f. and audio sections of the transmitter.

Physical construction of the r.f. section is made upon a "U" channel measuring 10" long, 3¼" wide and 2¼" deep. Inasmuch as W6WGD has been operated from hotel rooms and similarly restricted spaces for the past twenty years, an absolute minimum of space was utilized in this design, if only from force of habit. The unit may be constructed according to its builder's preference, although a similar parts layout should be followed.

Due to its small size, the transmitter uses miniature one-inch meters to read final grid and plate currents.

With reference to Fig. 4, note the point-to-point wiring; resistors R_5 and R_7 are bolted together through their lengths to form a single unit, supported by heavy wires making connections to various tie points. The power input connector provides support for this and other circuit components, as does the second tripler tube socket. Actual constructional features are left to the ingenuity of the reader.

Modulator Section

To convey maximum intelligence, the carrier must be modulated as fully as the law allows; the speech should have good fidelity and crisp response to be clearly defined at the receiving

end of the QSO. In order to meet these requirements, the modulator was designed to offer "broadcast" fidelity, supplying approximately ten watts of undistorted peak voice power to the carrier from an unusually small package.

Exclusive use of miniature dual triodes results in the smallest practical size for the modulator. With reference to Fig. 7, note that a single cascaded 12AX7 comprises the speech amplifier for a crystal microphone. An r.f. decoupling filter, R_1-C_1, serves to isolate r.f. from the speech input grid.

The shunt-coupled *UTC* 0-6 "Ouncer" transformer drives a 12AT7 amplifier; this dual triode provides push-pull amplification to drive a second 12AT7 cathode-follower stage which, in turn, drives a 12AU7 as the class B modulator. Use of the cathode-follower driver tube eliminates the necessity for a driver transformer, an item of some importance where space is at a premium.

Any type of small modulation transformer designed for 10,000 ohm plate-to-plate class B service may be employed rather than the unit recommended, the prerequisite being that its secondary should encompass an impedance range of 3000 to 5000 ohms to match the class C load. The transformer used provides three secondary taps of 3000, 3750, and 4500 ohms. At a plate voltage of 300 and loaded to 70 ma., the class C load represents 4643 ohms, matching the 4500 ohm tap closely enough to result in linear modulation.

Power supply for the modulator remains identical to that required for the r.f. section, although its current rating need not exceed 100 ma. The 12AU7 has a static plate current of 15 ma. with $-22\frac{1}{2}$ volts of battery bias and peak current of 75 ma. Oscilloscopic inspection of the 20-watt carrier shows linear modulation of approximately 97%, while signal reports place special emphasis upon the excellence of quality and the power-packed audio sidebands.

Fig. 6 illustrates modulator construction; a case measuring 10" long, 3¼" deep, and 3½" high encloses the complete unit. Parts layout follows schematic circuitry down a straight line from input to output; components bolt to a strip of aluminum "breadboard" which mounts above the bottom of the case upon four corner stand-off spacers. Fig. 2 shows the breadboard inverted to illustrate the wiring technique and parts placement.

When constructing the modulator, it will be found that point-to-point wiring becomes necessary, as the compactness of the unit is similar to that of a hearing-aid amplifier. Extreme caution in wiring will result in the least feedback in a high-gain system of this size. When operating properly, the gain control may run wide open with zero feedback, although this offers more gain than is required for the normal modulation of 20 watts input.

Two insulated mounting strips attach to the top of the modulator case at each end. The r.f. chassis grounds to one point only on the modulator case to foil v.h.f. circulating currents flowing between the metals. (Those circulating currents can cause untold grief by contributing to excessive r.f. feedback!) In addition to providing insulation, the strips are saw-slotted to afford footing for the bottom edges of the r.f. chassis, preventing slippage.

The case and r.f. chassis are fabricated from heavy brass plate, silver-plated, and polished. It is emphasized that this development model was silver plated not to enhance its electrical characteristics, but only to satisfy an aesthetic whim of the designer! The reader may construct a similar transmitter upon pewter or platinum, depending upon his taste and the size of his bankbook.

In constant use for the past several months, this transmitter has worked the same DX as have stations using more than five times its power input of twenty watts. Ninety-five per-cent of the DX contacts were solid QSA 5, using a four-element beam from a flat city location. This operation indicates that at W6WGD, a hilltop and kilowatt seem unnecessary for more than routine enjoyment of the two-meter band. —30—

"THE BACKTRACKER"

By JOHN M. HAMILTON

WITH grounded plate and cathode, no grid leak nor "B" supply, maybe our little set, "The Backtracker," shouldn't work at all; yet it does, bringing in local and DX stations with plenty of headphone volume.

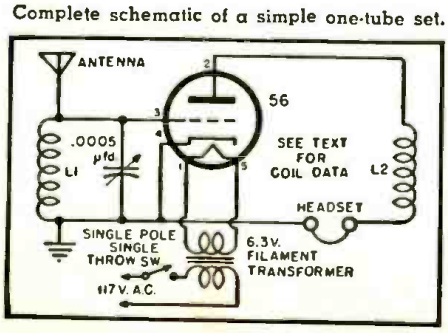
The set was built around a discarded Type 56 receiving tube (any other indirectly-heated tube will work), which obviously operates as a "square law" detector. The two coils shown in the circuit diagram form a grid-plate coupler, which increases the sensitivity and selectivity.

Coil L_1 consists of 100 turns of #28 enamel wire on a 1½-inch cardboard tube. L_2 consists of 300 turns of #28 on a 1¼ inch form. L_2 slides inside of L_1 to form the coupler.

Tuning is easy. Rotate the condenser until a station is heard; then pull out L_2 until the volume is strongest. The frequency may be changed considerably by pulling out L_2 several inches.

From our home in Youngstown, Ohio, using an ordinary 70-foot aerial, we've logged 27 broadcast stations. Our best DX so far is KOA, Denver, 1500 miles away—logged in the wee hours! —30—

Complete schematic of a simple one-tube set.



RADIO-TV Service Industry News

AS REPORTED BY THE TELEVISION TECHNICIANS LECTURE BUREAU

WHEN officials of manufacturing organizations attend gatherings of people now engaged in the business of servicing radio and television receivers they express amazement at the evident high caliber of the men who own and operate today's service businesses. In the eyes of too many people in the industry who seldom come in direct contact with present day service business executives, the servicing of television and radio receivers is still handled by a faceless, motley mass of people who, in the aggregate, constitute a tremendous market for replacement parts, tubes, and supplies, but whose identity as individuals is of no consequence. Many people still hold the mental picture of the average individual service business operator as being an unkempt character who is content to work for a marginal income and who is either not interested or incompetent to run his service activities in a business-like manner.

A Distributor's Party

A few weeks ago we were invited to attend a parts distributor's party for his service customers. This was something new. There are endless parties given by manufacturers for their distributors and by the distributors for the representatives, and vice versa, but this was the first time we had had an opportunity to attend a party given by a parts distributor for his service customers and their wives and sweethearts.

Seven years ago a former radio service technician started a parts distributing business in Columbus, Ohio. Ray Whitehead and his wife and partner, Polly, launched the infant business in a modest-sized storeroom not overly stocked with replacement tubes, parts and supplies. The business grew rapidly and on their fifth anniversary, the Whiteheads threw a party for the service business customers in central Ohio whose purchases were responsible for the success of the business.

They held another party on their seventh anniversary. They rented the ballroom of a popular hotel to entertain their customers and rented all of the other rooms on the same floor so their suppliers could display the latest products and meet the Whitehead customers. Enough chairs to seat eight hundred people were set up in the ballroom and another two hundred in an adjacent room to accommodate any additional guests who might attend.

The expression "the place was bulging at the seams" is the only adequate description of the tremendous crowd of service people and their wives who accepted the Whiteheads' invitation to attend their anniversary party. Possibly more than 1500 service executives, technicians, and their wives came. It was not a "sales meeting"—it was a gesture of appreciation on the

Part of the crowd of more than 1500 service executives, technicians, and their wives who attended the service party given by Whitehead Radio Company, Columbus, O.

part of a man and his wife to the customers who had made their success possible.

Close to one hundred manufacturers' representatives and company officials attended the party. It was high-lighted by the surprise presentation of a Certificate of Appreciation to John T. Thompson, replacement tube sales manager for *GE*, for his company's consumer campaigns on behalf of the independent service profession. The presentation was made by Fred Colton of *Graham & Colton*, president of the Associated Radio & Television Service Dealers, Inc., as an award from the Association.

Ray and Polly Whitehead were also surprised with an ARTSD Certificate of Appreciation which was presented by Sam Oppenheimer of the *Columbus TV Laboratories*, vice president of the association.

Lesson in Cooperation

For many years Columbus, Ohio, has been one of the "cleanest" radio-TV service areas in the country. When the TV boom struck it attracted, as in all other areas, some "fast-dollar" and quick change service operators. But down through the years the ARTSD had created a healthy respect for the quality and high standard of service performed by its members. They were able to get the wholehearted support of the Better Business Bureau and other civic organizations in weeding out the parasites who were trying to feed off the ignorance of the set-owning public about what they should pay for and receive in the way of competent TV service.

There are two important factors back of the continuing success of the Associated Radio & Television Service Dealers in maintaining a healthy climate for radio-TV service as a profitable business activity in Columbus. The first is the amount of time that is given by its officers to create and carry out the Association's programs. These well-conceived programs regularly cover all facets of interest to the men engaged in the business of service. First, they hold their regular monthly sessions where they discuss frankly all phases of the operation of their businesses and all factors that influence the course of their businesses; next they conduct a regular series of technical sessions to keep their members and their members' employees abreast of the fast-growing technology of the industry; and third, they have regular social gatherings that enable the members' families to get acquainted.

The second important factor in ARTSD's success is the excellent cooperation between the Association and Columbus parts and set distributors. Every three months the members of ARTSD invite all Columbus distributors to have dinner with them and afterwards air their grievances against each other. Columbus distributors have cooperated whole-heartedly in this program and it is quite possible that, as a result, Columbus is a poor

market for fringe distributors and the extra discount boys in the distributor business.

Why Do Service Associations Fail?

Many service associations have been formed with a great deal of enthusiasm only to quickly wither and die from ennui. Why? The first reason is that associations usually are formed when service businesses are in trouble. Those who join think an "Association" will solve their troubles. Usually, the first acts of an association are along the lines of "forcing" someone to do something or to quit doing something that the members think is hurting their businesses.

For an association to be successful it must first be ready to "give" something to the industry in which it operates. Its members must be willing first to get their own business houses in order before they start asking others to clean up theirs.

A successful organization must have a series of self-help programs. These must be carefully planned, intelligently organized, and carried out aggressively. This requires time, effort, and thought on someone's part. It also takes money. If the officers of an association are not willing—or not able—to give unstintingly of their time and effort to develop and carry out these self-help programs the organization will wither away. If the members are unwilling to pay the dues necessary to defray the expenses necessary to operate an association it cannot exist.

The first requirement of an association is to have a carefully planned series of activities that will cover the business phases of a service company and the technical developments in the industry that affect service, and will provide an opportunity for the members to get acquainted socially. The second requirement is for the association to have an officer, or officers, who can afford to give the time and have the natural "drive" to keep this program rolling.

All too often after an association is formed the members are too busy to engage in association activities when business is good and they can't afford it when business is bad.

A Case History

The Television Service Association of Michigan is a comparatively new organization that has created an important place for itself in the TV industry in Detroit. Like ARTSD and other successful associations, it is primarily concerned with the problems of service as a business but at the same time, keeps its members and Detroit technical service personnel abreast of technical developments by sponsoring service clinics and lectures.

TSA has the active support of both set and parts distributors in the area and they work closely with the Better Business Bureau and law enforcement agencies in policing service business practices in the city.

Hal Chase of *Chase Television Service*, president of the Association, gives a lot of his time in planning and directing the Association's activities. "TSA News" has been developed into a self-supporting house organ with a wide circulation in the area. Recently they launched a "consumer" bulletin which is included as a section of "TSA News." It is available in quantities to members for mailing to their customers. The consumer bulletin carries TV-connected news of interest to set owners and is supported by merchants who advertise in it.

The Association holds regular monthly business meetings. These are held in a private dining room in a downtown hotel with members and guests meeting for dinner. After dinner a guest speaker usually gives a short talk on some subject of immediate importance to service executives with the regular business meeting and round table discussion of problems following it. Parts and set distributors attend these monthly business meetings.

The technical meetings include at least one general service clinic each year. The purpose of the service clinics is to permit technicians to get circuit information on all standard TV sets in as short a time as possible. Distributors display their latest model chassis and have either factory or distributor service personnel on hand to discuss circuit individualities with service technicians.

TTLB Lecture on U.H.F. TV

The TSA recently sponsored the Television Technicians Lecture Bureau's lecture on u.h.f. TV. In this type of lecture the technician is able to get a complete picture of all possible installation and servicing requirements that may be demanded for u.h.f. reception. It covers u.h.f. converters and how they are applied to present v.h.f. receivers. Sample units of most converters are displayed and alignment procedures are demonstrated for the converters that may need to be aligned in the field.

The presentation then covers the circuitry of the new u.h.f.-v.h.f. combination receivers and technicians are shown what they may be called upon to do in servicing these new sets in the field. And, since the antenna system may possibly be the most important element in the reception of u.h.f. programs, either in converted v.h.f. sets or in the new u.h.f.-v.h.f. combinations, an extensive coverage of u.h.f. antenna and systems requirements is included as a part of the lecture.

These technical training programs as carried out by TSA and ARTSD are planned to conserve a technician's time by giving him the maximum amount of practical information in a minimum of time.

Business or Technical Associations?

Television introduced a new factor in the operation of service businesses that has made a complete change in

the complexion of the service industry. Prior to the advent of TV it was entirely possible for an ingenious technician possessed of some business acumen, able to get along well with people, and willing to work long hours, to make a pretty good living out of servicing radios. Not much equipment was needed for radio service work since the characteristics of the conventional a.c.-d.c. circuits were so well known that almost eighty per-cent of the jobs could be completed without the use of even a v.o.m.

TV changed all that. Larger chassis, more tubes per set, multiple circuits, bulky picture tubes, and on the job servicing, plus a number of other factors, made it necessary for the operator of a TV service business to get familiar with work planning, organization of time, and adequate record keeping. The need for precision test instruments, trucks, larger stocks of tubes, parts, and supplies add up to a substantial investment that can seldom be carried by the income from one man's time. So the TV service business man has employees and all of the attendant responsibilities of keeping his help profitably occupied.

TV service adds up to a tremendous dollar volume business. This attracts the attention of men who are not necessarily TV technicians. They are basically business men who know that good management can operate any business at a profit where there is such a large and growing market for the needed service.

Successful TV service operators are businessmen primarily, whose major interests are in selling service, reducing costs of operation, watching inventories, and planning the work of their employees to make a profit from the labor they are buying.

These men need service *business* associations. They need to know their competitors in the service business. They need to cooperate with their legitimate competitors to discourage practices that are both unprofitable and not in the best interests of the owners of TV sets. A good trade association can actually create more business in any given area through programs of user education.

Technical Associations

Then there are many thousands of men employed in servicing who are mainly interested in the technical phases of the business. Lots of men now engaged in TV receiver servicing do not aspire to own their own service businesses. They prefer the technical side of the business and would rather work as a top technician in a good service organization than run their own service businesses.

These men prefer to belong to technical associations where they can discuss circuitry and technological advances with their fellow technicians. We should have more such associations in the industry. Perhaps they could be termed ISE—Institute of Service Engineers. In large cities techni-

cal service associations should arrange themselves in small groups so that members can meet regularly at a central point close to their homes. Perhaps twice a year the entire city association could sponsor a big meeting in some central location to hear an outstanding lecturer or plan a service clinic that would feature discussions of the important technical developments or servicing problems.

Service Industry Identification

A common complaint among service shop operators is that manufacturers are not interested in the problems or welfare of the independent service industry. This is not true for the average manufacturer realizes full well that a strong, financially successful servicing industry will provide a healthy, stable market for his product. It is equally obvious that a manufacturer cannot get enmeshed in the problems of the service industry without getting involved with some laws that tell him to keep his nose out of other people's business.

The independent service industry has several unused "tools" available to it that would lift the entire activity to a much higher level of importance in the industry. The most important of these tools lies in the way you order tubes, parts, and supplies from your jobbers. How often do you specify the brand names you want when you order tubes, parts, or supplies?

How important are you in any manufacturer's "chain of distribution"? If you do not order your tubes, parts, and supplies by brand name—and insist on getting the brands you order—you are not important at all. You are merely a small part of a mass market for these products. Your parts jobber is the key man in the manufacturers' chain of distribution because he selects the brands that you accept without question.

Consider this: If you order fifty tubes from your jobber and accept any brand that he supplies, you as an individual mean nothing to any individual tube manufacturer.

But suppose you specified a particular brand when you ordered tubes—and insisted on getting that brand. Then you become very important to that tube manufacturer because your preference for his tubes has placed you on his sales team. Your jobber will become less important in that manufacturer's chain of distribution because he knows that if one jobber will not or cannot fill your order for his brand of tubes you will go to some other jobber who will. You become a very important factor in that manufacturer's distribution chain.

The independent servicing industry would increase its importance immeasurably in the eyes of manufacturers if every service shop operator would specify a particular brand on all tubes, parts, supplies, and accessories he orders from his jobber—and would insist on getting the brands he specifies.

—30—

Tone Controls

(*Continued from page 57*)

equipment and the listener. The general relationships to observe are that phase shift and subsequent mixing tends to lower the apparent frequency of transients and asymmetric waveforms and if the phase rotation is greater than 90 degrees will tend to suppress sine waves. The opposite relationship is when phase shift, inversion, and mixing takes place in which event the apparent frequency of transients and asymmetric waveforms is increased for phase rotations of less than 180 degrees. Likewise, sine waves will tend to be suppressed in the case of phase rotations of less than 90 degrees.

As mentioned earlier, the effect of phase-shift mixing is generally to increase the ratio of transients to sine waves in the reproduction. In addition to some of the previously mentioned advantages this effect may cause reproduction with greater "presence," apparently due to the fact that transients stimulate individual room resonances to a greater degree, an element apparently easily recognized by a listener thoroughly familiar with his particular acoustic environment. Nevertheless, the reproduction of a signal having a high transient-to-sine-wave ratio usually means that the peak power handling capabilities of the audio system must be considerably greater than that of a system handling continuous wave trains in order to present the same apparent loudness level to the listener. Likewise other problems may present themselves, such as an interesting form of distortion which the author characterizes as "demodulation distortion."

In considering speech or music it should be realized that the various wave trains tend to produce a modulation envelope, which can be produced either by a tone of constant pitch or by a combination of unrelated frequencies. Usually these modulation envelopes vary from a few cycles-per-second on up into the audible range. If nonlinearity or rectification is present in the audio system, such as might be caused by second harmonic distortion in an amplifier stage, then the envelope components will tend to be demodulated and will appear in the output as a spurious low frequency tone. In the case of a phonograph pickup having a serious ringing resonance, even in the ultrasonic region, the effect of demodulation distortion will be to introduce spurious noise components of a frequency dependent upon the amplitude of the exciting transient and the consequent duration of the ringing envelope. The cure for these effects is, of course, low distortion circuits, however, it is of interest to note that if nonlinearity is present in the loudspeaker system the use of tweeters and woofers with low frequency acoustic cut-off may help to

reduce this effect although other symptoms of distress may occur. In the event of an input signal containing rapidly damped wave trains, such as might be produced by the phase-mixing technique, demodulation-distortion components will tend to occur at a higher rate than in a signal containing wave trains of fairly long duration. Similarly, loudspeaker hangover may represent a greater problem due to the increased intensity of the transients.

In conclusion, it appears that controllable phase-shift mixing in reproducing equipment has a number of unique advantages in securing the best possible sound. This technique can be used for corrective purposes in obtaining greater clarity of reproduction either in the original signal, in the audio equipment being used, or in the acoustic characteristics of the listening environment and appears to achieve some of the desirable characteristics found in live listening or two-channel binaural reproduction. The ability of phase-shift mixing to greatly affect transient-to-sine-wave relationships as well as altering the apparent pitch of asymmetric sounds likewise suggests the need for a re-evaluation of many audio practices, circuits, and reproducing components. In the author's experience it is possible to obtain improved clarity and quality of the reproduction of indifferently good audio equipment through use of the acoustic phase mixing alone, inasmuch as multiple-path sound reproduction tends to allow the phase-sensitive properties of the auditory apparatus to be used by the listener, a situation not found when listening to the direct output of a single radiation source. Similarly, the experimenter will undoubtedly find that phase shift mixing represents one of the most versatile and interesting techniques of varying the characteristics of an audio system.

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PHOTO CREDITS

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36 (Fig. 1)	Technical Appliance Corp.
36 (Right)	Walter L. Schott Co.
37 (Fig. 1), 38 (Fig. 8C), 50, 51, 113, 114, 115, 122, 127	Radio Corporation of America
37 (Fig. 6)	Daris Electronics
46	Emerson Radio & Phonograph Corp.
55	National Broadcasting Corporation
146	Television Technicians Lecture Bureau

ERRATUM

In the circuit diagram of Fig. 7, page 62 of the November issue ("4 Problem Preamps"), a 1 megohm resistor was omitted from the diagram. It should be inserted between the grid of the second half of the 12AX7 tube and ground.

INDEX OF Advertisers

JAN. 1953

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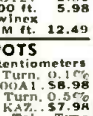

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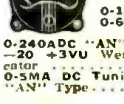

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0D3/VR150	.90	3K30	300.00	6SJ7	.70	117Z7GT	1.49	726B	45.00
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1B35	10.98	5C/1230	27.45	6SX7GTY	2.69	304TH	8.90	811	2.90
1B37	16.98	5D23/ RK65	36.50	6V6	1.39	304TL	8.90	812	2.70
1B38	29.95	5J29	12.40	6V6GT	.57	388A	1.49	813	12.49
1B40	4.95	5R4GY	.60	6W4GT	.57	WL417A	8.95	814	2.75
1B41	49.95	5R4GYW	1.75	12AH7GT	1.45	417A/ 5R42	18.50	815	2.98
1B42	18.00	6AG5	.79	12AK5	1.98	GL434A	18.45	R16/866Jr.	1.07
1B46	1.98	6AG7	1.98	12AK5W	2.98	446A	1.05	826	.95
1B53	49.95	6AG9	1.49	12AL5	.75	446B	1.05	829	11.49
1B56	38.50	6AH6G	1.49	12AT6	.52	450TH	45.00	829B	12.45
1B58	175.00	6AH6	1.22	12AT7	.81	450TL	52.00	832	7.65
1B60	69.75	6AJ5	1.40	12AU6	.72	460 HF200		832A	9.65
1B63	50.00	6AK5	.74	12AV7	.63		15.95	833A	39.45
1B63A	75.00	6AK5W	2.95	12AV6	.49		2.69	834	5.95
2C39	3.98	6AK6	1.05	12AV7	.98	GL471A	2.69	836	4.75
2C40	7.29	6AL5	.54	12AW6	1.79	CK501X	1.26	837	1.45
2C43	26.75	6AL7GT	1.29	12AX4GT	1.20	CK501AX	2.20	849	29.45
2C43/464A	9.49	6AM5	2.90	12BK7	1.79	CK502AX	1.49	860	4.90
2C44	1.29	6AQ5	.55	12AY7	2.95	CK502AX	1.49	861	23.95
2C51	6.45	6AQ5W	3.98	12AZ7	1.49	CK503AX	1.49	865	1.29
2D21	1.26	6AQ6	.81	12BA6	.59	CK505AX	1.79	866A	1.50
2E31	1.49	6AQ7GT	1.29	12BA7	.79	CK506AX	1.49	866A	2.25
2E36	1.49	6AT6	.79	12BD6	1.23	RN502	9.98	CK1005	.85
2E41	1.54	6AR6	2.98	12BE6	.59	CK509AX	1.79	CK1027	2.98
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2G21	1.49	6AS6	2.45	12BH7	1.29	CK522AX	1.29	5654	2.79
2J31	27.25	6AT6/7G	4.14	12BY7	1.35	CK525AX	2.29	5670	5.30
2J31A	79.95	6AT6	.63	12BZ7	1.25	CK526AX	1.49	CK5672	2.29
2J32	27.45	6AU5GT	1.10	12SA7GT	.69	CK528AX	1.49	CK5678	2.45
2J33	27.25	6AU6	.59	12SC7	.80	CK529AX	1.79	5687	5.49
2J34	27.25	6AU8GT	1.29	12SF5GT	.72	531	6.98	CK5702	7.45
2J36	120.00	6AV6	.49	12SF7GT	.49	CK531DX	1.89	CK5703	.98
2J37	12.70	6AW6	1.89	12SG7	.83	531	6.98	Xtal Diodes	
2J38	11.75	6B4G	1.23	12SH7	.63	CK5320X	1.89	1N22A	$4.55
2J39	44.00	6BA6	.63	12SJ7GT	.59	WL5332	1.49	1N218	3.00
2J42	250.00	6BA7	1.27	12SK7	.72	CK533AX	1.29	1N21C	21.50
2J48	24.25	6BC5	.63	12SL7GT	.65	CK534AX	.99	1N22	1.25
2J49	34.00	6BC7	1.23	12SN7GT	.75	CK536AX	.99	1N23	1.35
2J50	21.25	6BD5GT	1.65	12SQ7GT	.63	CK537AX	1.04	1N34A	2.35
2J52	249.00	6BD6	.83	12SR7	.63	CK538DX	.98	1N23B	3.49
2J55	85.00	6BE6	.59	FG17	3.95	CK539DX	2.19	1N25	4.98
2J56	149.00	6BF5	.98	19T8	1.09	CK541DX	1.99	1N26	8.75
2J61	49.95	6BH6	.65	19V8	1.82	CK542DX	.99	1N27	7.95
2J62	49.95	6BF7	2.55	RK20A	8.95	CK543AX	.99	1N29	3.50
2J63	49.95	6BG6G	1.39	24G 3C24	1.90	CK544DX	.99	1N32	23.75
2J64	29.00	6BG7	1.98	25BQ6GT	1.19	CK546DX	1.99	1N34	.64
2K25	39.95	6BH6	.63	25L6GT	.69	CK547DX	1.98	1N34A	.90
2K25/ 723AB	31.59	6BJ6	.69	25Z5	.79	CK571AX/ 6029	3.49	1N35	1.65
2K28	32.00	6BK7	2.15	25Z6GT	.99	5886	2.49	1N38	1.43
2K33	300.00	6BL7GT	1.45	FG27A	8.70	CK573AX/		1N39	4.15
2K41	145.00	6BN6	1.49	RK28A	4.89	WL5798	10.49	1N40	7.95
2K42	145.00	6BN7	1.69	28D7	1.95	KU627	12.98	1N43	1.69
2K43	135.00	6BQ6GT	1.20	FG32/ 5558	13.85	WL652	18.00	1N44	1.21
2K46	360.00	6BQ7	2.15	35Z5GT	.59	WL653	65.00	1N45	1.39
2K47	360.00	6BR8G	1.45	RK39	2.89	WL672	117.00	1N46	.90
2K48	118.00	6C21	29.45	RK48	6.85	WL676	39.95	1N47	5.49
2X2	.49	6CB6	.69	RK49	7.50	WL677	34.00	1N48	.59
3B22	2.70	C6J/5C21	6.95	50L6GT	.69	WL686	35.00	1N51	.45
3B23/RK22	4.25	6J4	6.66	RK61	3.05	707B	7.90	1N52	1.85
3B24	5.40	6J5GT	.47	80	.69	707B	13.50	1N54	.89
3B25	4.50	6J6	.63	81	1.69	715A	6.00	1N55	2.35
3B26	3.70	6K4A	6.45	82	1.19	715B	8.40	1N56	.89
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3C23	9.90	6L6GA	1.35	84/6Z4	1.79	718BY	48.45	1N60	.60
3C31/C1B	3.45	6L6GAY	2.29	FG95/ 5560	.99	718CY	48.45	1N61	2.10
3C33	14.98	6SA7GT	.63	FG98	24.85	719A	28.50	1N63/K63	2.49
3C34/HK24	5.49	6SA7GTY	3.37	100TH	19.95	721A	2.49	1N64	.69
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