HUGO GERNSBACK, *Editor*

RADIO CRAFT

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RADIO CLUB
STATION
SEE PAGE 828

In this issue—

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Rebuilding a Televiser

Design of Audio Mixers

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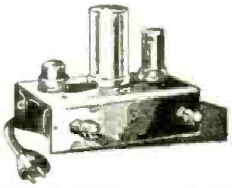

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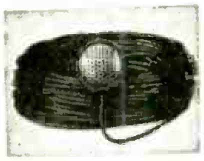

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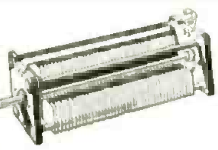

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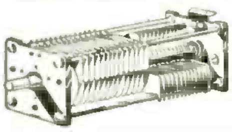

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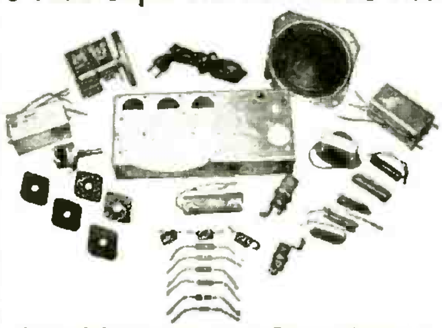

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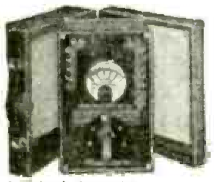

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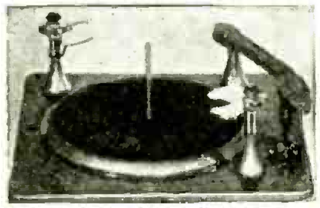

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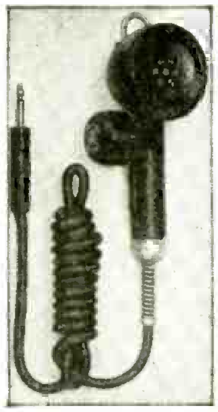

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24 Mfd. 150 Volt—30c ea.
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IN AN EARLY ISSUE

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ON THE COVER

The Army-Amateur radio station, W2OEC, at Fort Monmouth, New Jersey, is depicted on our cover this month. Home of the Signal Corps, Fort Monmouth is crowded with hams from all districts of the United States, who are able to keep up with the postwar ham world by means of the station.

Chromatone by Alex Schomberg from Signal Corps Photo

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By HUGO GERNSBACK

IS TELEVISION REALLY HERE?

The Cathode-Ray Tube Is Not the Final Solution to Television

WE HEAR continuously from many of our readers who are bewildered—as is the general public—as to the true status of television today. There is a great deal of confusion regarding television as a whole. Nor is it abated by the industry, which itself is at odds on more than one of the art's major questions. The entire video picture is highly complex, to say the least, while little is being done to clarify the situation.

Within the industry certain factions are at odds with each other. Much could be written about such points as the disagreement between the industry and the Federal Communications Commission as to time schedules of operation, freezing of standards, etc. Within the industry one faction is for color television, which is denounced by the other. Then there is the size of screen for best viewing, whether the image should be on the cathode tube screen or whether it should be projected on the wall (or a wall screen). These are but a few points.

Commander E. F. MacDonald, Jr., President of Zenith Radio Corporation, has long taken the stand that commercial television procedure is all wrong in following the paid-advertising broadcast technique. He maintains —not without good reason—that it will never be possible to have nation-wide "free" television reception as we have "free" broadcasting. The cost of good television broadcasts is in the order of making good motion picture films. And as everybody knows, production of a good motion picture film costs anywhere from a quarter of a million dollars to two million dollars.

What makes matters worse in television is that there cannot be any "retakes." Inasmuch as a television production must be carefully rehearsed and must be letter-perfect at the moment of broadcast, the television director has no way of correcting any mistakes, as is the case in motion pictures.

Therefore, a good television broadcast program would of necessity cost more than a like motion picture production. Commander MacDonald thinks that the excessively high cost of television broadcasts cannot be met by sponsored advertising, as it is in broadcasting today, but that television programs should be paid for in some other way; either over line wires or by radio using special equipment, where only those who pay for the service would have sets that could receive such paid programs. That is one angle.

Dr. Lee deForest, of radio fame, has pointed out in an article in RADIO-CRAFT (April and May 1945 issues), the simplest way would be to take a motion picture film of the production. This could then be edited *before* the broadcast; the final film would *then* be run at the television transmission studios and broadcast. This would make it as cheap, or cheaper than motion picture practice. Sponsored advertising programs could be presented in this way whereby the admittedly still high production costs would leave a profit to the television broadcasters. That is another angle.

This suggestion, however, is not at all welcomed by the television industry who wants none of it, but believes that television's credo is that events should be broadcast *when the event actually occurs*, instantaneously, as for instance, the recent Louis-Conn fight.

This is only one part of the story. So as not to lose our perspective, let us turn the clock back to 1921 when broadcasting started. At that time anyone with a $10 bill—or less—could receive radio broadcast programs simply by either buying a crystal detector and a pair of headphones, or by making the detector himself and buying the phones. From such small beginnings broadcasting began.

A little later the radio tube came into its own and then with one- or two-tube sets which gave better selectivity, stronger and clearer reception, broadcasting marched on its triumphant way. Still later loudspeakers were added. Millions of enthusiasts in the United States now were building their own sets, and the radio age was here to stay. Soon—with tens of millions of listeners getting programs—the advertised products via the radio waves paid handsomely for the broadcast effort.

Now let us turn to television. The situation here is far from parallel. To begin with, television must in its very nature be broadcast on higher frequencies (low wave lengths). That means that the reception range cannot be greater than an average of 25 to 30 miles from the transmitter. Now then, if the entire country is to be blanketed with television, this requires thousands of television transmitters. The capital outlay, therefore, for the television broadcast industry will be immeasurably greater than was the case with the broadcast industry. At the present time we only have a handful of television transmitters in this country, in actual numbers only six stations, now operating on a schedule, plus three *experimental* stations.

Against this the radio broadcast industry has 1003 transmitters as of December 1945. Even if we soon had a like number of television transmitters in the U.S., they would by no means blanket the entire country to support an advertising-sponsored television program that could conceivably pay out. To cover the entire nation with television trans- *(Continued on page 853)*

RADIO-ELECTRONICS

Items Interesting

TELEVISION PICKUP relay apparatus capable of relaying signals from the pickup point to a television transmitter within a 15-mile range, was announced last month by the Radio Corporation of America.

This new radio relay equipment produces a frequency-modulated signal with approximately 100 milliwatts of power for the picture carrier. The band width permits reproduction of the finest detail in the camera picture. It operates at any selected frequency in the 6500 to 7050-megacycle band.

The use of a highly directional parabolic transmitting antenna provides a signal gain of about 5000 times, with a 4-foot reflector, or 11,500 times with a 6-foot reflector, thereby providing an equivalent power of 500 or 1150 watts, depending on reflector size, in the direction of the receiving antenna. To obtain this high gain, a hook-shaped wave guide literally pours power into the focal point of the saucer-like reflector, much as the filament in an automobile headlight sends its light to a concave reflector for intensification. The same principle is employed at the receiver unit, where the parabolic reflector receives the signal and concentrates the beam into a wave guide to add another gain of 5,000 or 11,500 times. The total effective signal gain from the transmitter waveguide to the receiver waveguide is therefore approximately 25,000,000 times with the smaller reflector or 132,250,000 times with the larger one.

The control unit of the microwave receiver, which is usually located at some distance from the antenna, is mounted in a small carrying case containing the remainder of the receiver stages, the video unit, and automatic frequency-control amplifier, and a master meter, as well as other adjustment controls. The transmitter control unit is also built into a carrying case. It contains all the necessary operating and monitoring controls, plus a regulated power supply for transmission. Either of these control units can be removed from its carrying case and mounted in a rack for permanent installations.

WIDE-BAND amplification will take on a new meaning, as a result of a new tube announced last month by Bell Telephone Laboratories.

Conservative figures for the tube show a power gain of 10,000 times over a band width of 800 megacycles. By comparison the present pentode tube can give a power gain of only 10 times over a band width of 20 megacycles, and a velocity-modulation tube, operating in the microwave range, gives the same amplification over a band width of 10 megacycles.

The tube is remarkably simple. It is a little more than a foot long and only a few inches across.

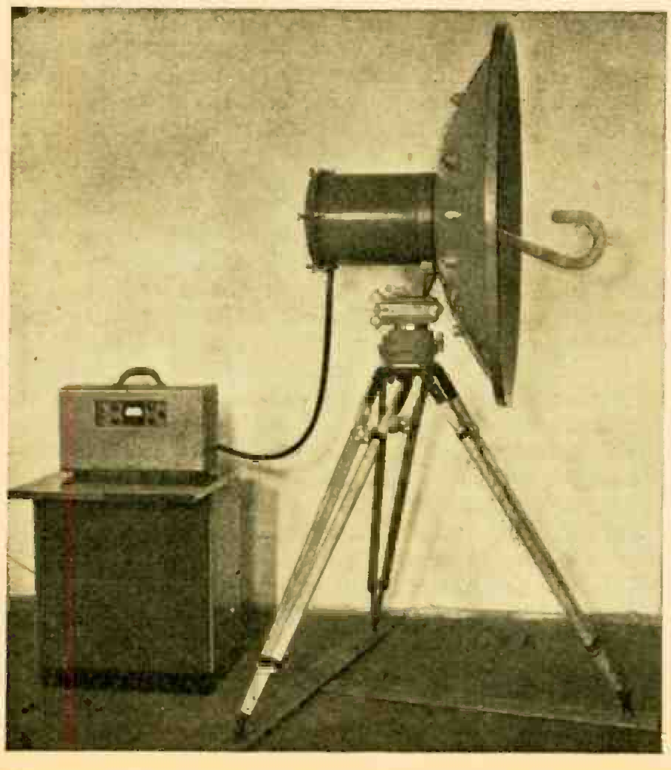
It does not even look much like an ordinary tube for it has a narrow, glass stem about a foot long, flaring into a bulb on one end.

Inside the stem, a long coil of thin wire, or helix, runs from one end to the other. The wave which is to be amplified is fed onto the coil at the bulb end through a wave-guide and then drawn off at the other end in the same way.

The wave travels along the coil at the speed of light but because it follows the winding, it moves along the length of the tube at only a thirteenth of this speed. Meanwhile, from the bulb—actually, an electron gun—a beam of electrons is shot through the inside of the coil down the stem in the same direction the wave is moving and at approximately the same speed, i.e., one-thirteenth the speed of light.

The speeds are not exactly matched, however, and on the average the electrons go faster than the wave. They tend to slow down, though, and in so doing, they give up some of their energy to the wave. As a result the wave gains a tremendous amount of energy and becomes many times amplified.

Preliminary tests indicate the tube may amplify dozens of full color or black and white television programs simultaneously—should anyone want to send that many at once. Or it might theoretically handle more than 10,000 simultaneous cross-country telephone conversations or over a hundred million words a minute by telegraph!



The new tube which can handle 10,000 phone conversations at once. Left—Television pickup and relay set, with its recurving waveguide.

MONTHLY REVIEW

to the Technician

ITEMS OF THE RADIO MONTH

"Television is getting off on the wrong foot because the screen on receivers is wider than it is high," says James T. Mangan, industrial designer and public relations expert. "This shape (foolishly copied after the shape of the movie theater screen) necessitates a small image and makes impractical the televising of dancing acts and other features requiring full-length views.

"Before the television industry goes much farther," said Mangan, "someone ought to be brave and different enough to experiment with an image and a screen that is about one-third higher than it is wide. Television must be an art by itself and shouldn't try to copy or use the movies in any way!"

New trend in servicing may be marked by the recent establishment by *Hallicrafters* of six service centers for the checking, repairing and servicing of their amateur, home, aircraft and marine radio equipment.

Set up at strategic points with a complete stock of parts for replacement, the centers will be manned by personnel selected for their ability and experience in the servicing of Hallicrafters' radios.

Milwaukee reports its first postwar ham meeting. About 325 hams—members and friends of the Milwaukee Radio Amateurs' Club—participated. Numbers of amateurs from Iowa and Minnesota, as well as Wisconsin hams, were present, and there were visitors from Illinois, Michigan, and even two hams from California. The meeting was addressed by Cy Read of the Hallicrafters.

Tests made by Bendix on the lines of the B. & O. Railroad prove v.h.f communication practical in tunnels. A special system which includes antennas at the tunnel mouths and a single wire running through it, produces loud signals.

Largest television audience at the Louis-Conn fight was at Princeton, N. J., where 3000 saw the fight projected on a 16 x 22- foot screen. The exhibition was put on by RCA Laboratories, using a 60,000-volt kinescope.

Facsimile transmission from ground to plane was demonstrated last month by Finch Telecommunications of New York City.

A battery for use with lifeboat and life raft transmitters, developed during the war, employs ordinary sea-water as the electrolyte.

POLICING PLANS to minimize interference and confusion in the greatly expanded postwar radio spectrum went into effect July first, states the FCC.

Wartime technological developments have increased the usable spectrum space from a prewar limit of 300,000 kilocycles to 30,000,000 kilocycles and beyond. Hundreds of thousands of additional channels will be licensed in this added space to augment existing radio services and to introduce many new ones. Despite the vast new spectrum space available, the demand for radio channels still far exceeds the supply, making efficient policing of paramount importance.

When the federal government began policing the spectrum in 1911, after the passage of the first radio legislation, it was concerned only with a few ocean-going steamers. Today, the government, through the FCC, is confronted with the problem of preventing traffic snarls or law violation on radio highways which were not even imagined before the war.

"PIRATE AMERICANS" have drawn up plans for a commercial radio invasion of England, the *London Sunday People* charged last month.

The paper states that regular broadcasts are planned by a string of stations on the Continent and in Iceland. These would be supplemented by powerful broadcast stations on ships moored just outside British territorial waters.

Purpose of the "invasion" is, of course, to profit from the rich harvest of advertising expected on these broadcasts. Advertising is not accepted by the BBC, but British manufacturers and distributors found such advertising—over Radio Luxembourg—very profitable in the period just before the war.

The rumors were important enough to be discussed in Parliament, where a government hint that outside commercial broadcasters might be subjected to "jamming" was fiercely attacked by Winston Churchill, who charged that the citizens' "right to listen" was being threatened.

RADIO SURPLUS SALES are being handled in a "scandalous" manner, Senator Wiley of Wisconsin charged last month in a letter to Representative Slaughter, head of the House Committee now investigating war surplus disposal.

Senator Wiley pointed particularly to sales of $200,000,000 worth of electrical equipment, from $400,000,000 worth declared surplus. Radio, radar and communications equipment are included in this surplus material.

He said priority claimants, such as veterans and schools, had obtained supplies to the value of only $2,120,000, "while private, commercial sources got $198,000,000 worth."

Veterans and schools and colleges, despite priority rights, said Mr. Wiley, "are being intentionally ignored by WAA (War Assets Administration)," although they desperately need equipment. He estimated that "at the most" veterans obtained $50,000 worth and schools and colleges another $50,000 worth out of the total of $200,000,000 that has been sold.

RADIO COMMUNICATION growth has increased, due to wartime technological developments, to such an extent that some believe the art has been pushed forward a whole generation, the Federal Communications Commission reported last month. Expected increases in radio services are illustrated graphically in the accompanying chart. In tabular form, they are:

Standard broadcast stations, from 1000 to 1400.

Frequency modulation (FM) stations from 50 to 3000.

Television stations from six to 200 or 300.

Radio-equipped planes from 3000 to 50,000.

Aviation ground stations from 700 to 2500.

Two-way service for autos, taxicabs, etc., from one city to 200 cities.

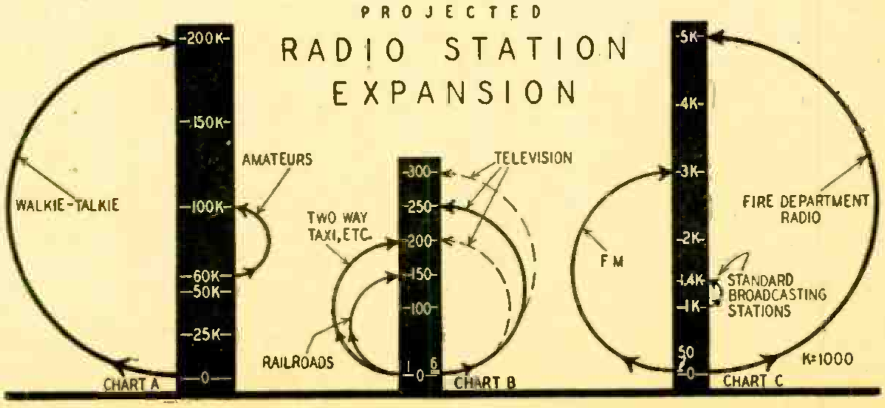
Radio-equipped railroads from one road to 150.

Fire department radio from no cities to 5000.

Citizens walkie-talkie from none to 200,000.

Amateur operators from 60,000 to 100,000.

In addition there will be thousands of channels for radar, for point-to-point communication, for diathermy and many other safety and special services.



By E. A. WITTEN

ATOM BOMB OVER BIKINI

A Radioman's Eye-Witness Story of the Great Experiment

SEVENTY million dollars worth of time, energy, equipment and incidental expenses literally went up in a blaze of glory—and light and color—when the fourth atomic bomb to be dropped in the history of the world was unloaded on a phantom fleet of seventy-seven ships at anchor in Bikini Lagoon. From the standpoint of scientific advance it was money well spent. While $70,000,000 seems like a lot, actually it comes down to fifty cents for every person in the United States—surely a small price to pay for a ticket on Peace, the possible winner in the World Sweepstakes.

Radar antenna used in gathering atomic test data, on the island of Aemende, Bikini Atoll.

No one—not even the scientists—quite knew what to expect as direct and indirect results of the tests. Comic strip writers injected Bikini into their adventure strips and predicted all sorts of things. Human guinea pigs volunteered for the privilege of being aboard the target ship, but were turned down by the Navy for obvious reasons. Publicity-mad scientists and pseudo-scientists predicted that all the observers of the tests were doomed to die at Bikini.

In short, everybody and his brother rushed in to predict what not even the scientists who actually worked on the bomb were ready or able to comment on.

The Navy found it necessary to create the position of *staff phenomenologist*. A top scientist from the Army's Manhattan Engineer District was chosen to fill this job. His duty was to *scientifically venture* to predict what has never happened before and what was likely to happen during this test, the first of its kind over water. In the course of preparing for the Bikini tests, his estimates were revised from time to time. For example, at first it was believed that the burst would blow a hole in the water of the lagoon approximately 150 feet deep and 500 to 600 feet across, and that the water falling back into this hole would force itself into the air in a column—a gigantic water spout four or five miles high. The original estimate had to be revised when in scale tests with small TNT bombs, only a slight depression was made in the surface.

The oceanography section of the technical staff started with a wave motion unit, added oceanographic surveys, and later radiological safety reconnaissance, which was discussed in the first article in the July issue of RADIO-CRAFT. The measurement of wave motion is the first phase of the oceanographic program. In this respect, the atomic bomb is a wonderful oceanographic tool. Knowing the point of release of the bomb, its time and the amount of energy released, the oceanographers were able to make exact measurements of the height of waves, their action in shallow water, their effect on the sea bottom, and their eroding effect on the beaches, in terms of both time and distance. Instruments for the measurement of wave motion fall into three general categories as follows: supersonic echo sounders, aerial photography, and surface photography. In addition, there were maximum water height recorders on Bikini Island and water level meters on several of the other islands of the atoll.

The supersonic echo sounders or fathometers recorded the larger waves while eleven supersonic sounders on buoys recorded the passage of the short-

(*Continued on page 872*)

Elliott A. Witten, RADIO-CRAFT's special correspondent at the Bikini atom-bomb test, is well known to our readers as a former Technical Editor of the magazine and author of a number of articles, chiefly on problems of the ex-GI and serviceman. He was also the author of the article "Radio and the Atom Tests" which appeared in the July issue.

Like many another radioman, he came up by the servicing road, having been a radio repairman no less than seven of his twenty-five years. Joining the Army in 1942, he was given specialized radio training at New York University and the Universities of Iowa and Wyoming, later acting as instructor and radar operator. Invalided out of the Army after combat service in the Air Forces, he worked as technician in a New York war plant, later as radio writer and editor.

Is now a free-lance writer. Hobbies: Instructing radio classes in the Civil Air Patrol; painting.

Joint Army-Navy Task Force One Photos

Mother plane in background turns after releasing drone, in rehearsal for Bikini bomb tests.

By R. L. PARMENTER

V.H.F. RECEIVER

This 144-148 Mc Set Has an Interesting Tuning Unit

INTEREST in very high frequencies has resulted in a demand for a good, modern receiver for the very short waves. Some of this demand has been supplied by modified war surplus gear. The v.h.f. war surplus receivers are a bargain to the experienced radio man who can alter them to suit his purposes. For the beginner and probably for the average experimenter and ham the superregenerative receiver would still seem to be the best bet.

This receiver is easily built, the circuit is simple, the total cash outlay (even if all new parts are used) is nominal and its performance is very satisfactory.

The circuit is the self-quenched superregenerator. A 9002 tube is used for the detector. It mounts in a "button" type miniature socket whose contacts are very secure as compared to some types of new sockets. A base connection plan is shown on the circuit diagram (Fig. 1).

A relatively new tuning system—the butterfly tuning capacitor—is used. This provides practically linear tuning and completely eliminates the noise from the moving rotor. A manufactured type would have been used but none were available at the time. Cardwell has advertised two units, one having a range of 11 to 14 μμf and the other of 6 to 11 μμf. If the reader prefers a ready-made part we recommend the smaller size. It will provide better Q at the frequencies desired.

A 6SF5 was used in the first audio stage. Greater gain is thus realized even if the plate voltage supply is low. A 6K6 was used in the output section. Plate and screen connections are brought out to two banana jacks on the rear of the chassis for speaker connection. The switch (SW) is for standby.

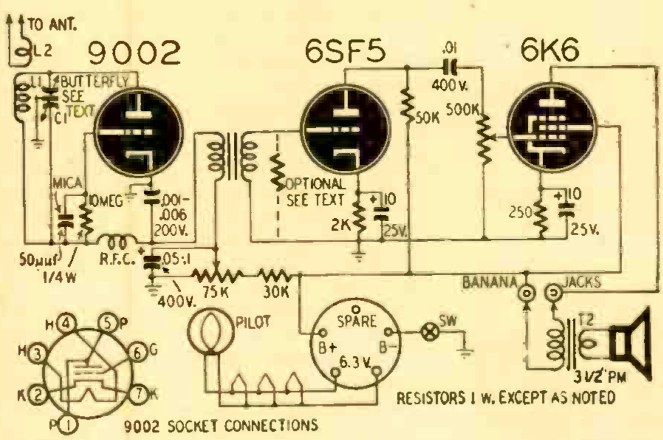


Fig. 1—Except for the butterfly-tuned superregenerative detector the circuit is a plain three-tube s.w. radio.

SIMPLE CONSTRUCTION JOB

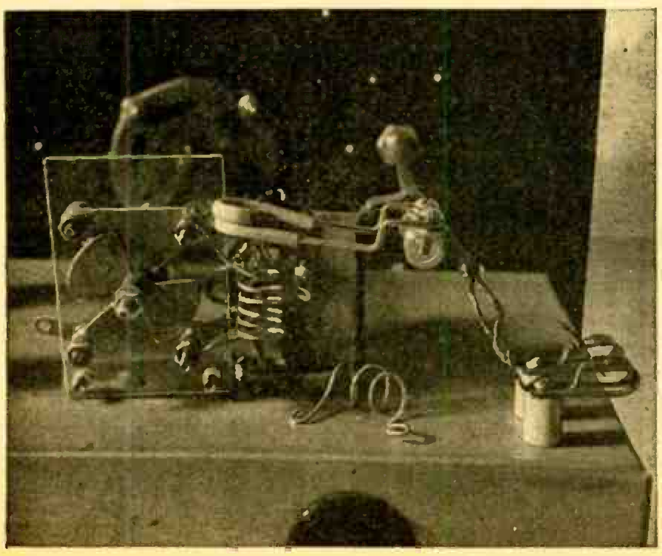
Construction of this receiver is not difficult. A 7 x 10 inch chassis was used. This allows plenty of room to add an r.f. stage later if desired. This extra space also permits placing the audio section at some distance from the detector. No dimensions are given for actual layout of parts since the photos show approximate locations.

The panel is a piece of masonite 6 inches high by 11 inches long. Holes for

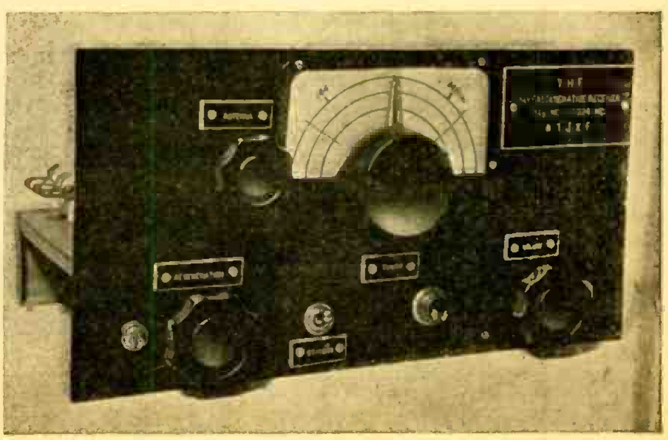
(Continued on page 866)

Richard L. Parmenter was born in Brockton, Mass., 37 years ago. Became interested in electricity at an early age—even while in grade school. Took technical course in high school and studied Electrical Engineering at Northeastern University—specializing in Communications. Became interested in amateur radio and operated a "ham" station, W1JXF, on 40 and 80-meter c.w. He has been active on 5, 2½, 2 and 1¼ meters.

During the war was employed at Beth-Hingham shipyard as key-worker on automatic fire-control wiring. Now employed at Aerovox Research Laboratory—working on design and construction of test equipment. Amateur radio and fishing are his hobbies.



Left—Rear view of the receiver, showing the antenna-coupling link. Below—A front view. Note the boundaries of the 144-148 mc band.



By SANFORD ESSIG*

BLACK-LIGHT TELESCOPE

New Infra-Red Tube Permits Sight in Total Darkness

SEVERAL animals are popularly accredited with the ability of night vision. Such sight is dependent solely upon a faster eye lens and they are helpless in the complete absence of light. Man now truly possesses clear vision in *total darkness*.

Such vision is made possible by an electron-image tube designated the 1P25, which was manufactured in large quantities during the war by the Farnsworth Television & Radio Corporation and others. Instruments based upon the tube were extensively employed in wartime activities, particularly in the Pacific Theatre. They assisted all manner of nocturnal activities, such as night driving, shooting, reconnaissance in airborne, land and naval operations.

Operating on the principle of infrared detection, they were used in conjunction with infra-red searchlights, large and small—even with flashlights!

Light of weight and small in size, they were attached to the service helmet much as a miner's lamp, giving complete hand freedom while observing the objective through the eyepiece. This model was used by pilots of aircraft and made possible night driving at speeds up to 40 m.p.h. with infra-red filtered headlamps; greater speeds with more powerful lamps.

Properly dubbed the "sniperscope," a smaller type was mounted in sighting position on rifles. Closely resembling a telescopic sight in appearance, it formed gunsights, making possible hits on a target the size of a man at seventy-five yards in total darkness—a very formidable device for night fighting.

A third model, the "snooperscope," is an instrument intended for hand operation in general use and reconnaissance. A small battery-powered infra-red searchlight is mounted below the telescope or pickup device, the entire assembly attached to a pistol-grip handle. Illustrating ease of operation, one typical general purpose instrument weighs but seven pounds, including battery and power supply, and is readily held in one hand.

Extensive use of these infra-red telescopes applies also to signaling, to night landing of aircraft, to assembly of paratroopers after landing and to all operations demanding that black-out conditions prevail.

The image tube—the essential element in infra-red electron telescopes—converts an invisible infra-red image into a visible image. It consists of a semi-transparent photo-cathode sensitive to the infra-red radiation, an electrostatic electron lens system and a fluorescent screen. An infra-red image on the photo-cathode causes electrons to be released in conformity with the image. These electrons are accelerated and focussed by the electron optical system, shown in the figure, onto the fluorescent screen where a visible reproduction of the original image is formed.

Response of the photo-cathode is confined to between 8000 and 10,000 angstrom units, the limit of human eye response being approximately 6750 angstrom units. Therefore, the subject under observation is wholly unaware of his vulnerability.

Alkali metals form the basis of all known best emitters, long wavelength response increasing with atomic weight. Therefore, caesium is used for a surface of high infra-red sensitivity.

In processing the cathode, a layer of silver so thin as to readily transmit light is evaporated on the inside glass surface. The amount of silver deposited is, in fact, determined by its light transmission. The silver surface is partially oxidized and exposed to caesium vapor, then subjected to thermal treatment. Caesium reacts with the silver oxide to form caesium oxide and free silver. The final surface then consists of silver, a layer of mixed silver and caesium oxide with metallic silver interspersed in it, and a bound layer of caesium.

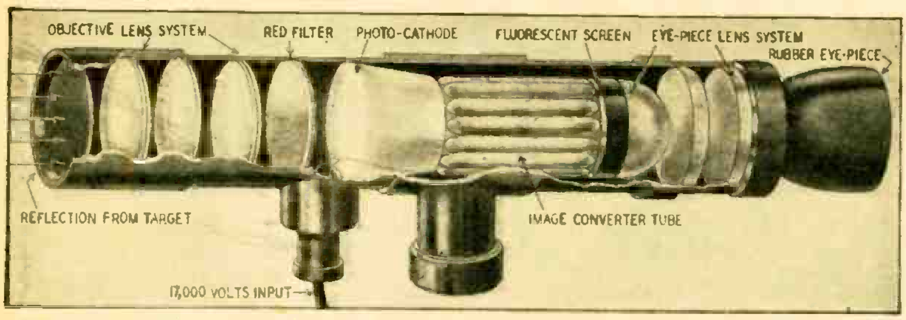
The 1P25 tube, as shown in the figure, contains a four-element electron lens assembly, the final anode operating at 4100 volts; operation, in principle, is similar to that of the cathode-ray tube, electron microscope and other electrostatically-focused devices.

A fairly large class of materials, termed phosphors, become luminous when bombarded with particles or radiation. The materials within this class which can be excited by electron bombardment are useful as fluorescent screens in image tubes.

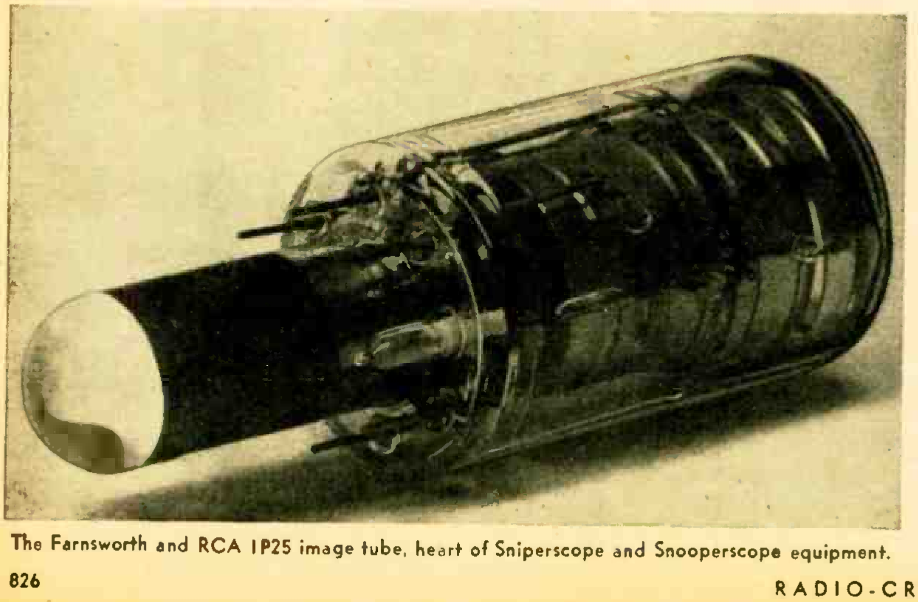
In view of several desirable screen requirements, such as high efficiency at

(*Continued on page* 884)

*Research Dept., Farnsworth Television and Radio Corp., Fort Wayne, Indiana.



This captured German night-sight telescope worked with the aid of an infra-red image tube.



The Farnsworth and RCA 1P25 image tube, heart of Sniperscope and Snooperscope equipment.

By JOHN W. STRAEDE

AUDIO RESPONSE CORRECTION

Compensation Circuits for Phonograph Record Amplifiers

THE average magnetic pickup should be followed by some equalizing circuit for two or three of the following reasons:

1—The lower frequency (bass) notes are attenuated in most recordings, usually at a rate of from 3 to 6 db per octave below some frequency called the "change-over frequency." The rate of attenuation is usually 6 db per octave because such a rate corresponds to "constant amplitude" recording.

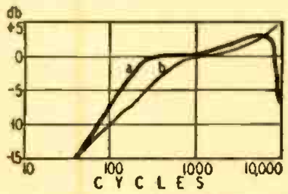


Fig. 1—American and English record curves.

2—In some recording systems the higher frequency notes are given a slight boost—there may be a gradual rise of about 1 db per 1000 cycles above about 1500 cycles or there may be a broad peak around the 4000 to 8000 mark.

3—Any pickup contains *two resonant frequencies;* the lower or *bass resonance* due to the pickup head vibrating to and fro and the upper or *needle resonance* due to the armature vibrating against the needle-tip (needles are not perfectly rigid).

The lower resonance is sometimes used—especially in cheap pickups—to partially compensate for the bass cut in recording, but the upper resonance is just plain nuisance as it occurs at a very audible frequency and is excited to a large degree by surface irregularities in the record.

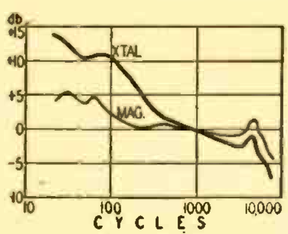


Fig. 2—Crystal and magnetic pickup response.

Scratch and surface noise occurs at all frequencies, high and low, but mostly around the resonant frequencies.

A pickup filter is necessary then for three reasons: To compensate for lack of bass, to reduce excessive high-frequency response and to reduce the response around the resonant frequencies. In Fig. 1, the frequency characteristics of various records are shown. That labelled *a* corresponds to a large number of English records and that labelled *b* applies to many American discs. However, individual discs vary. It will be noticed that the crossover frequency is generally lower for the English records while these also have a more pronounced rise in the "lower highs." Generally speaking, American discs have more upper highs and less bass than the English records. The different frequency characteristics require different compensation circuits.

In Fig. 2, the frequency responses of a typical good-quality magnetic pickup and an average crystal pick-up are shown. It will be noticed that while in both cases there is a peak at about 4500 cycles, because both employ steel needles, the crystal pickup has a rising bass characteristic in addition to bass resonance.

OVERALL RESPONSE

Now suppose we combine the four graphs so far presented and see what we get.

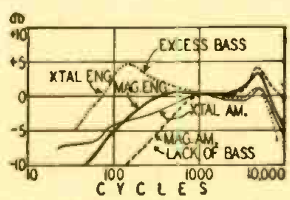


Fig. 3—Combination of the previous graphs.

In Fig. 3, the rising bass of the crystal pickup gives just about the correct bass response to the American disc while the bass resonance of the magnetic pickup provides almost enough compensation for the lesser bass cut of the English records. Possibly this is why cheaper American radio-phonograph combinations almost invariably use crystal pickups while most English "radiograms" employ magnetic pickups. (It should be noted that the vertical scale of these graphs has been greatly exaggerated.)

The high frequency end of the graph is still to be considered. High frequency attenuation is usually obtained in the amplifier by means of a shunt condenser.

Overall frequency characteristics do not tell the whole story. Although a resonance peak may be levelled out, there is still no compensation for the *longer time* a note (recorded or "scratch") is played if it occurs at that resonant frequency. When a sound is heard for a fairly short time, its audibility is largely proportional to the product of its intensity and its duration, so a partial compensation for excessive duration can be achieved by *over-reduction* in response at the peaks.

In designing correction filters, it is necessary to know just what is being aimed at, otherwise the filter is apt to be a flop. A simple but correctly designed filter consisting of only two or three elements can easily give results superior to those from an elaborate but badly designed one.

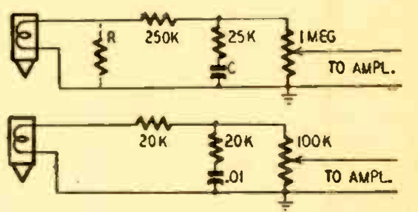


Fig. 4—Circuits used for boosting the bass.

POSITION OF FILTER

The position of a filter *affects its action* If connected directly after the pick-up, reactive elements in the pick-up must be considered. If connected after the first tube, the type of tube must be taken into account. In simpler amplifiers, some compensation can be left until the output stage.

Three main types of correction circuits will be considered:

1—Resistance-capacity circuits (these are probably the most interesting to the amplifier enthusiast and the easiest to build).

2—Tuned circuits, including acceptor (series) and rejector (parallel) circuits.

3—Circuits in which compensation is made by varying the amount of negative feedback.

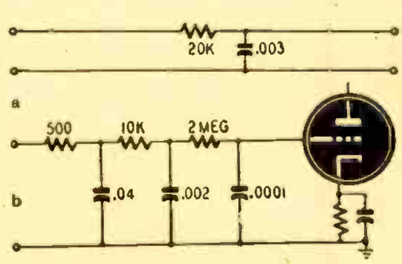


Fig. 5—Two circuits for cutting the highs.

No account is given of low-pass or band-pass circuits because — although restriction of unnecessary frequency response is sometimes helpful in eliminating background noise and in scratch reduction—the circuits are difficult to adjust and not at all suitable for the average amplifier enthusiast.

(Continued on page 877)

By CAPT. L. A. OLSON

ARMY-AMATEUR RADIO CLUB

Signal Corps Ham Organization at Fort Monmouth, N. J.

FORT MONMOUTH, New Jersey, world renowned as "the home of the Signal Corps" is making a new claim to fame. The idea of having the world's outstanding amateur radio station at Fort Monmouth was conceived in the mind of Colonel Brooke E. Sawyer, W6CV, (now Mr. Brooke E. Sawyer of Redlands, California). Already The Fort Monmouth Radio Club has been organized, chartered, and is operating under the call W2OEC in an effort to earn the reputation envisioned by Col. Sawyer. The trustee and secretary of the club, Major John M. Moss, W2OEC (formerly of Moss Radio Company, Russellville, Arkansas) obtained FCC approval of the club charter and the station license. The club charter, patterned on the American Radio Relay League model charter, was adopted by the members of the club on April 10, 1946.

The club will primarily serve the enlisted, officer and civilian personnel stationed in the Signal Corps schools and laboratories. It is expected that many messages to and from military and civilian personnel on overseas duty will be handled. Round-the-clock operating schedules will be maintained with amateur stations all over the world to relay routine amateur traffic, as well as emergency messages. The Field Director of the American Red Cross at Fort Monmouth will keep in close touch with the club so that certain emergency messages may be transferred to usual commercial facilities by the Red Cross. Code and theory classes will be conducted by the club to assist members in obtaining amateur radio licenses.

Due to the concentration of Signal Corps personnel as well as the presence of a number of commercial radio research laboratories, the area has an unprecedented concentration of hams and ex-hams, many of whom are divorced from their own means of communication. The officers of the Club have calls from the First, Second, Third, Fourth and Eighth Districts, and there is an equal spread of calls in the membership. Indeed, there are rumors of a new over-the-air club, composed of amateurs who have worked all United States districts *within* Monmouth County, New Jersey.

A wide assortment of communications gear has been obtained by the club and it is planned that a one-kilowatt transmitter will be maintained on each of the amateur bands below 30 megacycles. The equipment now installed includes four radio transmitters BC-610 (major component of the famed SCR-299 and SCR-399), two radio transmitters BC-452 and one radio transmitter BC-339. See Figs. 1 and 2 for block diagrams of the BC-610 and BC-339 transmitters. The BC-452 transmitter consists of an 837 crystal oscillator, 807 buffer stage, and a pair of 813's in push-pull as the final radio frequency amplifier modulated by a pair of 805's.

A ten-meter rotatable horizontal beam antenna built by Cpl. Jack D. Rodebaugh, W8LIO (formerly of Brush Development Company) has been erected on a fifty-foot pole. This beam antenna consists of a single fed element, and two stacked untuned reflectors, as shown in Fig. 3. The excited element is fed by a 72-ohm coaxial cable. Two eighty-foot poles were obtained for mounting the eighty-meter folded dipole antenna of Fig. 4. When the holes for the eighty-foot poles were being dug water was struck at a depth of four feet, consequently six-foot concrete aprons had to be built around the base of each pole. Additional guys were required to give adequate support to the poles, which

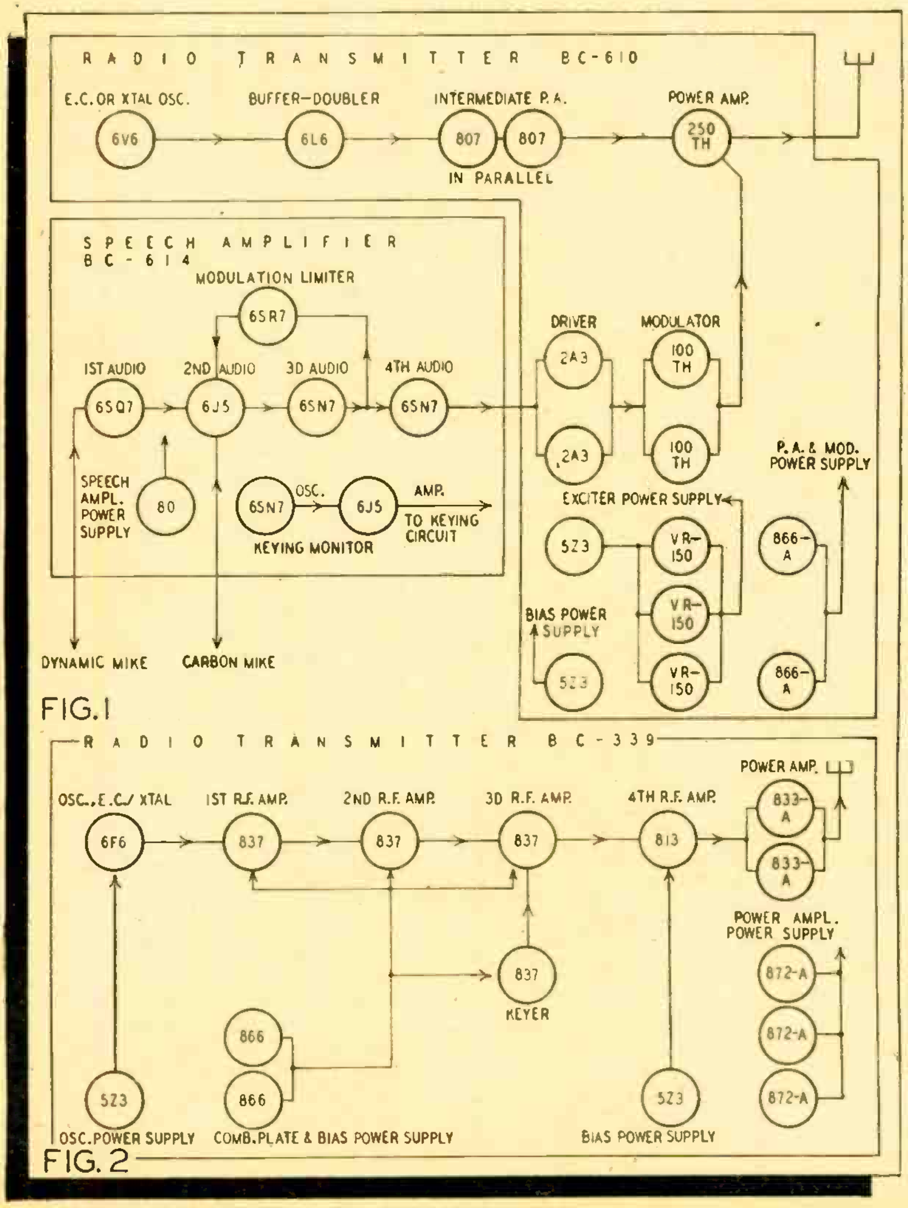
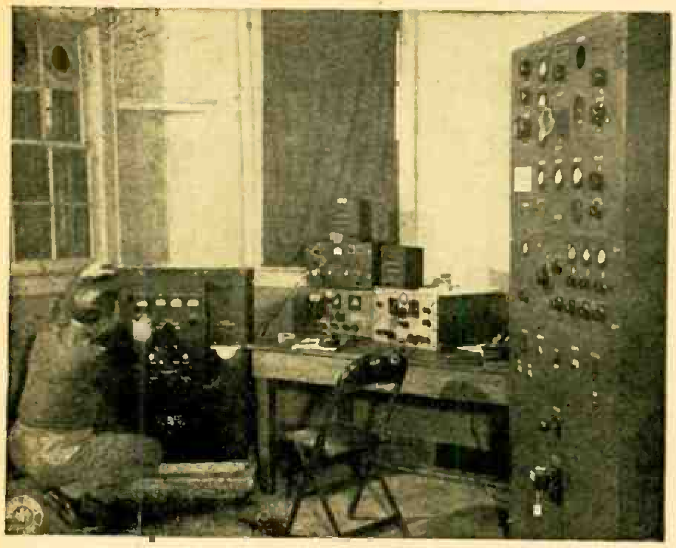
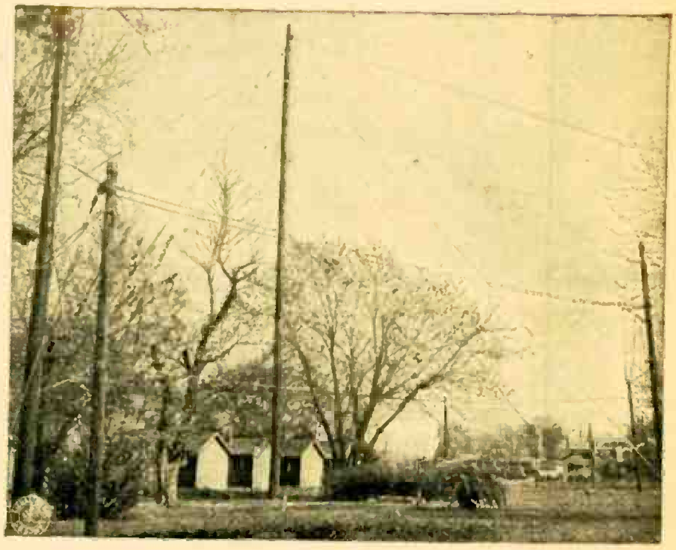


Fig. 1, above and Fig. 2, below—Block diagrams of the BC-610 and the BC-339 transmitters, first to be installed in the new club.



An interior view of the ham shack. Adjustments are being made on the BC-610, which was actually on the air as the photo was taken.



Part of the 80-meter folded dipole antenna, with the transmission line which is brought in on telephone poles to the shack at left.

now extend approximately 76 feet above the ground. This 80-meter antenna is oriented so that its directivity centers on the middle of Missouri. It is expected that it will give fairly complete coverage of the United States.

At present the club has only two receivers, but more are expected shortly. A BC-1004 (Hammarlund Super-Pro) is used for the lower frequencies while a Hallicrafters Model SX-24 with a converter is used on the higher frequencies.

Building 498 at Fort Monmouth has been authorized by Colonel Hugh Mitchell (Commandant of the Eastern Signal Corps Schools) as the club headquarters. The building has two rooms, one of which will be used as a lounge for visitors and as a classroom; the other room will house the equipment and will be the operations room. Two small shelters will be used as workshops for persons who want to build their own amateur equipment. One shelter will contain equipment for drilling and punching chassis while the other will be used for wiring and testing equipment.

As can be seen in the photos, there is already a considerable amount of equipment in the transmitting shack, and though the skids under one of the transmitters indicate that some of the material is still in the process of installation, it is expected that by the time this appears in print everything will have been "shaken down" and the Club will be operating on a regular routine.

The following is a roster of club officers:

President—Capt. Edward L. Neilsen, W4IAI.

Vice President—M/Sgt. Phillip H. Huston, W3EHB (who served in China with the Office of Strategic Service as a major).

Secretary—Major John M. Moss, the trustee of W2OEC.

Treasurer — Pfc. Francis E. Lajoie, ex-W1HXD.

Property Officer—1st Lt. E. J. Mazzi.

Activities Manager—Cpl. Jack D. Rodebaugh, W8LIO.

Chief Operator—Pfc. Peter N. Borsie.

Already excellent contacts have been made with amateur radio telephone stations in California on the 80-meter band and it is expected that many GI and ex-Gi amateurs will maintain contact with the Signal Corps and Fort Monmouth through W2OEC. Schedules will be increased in number and operating time expanded to a full twenty-four hours daily, as soon as traffic increases sufficiently to make it practical.

The Club would like to make contacts with any similar Army-Amateur clubs throughout the United States (and elsewhere, if such exist).

Right, foreground—10-meter, background—80-meter antenna. Below, Figs. 3 and 4—Details of 10- and 80-meter antennas, respectively.

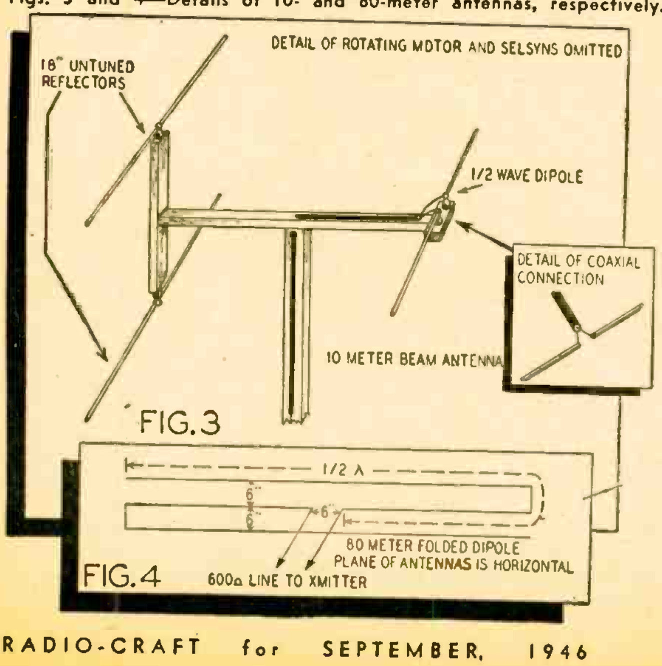
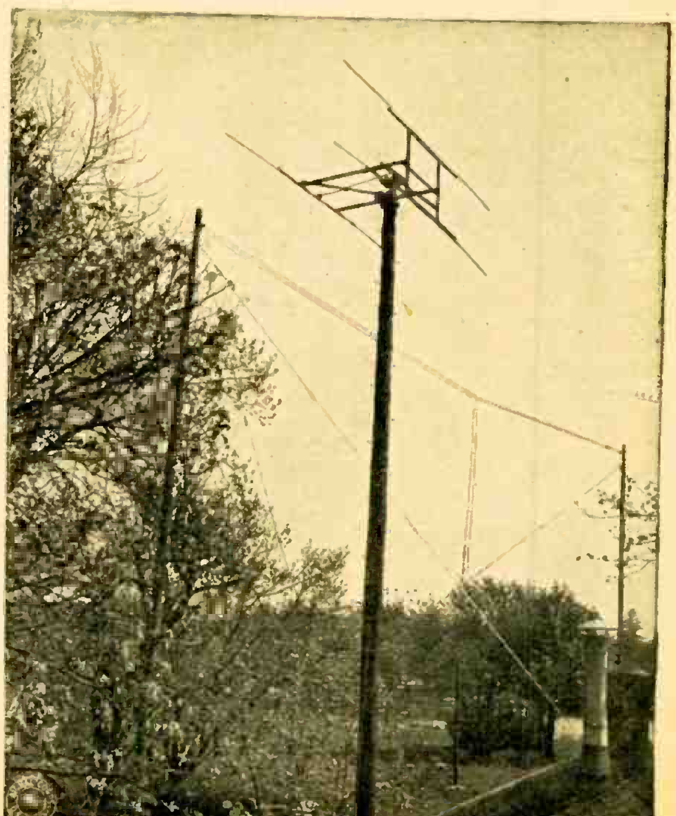


FIG. 3

FIG. 4



By R. E. ALTOMARE

GERMANIUM CRYSTAL PROBE

Another Valuable Application of the Germanium Crystal

THE majority of present-day Vacuum Tube Voltmeters are essentially d.c. indicating devices. A rectifier unit is employed to permit measurement of a.c.voltages.

Many factors influence the choice of the rectifier unit and its arrangement with respect to the d.c. indicator. Since operation over a wide frequency range is desirable, it is necessary to make all a.c. leads as short as practicable. Moreover, linear rectification is preferable so the d.c. indicator deflection will be directly proportional to the magnitude of the a.c. voltage.

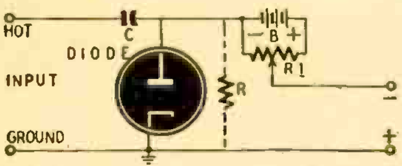


Fig. 1—Diagram of standard type diode probe.

A vacuum-tube diode rectifier, mounted in a convenient probe and arranged to feed the d.c. section by means of a shielded cable, is admirably suited to this purpose.

A wide variety of small vacuum tubes may be conveniently used. In general, it is necessary to choose tubes having a low input capacity. Thus the input impedance will be sufficiently high to preclude loading of the external circuit.

With the advent of the new Germanium crystal-diode (Sylvania 1N34), the constructor has a useful device which simplifies probe design. Most of the disadvantages of vacuum-tube diodes are eliminated.

A comparison of Figs. 1 and 2 will show immediately the simplicity of the crystal version. Fig. 1 illustrates a typical vacuum diode circuit. Fig. 2 shows its crystal counterpart. Note that a small battery and variable resistor are needed to balance out the contact potential of the diode. The properties of the Germanium crystal have been adequately described in the literature.* Hence no attempt will be made to discuss the theory of operation. An actual probe will be described.

The probe is simple to fabricate. It was built into a small penlite flashlight case details of which may be seen in the photo, which shows its use in conjunction with radio enthusiast Russell Suthard's version of the "Electronic-Omnichecker".** Note the extremely small size. The circuit is that of Fig. 2. The capacitor C is .01 μf and the function of R is taken over by the divider resistors across the input of the vacuum tube voltmeter. In operation the VTVM is set up to measure negative d.c. voltage. Full scale meter reading of 1.5 volts d.c. may be obtained with the circuit of Fig. 2 when 1.5 volts a.c. is applied to the probe. To increase the d.c. output voltage, the value of C must be increased. A value of .01 μf or less is to be preferred, however, in order to keep the input impedance at a high value.

An exploded view may be seen in the second photo. The front row of this photo shows (left to right) the capacitor, C, as it is soldered to a short length of pointed No. 8 wire and the tiny crystal and its mounting. The bakelite tubing fitted into the plastic case cap and the case proper are shown in the second row. In the background of the first photo rests the 7-prong plug which feeds the d.c. indicator.

The crystal will operate well at frequencies as high as 100 mc. The input

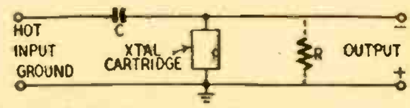
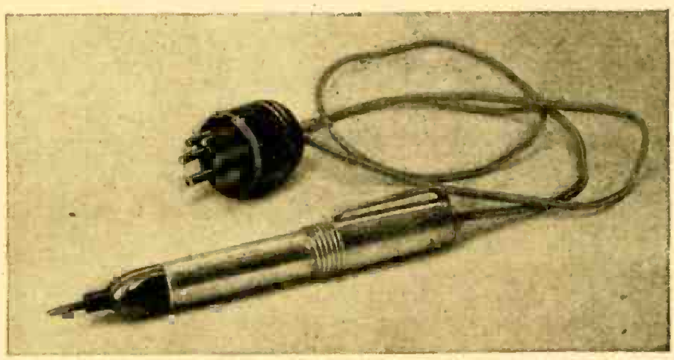


Fig. 2—A diode probe with germanium crystal.

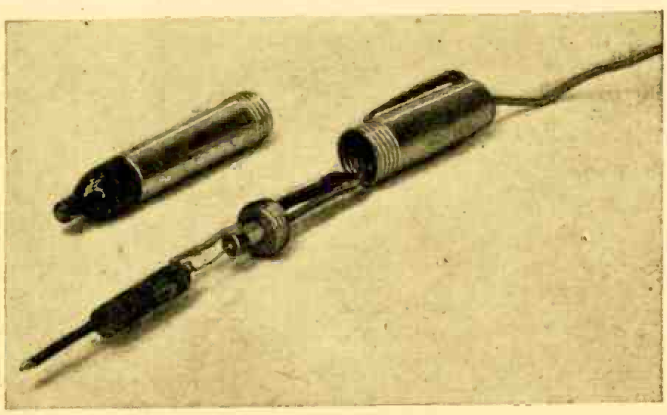
impedance of the unit shown was found to approximate one megohm at 1000 cycles per second. The output is non-linear on the lowest range and the meter must be calibrated accordingly. A linear scale, however, is sufficiently accurate for most purposes.

It is to be emphasized that the a.c. voltage applied to the probe must be limited to somewhat less than 50 volts. To double the applicable voltage, two crystals may be used in series.

The above material is considered merely suggestive. It is hoped the experimenter will find many new uses for the crystal. Doubtless, variant circuits can be adapted to special requirements to suit the user.



The crystal probe in its small penlite case.



Exploded view of probe. Crystal is at center.

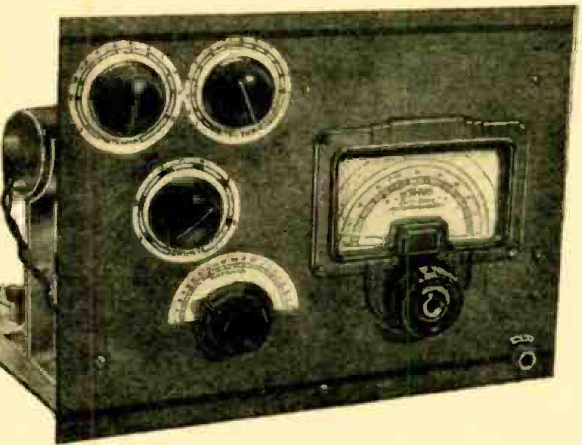
* See "Germanium Crystal Diodes"—Cornelius, *Electronics*, February, 1946.
"H.F. Crystal Diodes"—LeDuc, RADIO-CRAFT, March, 1946
** RADIO-CRAFT, June and July, 1945

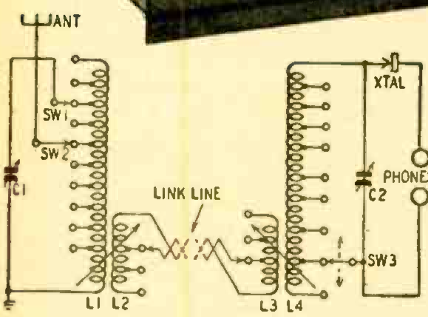
By CARROLL UTERMAHLEN

LINK-COUPLED CRYSTAL SET

A Selective Receiver with Surprising Distance Range

THE *Two Timer* is a new and different type of crystal set, and should appeal to those who have been searching for a truly dependable mineral operated receiver. Unlike the average set of its class the *Two Timer* offers extreme flexibility, a feature that is wholly responsible for its unusual bandspread and extended frequency range.





Above—The Two Timer from the front. Link lead extends from coil. Below—Schematic of the set. Coils L1 and L4 have 12 taps each.

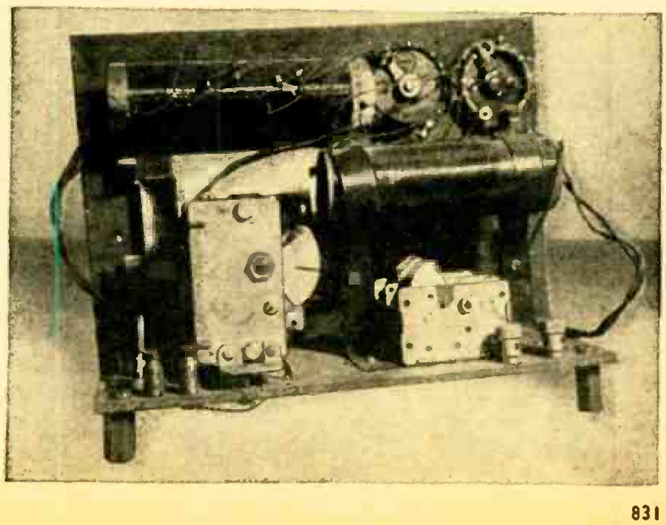
Consisting of two separate units (antenna tuner and detector) and employing link coupling, the receiver is operated much in the same manner as a one-tube regenerative set; one dial is used for tuning while the other is used as a sensitivity control.

Living just outside Baltimore (Maryland) the author has heard such stations as WGN, WOR, WABC and CBL, shortly after sunset of a winter's evening. Later in the evening it was not uncommon to log other stations like WSB, WWL, and WKBW. After our local stations sign off (excepting one, WITH, an all-night station) the dx really rolls in. . . . with XEG, CBM, CMAC and CMAQ, WIBC, and KXEL being heard regularly. WLW, WTOP, WCKY and WHAS are logged nightly. The signal strength of WLW and WHAS has at times exceeded that of local WITH! Ordinary "run-of-the-mill" DX includes WWVA, WBBM, and WGY.

All stations heard were positively identified; and, for the most part, the signals were loud enough so that the programs heard were perfectly understandable. The best dx "catch" to date was KOY (Phoenix, 1000 watts on 550 kc) heard while local WCAO (Baltimore, 5000 watts on 600 kc) was still on the air! There seems to be no limit to the dx possibilities of the *Two Timer*, and yet the antenna requirement of this set is such that a 100 ft inverted "L" with a 50 ft lead-in is sufficient for most locations. A shorter antenna may be employed for purely local reception.

The "Cut-your-antenna-to-the-listening-frequency" theory was given the well known "Bronx cheer" when such *long wave* stations as the Altoona (Pa.) and Washington (D.C.) airport control towers were heard, along with the aircraft beam stations BO, KW, WA, and NHK; while on *short wave* the police stations WCK, WPDP, WPFS, and WPFH were heard; as were the International 'phone stations WNRX and WLWK.

Before starting the actual construction of the receiver it would be wise to make a thorough study of the schematic diagram. It should be particularly noted that the *Two Timer* consists of two separate units. They may be mounted on the same baseboard and panel, yet they are, electrically, as much separated as if they were miles apart. This means that the coils should be mounted at right angles to each other; or on a different plane to each other; and that the set should be wired in such a manner that the antenna coupler and the detector will not be coupled by stray capacities. This is most important, because if the units are jammed together in a small space the operating efficiency will be but mediocre.



Right—Rear view of the Two Timer. Twisted lead is the link coupling line.

The coils L1 and L4 are exactly alike, and are wound with No. 26 enameled wire on forms 1⅝-inchs in diameter as follows: Wind 10 turns and make a tap; from this point make taps at the following numbers of turns: 15, 20, 25, 30, 35, 40, 45, 50, 55, 60; which means a total of 11 taps and a total of 385 turns of wire. The 11th tap is the end wire on the coil. L2 and L3 are alike in that each is wound on 1¼-inch diameter forms. Consisting of 30 turns (each coil) of No. 26 enameled wire, tapped at the 10th, 20th and 30th turn, these coils fit inside L1 and L4 and are joined together by a twisted-pair link-line. Any suitable wire may be used, and the length is unimportant, though it will seldom exceed 20 inches in actual practice. When the coils are completed a thin coat of Duco household cement will do much to preserve them and will keep the works from falling apart with constant use.

Band switching is accomplished by one of two methods: battery clips or tap switches. The author made his own tap switches from antique rheostats, but battery clips were used to advantage in the original experimental model. If you use switches DO NOT attempt to "lace" or bind the wires to and from the coils and switches. This might make for a neat job but was found to be detrimental to the overall efficiency of the receiver.

Assuming that the antenna and ground and earphones are connected, and that a "hot spot" has been found on the crystal, the first procedure is to

(*Continued on page* 875)

By NORMAN CHALFIN

REBUILDING A TELEVISER

Modernizing the Pre-War Television Receivers

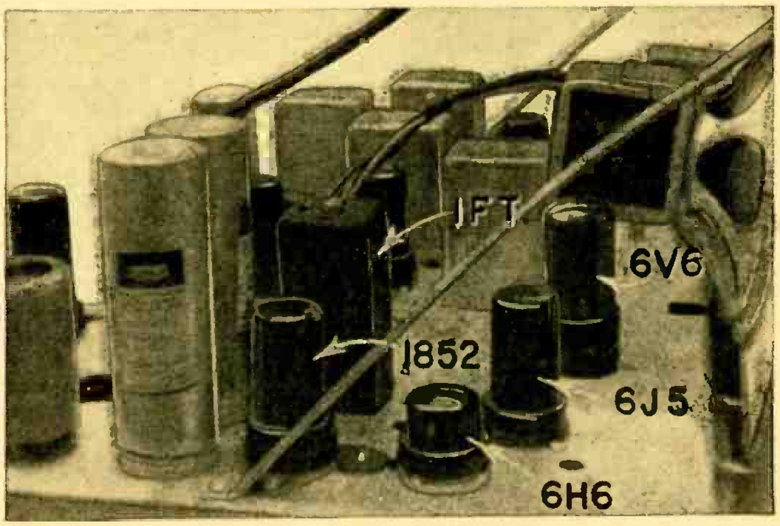
IT will be at least a year before many new television sets can be produced. Those who now have kit-constructed television receivers may be interested in improving their sets with a few simple changes and additions.

The circuit diagram of a typical television receiver kit (Andrea KTE5) is shown in Fig. 1. Changes that have been made are shown in the circuit at the points marked with letter designations. Separate drawings show each of these changes in detail.

At "A" the original circuit was revised to include a type 6AG7 as the video output amplifier in place of the 6V6 which was used in the original circuit. In addition to base connection changes the dropping resistor in the screen circuit must be reduced to a value of 25,000 ohms, 5 watts. This change will result in an improvement in brightness and overall detail. When wired for the 6AG7 an 1852/6AC7 can be used interchangeably if the lower filament drain of the latter is preferred. Its lower transconductance will make no difference. Changes "B" and "C" are substitution of the 6SN7GT tubes for the 6F8G's used as vertical and horizontal deflection voltage amplifiers. A number of base connections must be changed. This brings all connections below the chassis. The cathode-coupled circuit shown in "D" applied to the vertical amplifier improves the vertical uniformity. This can be seen in the equalization of the lengths of the vertical wedges in the test pattern.

The change made at "E" reduces hum pickup in the vertical height control leads. It consists of shielding the lead from the plate coupling capacitor of the 6N7 vertical sweep oscillator to the picture height control, and also shielding the lead from the slider connection of this control to the grid of the first half of the 6SN7GT (or 6F8G), vertical amplifier.

Hum picked up in the video circuits is evidenced in the appearance of horizontal dark areas across the picture which may remain stationary or move slowly in the vertical direction. Another indication of hum is in the appearance of "S" shaped sides in the raster, with consequent picture distortion. This type of hum is generally the result of either hum voltage in the horizontal deflection circuits, or is picked up directly at the deflection plates from electromagnetic fields surrounding components on the chassis. A soft iron or "mu" metal pipe of suitable diameter used as a shield around the neck of the cathode ray tube will reduce the pickup from such fields. Separation of power components from the chassis is desirable but impractical in this case unless a separate power supply is constructed, as described later.



Chassis changes necessary for new FM sound channel are shown in photo above.

At F, the insertion of additional differentiator elements as shown will give improved horizontal synchronization and prevent "tearing" of the picture by random noise, static or ignition pulses. The values indicated were satisfactory for the author's equipment. Experiment may provide better values for the reader's set. A similar addition of elements in the low-frequency (vertical) sync separator string will prevent random pulses from triggering the vertical sync out of control, resulting in the picture rolling vertically. This is shown along with circuits for horizontal sync in Fig. F.

Use of the contrast control on the author's set to lower the picture signal level or reduce contrast also brought the sound level down. This condition is eliminated by lifting the 1000-ohm cathode bias resistor in the 1852 mixer off the contrast control and grounding it. Thus the contrast control operates only on the video i.f. and cannot affect the sound level. This is illustrated at G. If the cathode bias resistor is changed from 1000 ohms to one of 250 ohms, increased signal will result in remote locations. The unby-passed 40-ohm resistor in the modulator cathode above the 1000-ohm resistor improves high frequency performance of the modulator tube. Some of us have either shorted out this resistor or by-passed it with a .006 μf capacitor to ground with consequent increase in signal.

The changes described above are all designed to improve the overall performance of the receiver in its present form. The balance of this article is devoted to the discussion of more ambitious changes of an experimental nature designed to make the author's set adaptable to larger tubes without necessitating further changes.

As this is being written the new channel assignments for the New York area

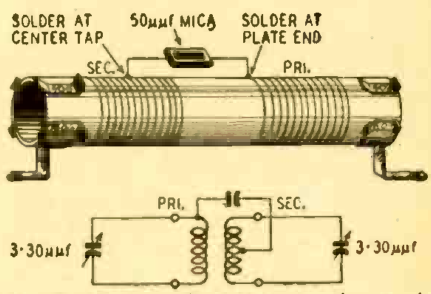


Fig. 2—How the discriminator coil is made.

are announced. They are Nos. 2, 4, 5, in the range below 100 megacycles. The removal of one full turn each on the grid and tickler of the oscillator coil, and the grid and antenna secondary winding of the antenna-input coil will make possible tuning all three channels. This appears at H in Fig. 1. A new switch will be required to accomplish the change. It will more than likely be necessary to revise some existing

(Continued on page 879)

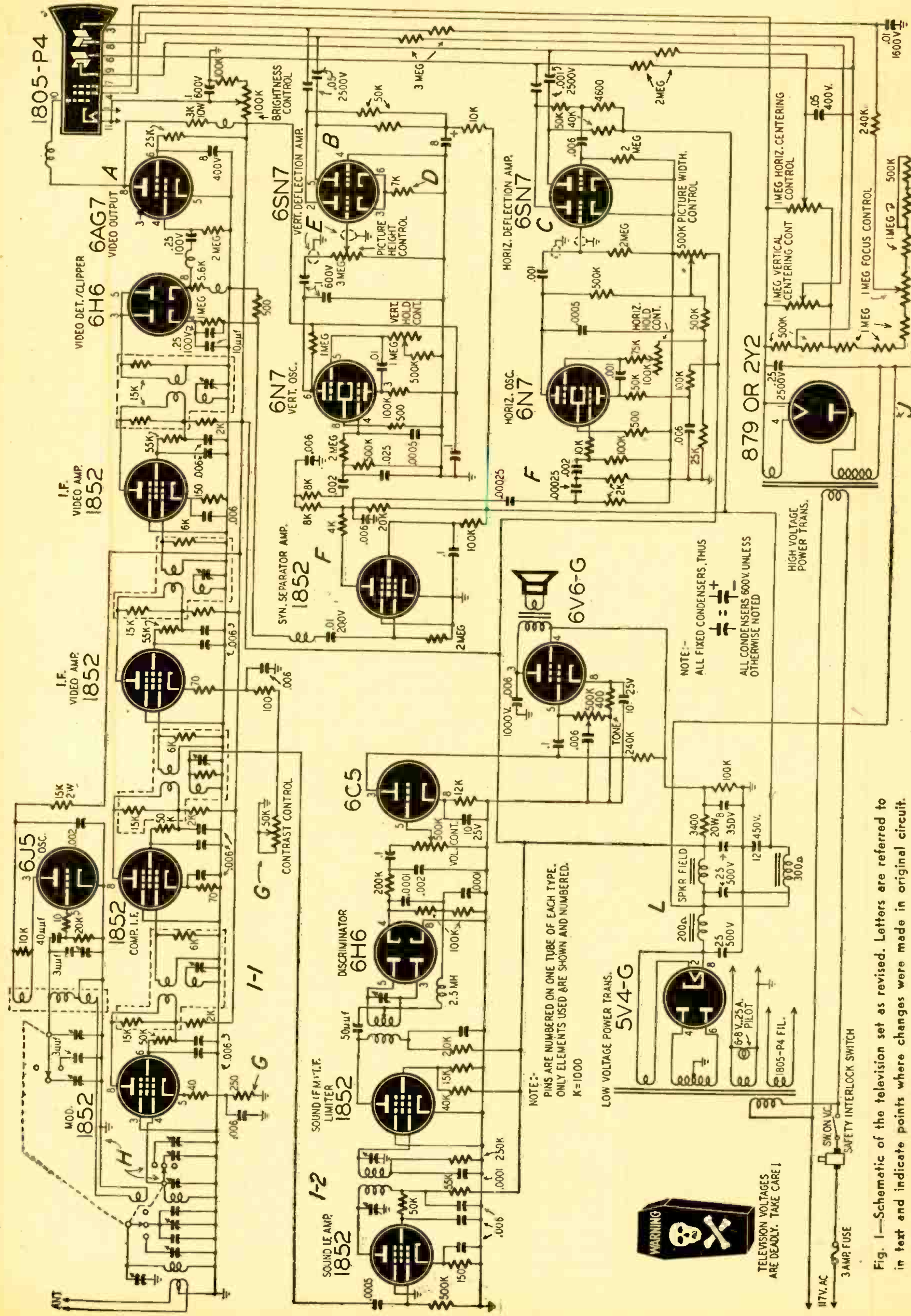


Fig. 1—Schematic of the television set as revised. Letters are referred to in text and indicate points where changes were made in original circuit.

By JOHN B. LEDBETTER

AUDIO MIXER DESIGN

How These Important Devices Are Constructed and Used

IMPORTANT factors in the design of broadcast audio equipment are operational and structural problems presented by the audio control panel or mixing console.

Since various types of fixed and variable attenuators go to make up the greater part of audio mixing equipment it may be well to touch upon some of their more important circuit applications before discussing the conventional audio mixer.

Attenuators are essentially resistive networks, accurately calibrated to give a known *insertion loss* and designed to match the terminal impedances of associated input and output circuits between which they are used.

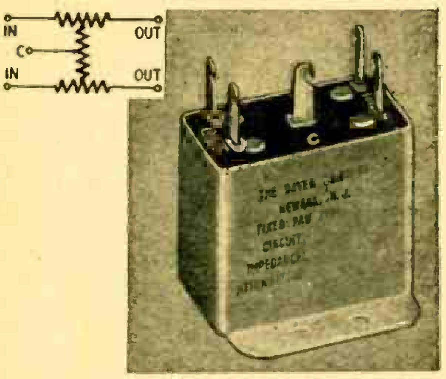


Fig. 1—Fixed attenuator (balanced-H type).

Attenuators may be divided basically into two classes, fixed, and variable. The fixed type is more often referred to as a *pad*, while the variable attenuator is commonly known as a *fader*, *pot* or *volume control*.

A fixed pad usually consists of a number of card-type resistors non-inductively wound on thin strips of bakelite and designed to give constant impedance over a wide range of frequencies. Well-designed pads have been found to maintain a constant-impedance characteristic to frequencies beyond 10 megacycles when the terminal leads were properly shielded. A typical fixed pad is shown in Fig. 1.

Another balanced-H network of lower wattage.

Fixed pads are generally classified as either "T" or "Balanced H". There are also a number of additional types known as "Ladder", "Pi", "U", Balanced "U", "O", Balanced "O", "L", etc. These are derived from the two general types "T" and Balanced "H". Pads may be made to match any circuit impedance to another at any desired insertion loss.

Fixed pads are probably used more extensively than any other single piece of broadcast equipment. Some of their more common uses are:

1—As impedance transformers (for example, to match a 500-ohm output to a 600-ohm line).

2—To isolate each branch of a multiple-feed circuit from the program bus.

3—To bridge a program bus and provide a simultaneous feed to a network of monitoring speakers, at different levels if desired.

4—To combine multiple-channel circuits.

5—To allow switching of a volume indicating meter from one circuit to another of different level or impedance.

6—To balance the output of several monitoring speakers connected across amplifiers of different output levels.

7—To provide the proper amount of insertion loss in frequency response measuring equipment.

8—As a standard reference in comparison resistance measurements.

9—To provide isolation between preamplifiers, mixing circuits, program amplifier and transmitter, at the same time attenuating or reducing the output of each unit to the proper level to prevent overloading, distortion and cross-talk.

In a typical application, four preamplifiers feed into a high-level mixer. Two of them are used for microphones, the other two for turntable equipment. Output of microphones ranges approximately from —85 db to —75 db; that of the turntables is about —50 db. Since it is desirable to provide an equal level in each leg of the mixer circuit, both to maintain similarity of fader control settings and to prevent cross-talk or overloading of one mixer leg, a pad of the required insertion loss (about 30 db) and proper terminal impedance is placed in the output circuit of the turntables. It is usually connected between the preamplifier output circuit and the input of the fader.

Potentiometers, rheostats, ladders, "L" networks and "T" or "H" networks are the basic types of attenuation networks, the latter three types being more commonly used in mixing circuits.

From the above types of networks have sprung derivatives such as the balanced and unbalanced forms of rheostat, potentiometer, "LL", "LR", bridged "T" and bridged "H". Some of these are shown schematically in Fig. 2.

Because it cannot maintain a constant impedance at various settings the type

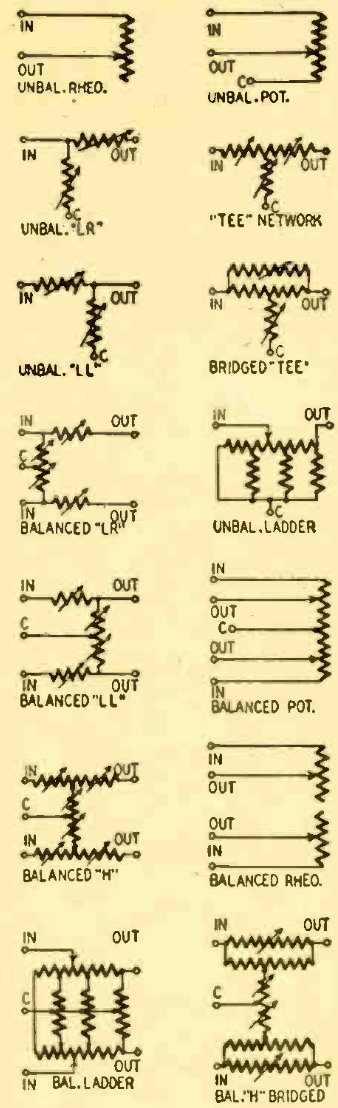


Fig. 2—Typical attenuator networks.

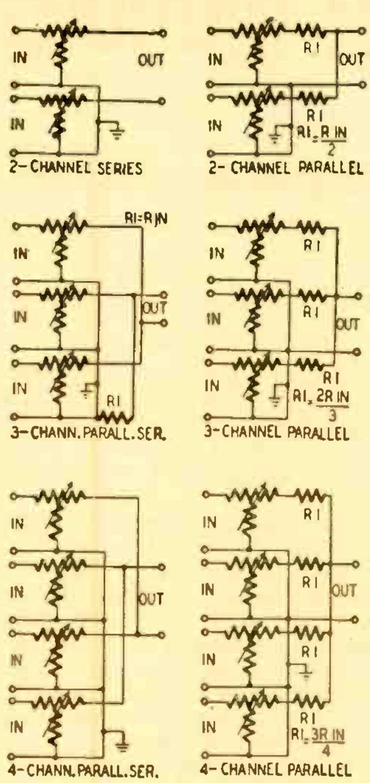


Fig. 4—Typical mixer networks.

"L" fader is used only in circuits where such variance may be tolerated or desirable. In mixer circuits and other constant-impedance networks, attenuators such as the "T", "H", and Ladder must be employed. The "T" is used in unbalanced circuits, and the type "H" fader where balance must be maintained.

The ladder-type attenuator is more commonly found in mixer circuits. Part of its popularity is due to its noiseless operation and excellent frequency characteristics. It represents a distinct advancement over the "T" and "H" types, affording a constant impedance in both input and output circuits over an attenuation range from 0 to 45 db, beyond which the attenuation gradually increases to infinity. The dial is calibrated in 1.67 db steps (Fig. 3).

The resistance elements of attenuators are composed of unifilar windings on thin bakelite strips or non-inductive wire-wound spools, either type of construction allowing production of pads capable of a noise level lower than —150 db. Contact arms are of heavy, multi-leaf construction. One set of leaf fingers makes contact with the outside resistance-contact studs while the inner set makes contact with a rotor slip-ring. The aluminum back cover is removed to allow access to the contact points for cleaning, a process which consists mainly of wiping the contact points and rings with either carbon tetrachloride or a mixture of half alcohol and half ether, and lubricating with a *very* small amount of Daven or fine clock oil. A small amount should be applied to the wiping arm, the arm rotated several times, and then the oil wiped off. This action removes any dirt or other matter from between the rotor blades. A thin film of lubricant is then applied to the blades and the cover replaced.

HIGH VS. LOW-LEVEL MIXING

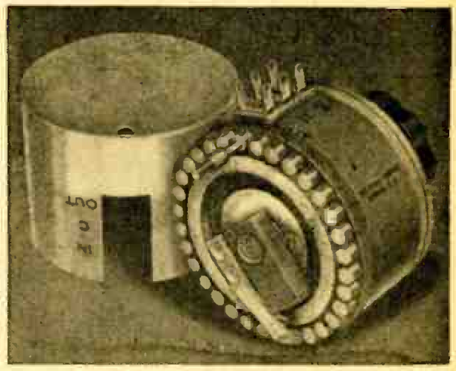
Faders are usually connected in series or series-parallel, depending on the number of channels used. They are fed to subsequent stages of amplification through a 1:1 ratio isolating transformer which has an electrostatic shield between windings and a grounded center-tap on each coil winding. The transformer eliminates cross-talk and stray noise pickup, in addition to acting as an impedance-matching coil where 50-ohm or 200-ohm faders are connected to a 500-ohm line.

Two types of mixing systems, high-level and low-level, are in use. Each has its own merits. (See Fig. 4). High-level mixing is accomplished by feeding each microphone or turntable output through a stage of pre-amplification and thence to the mixer, the action taking place at the comparatively high level of approximately —40 db. In low-level mixing, outputs of the various microphones are fed directly into a mixing circuit and thence to a pre-amplifier.

In the field, low-level mixing makes compactness possible in remote amplifier design. Only one amplifier unit need be used, instead of one for each microphone circuit. In the studio, the advantages of high-level mixing more than outweigh the slight disadvantage of increased unit cost. High-level systems have an inherent noise level 10 db lower than the best type of low-level circuits, and a corresponding decrease in sensitivity to tube hiss and the "shot" effect of amplifier input tubes.

STUDIO CONTROL CONSOLE

Since the mixing panel or console is the central control and distribution point for all programs originating in or outside the studio, it may well be termed the "heart" or "brain" of the entire program facilities. In fact, one can hardly name a type of program in which at least two mixing points are not employed. A certain type of network program includes mixing and pickup points in a number of widely separated cities, with the master control point being located in still another city. In another case, a remote pickup, constituting one mixing point, is fed through a studio mixer (the second



Typical variable attenuator (ladder network).

mixer point), where local announcements are inserted, and the combined programs fed to either the third mixing point at Master Control or to the speech input equipment of the transmitter.

Keynote in studio console design should be simplicity, flexibility, ease of operation and quick access to all associated gear, with neatness and compactness playing important parts. Design simplicity reduces percentage of operating error by eliminating elements

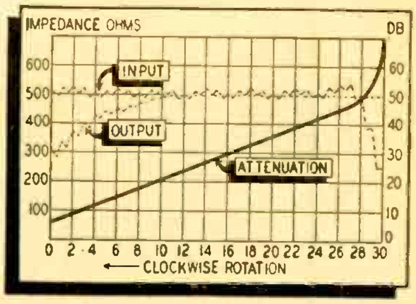


Fig. 3—Curve of attenuator pictured above.

of confusion, while flexibility of operation allows adaption to a wide variety of programs, and facilitates easy switching or circuit patching in case of equipment failure. Flexibility is greatly increased by terminating the input and output circuits of all pre-amplifiers, amplifiers, attenuators, keys and other operating facilities in a jack strip or panel, the circuits being *normalled* to allow transfer of any part of equipment to another circuit.

The input and output terminations of the line or program amplifier are usually connected to a "multiple" set of jacks which allow patching into either circuit without program interruption.

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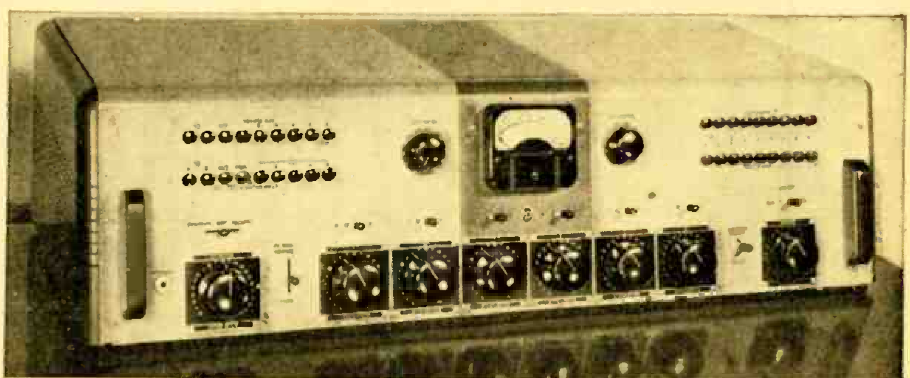
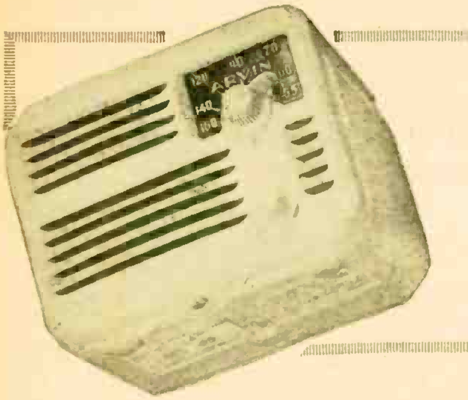


Appearance of the RCA 76-B2 Studio Control Console, a typical and commonly-used type.



THE POSTWAR RADIOS

Arvin Model 444

THE Arvin Model 444 is one of the more unusual post-war radios in its class. It uses four full-size tubes in an efficient a.c.-d.c. superheterodyne circuit. It is housed in a cabinet of modern design 6½ inches long by 5 inches high by 4 inches deep. From all outward appearances, the cabinets seem to be made of thin plastic. Close examination shows that they have been stamped from heavy sheet metal. Careful tests discovered no cabinet resonance or "ringing" even at high volume levels.

The Model 444 uses a 12SA7 mixer-oscillator, 12SQ7 second detector, a.v.c. and a.f. amplifier, 50L6-GT a.f. output and 35Z5-GT half wave rectifier.

A 25-foot "hank" antenna replaces the relatively inefficient loop antenna commonly used on sets of this type. The secondary of the antenna coil is tuned by one section of the cut-plate ganged tuning condenser.

The smaller condenser section tunes the oscillator, which is a modified Hartley circuit with the tickler coil connected in the cathode circuit. The tuning condenser gang is insulated from the chassis and cabinet to prevent the user from being shocked by coming in contact with a "hot" chassis. The rotors of the condensers are connected to the a.v.c. line.

There is no i.f. stage in this receiver. The 455-kc i.f. signal from the plate of the mixer is transformer coupled direct to one detector diode. The B-plus lead to the mixer plate is connected to a tap on the primary of the i.f. transformer instead of to the bottom of the coil in the conventional manner. This connection increases the amplification and selectivity of the set.

The second detector uses a standard half-wave circuit. A 2-megohm volume control is connected so that it will serve as a diode load for the detector. The d.c. voltage drop across this resistor is filtered by a 4.7-megohm resistor and 100-μμf condenser and used as a.v.c voltage for the mixer. The a.f. signal is fed to the grid of the triode section of the 12SQ7. Resistance-capacity coupling is used between the plate of the 12SQ7 and the 50L6-GT; a pentode connected, beam-power amplifier supplies more than 2 watts of audio power to a 4-inch PM speaker.

The tuning dial, 2 inches long by 1½ inch high, is calibrated at 550, 600, 700, 900, 1200, 1400 and 1600 kc. In each

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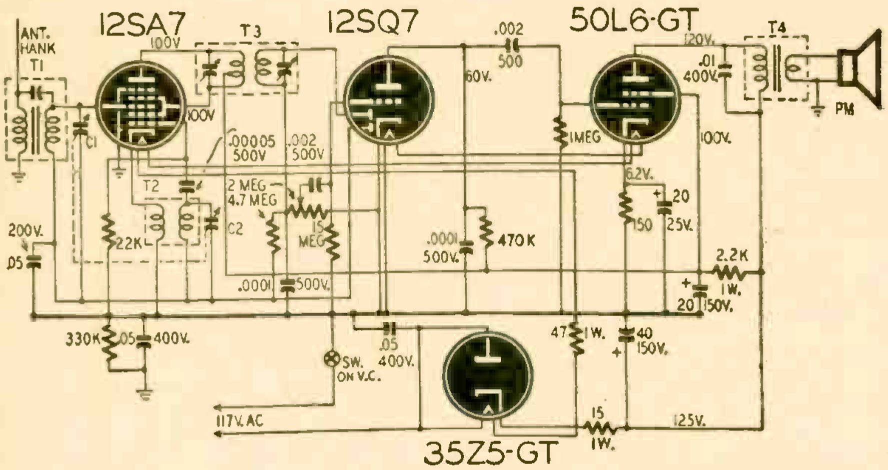
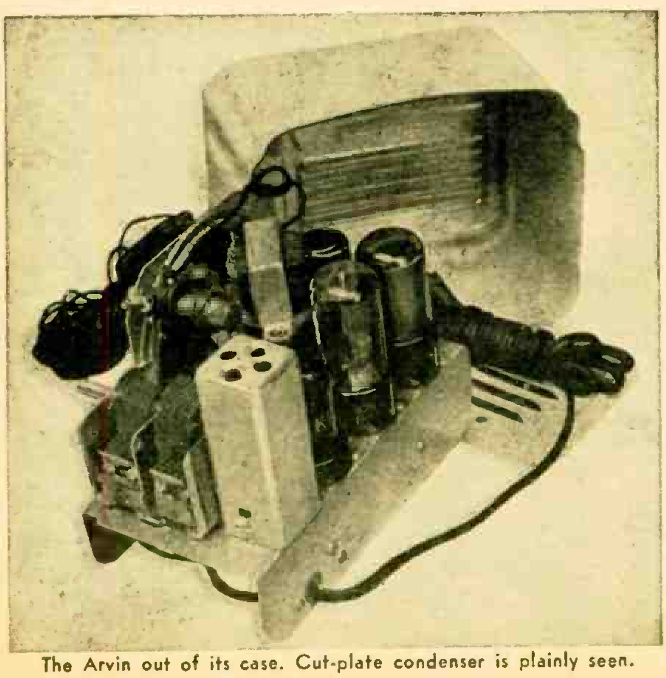
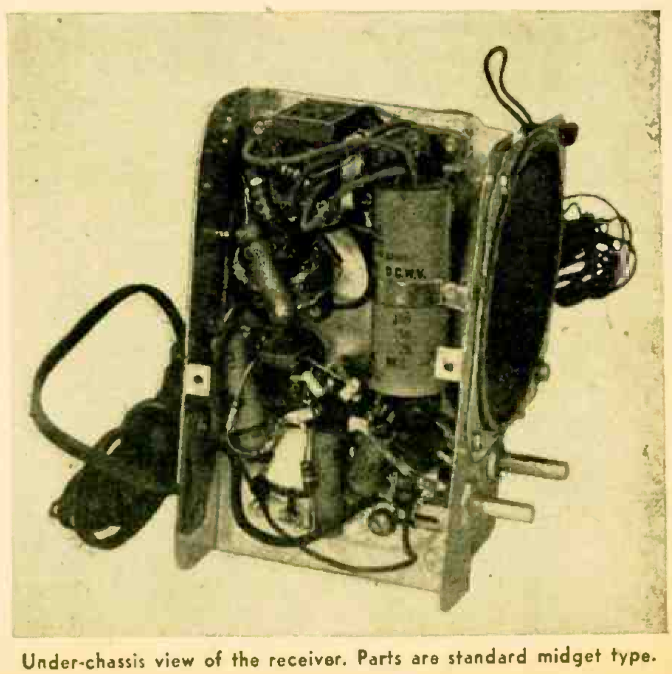


Diagram of the Model 444. Positive feedback in the i.f. circuit is especially interesting.



The Arvin out of its case. Cut-plate condenser is plainly seen.



Under-chassis view of the receiver. Parts are standard midget type.

By SHEPARD S. LITT

RADIO TEST EQUIPMENT

Realizing the Most from a Meter in Radio Servicing

TEST equipment used by radio-servicemen must cover a large voltage, current, and resistance range. Voltages may be as low as a few microvolts in radio receivers and as large as 10,000 volts on peaks in television receivers. Currents may be as high as 10 amperes in automobile receivers and as low as a few microamperes in the plate and a.v.c. circuits. Resistances may be a fraction of an ohm and may run as high as several million ohms. The extreme ranges, make it imperative that the user know exactly what is happening in his tester. A working knowledge may mean the difference between a quick repair and a burnt-out tester and the loss of the money invested.

The D'arsonval is the foundation movement for most radio test equipment in use today. This part is the heart of the tester.

It consists of a wire coil rotating on pivots, set in jewels and mounted in the field of a powerful magnet. Springs mounted above and below the coil serve as connectors to the coil, allowing the entry and exodus of current, and also as the restoring torque to return the coil and attached pointer to its original position. Sensitivity of the meter is governed by the strength of the magnet, number of turns on the coil, and strength of the springs.

The most common sensitivity in use today is one milliampere (1,000 microamperes) full-scale deflection. (200-microampere and 50-microampere movements are also in use, but their high price and extreme delicateness limit their popularity.) D'arsonval meters are made with current sensitivities of 40 μa to 10 ma (self-contained). Meters with higher ranges than 10 ma usually have shunts built into their cases. The D'arsonval movement is usually made with a scale arc of either 90° or 100°. 270° meters are available. A 4-inch meter having a 270° arc, has the same scale length as a 7-inch meter having a 90° arc. The accuracy of the smaller model is 2 percent of full scale. Larger models can be built to an accuracy better than 1/10th of one percent. When it is necessary to measure currents in excess of about 10 milliamperes, most of the current is made to flow *around* the meter. The device which permits this is a *shunt*. Shunts are made in two movement types, the single-range and the multiple-range or *Ayrton shunt* (sometimes called the *ring* shunt).

The single-range shunt (Fig. 1) consists of a resistor placed *across* a meter, thus reducing its sensitivity. If we assume a meter with a sensitivity of 1 ma and a resistance of 100 ohms (100 millivolts), and desire to measure 10 ma

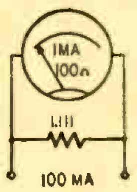


Fig. 1—A simple shunt, designed to step up the current-carrying capacity of the meter by a multiplication factor of one hundred.

of current, a shunt is constructed so that 9 ma flows through the shunt.

Therefore the shunt must furnish 9 1-ma paths *in parallel*, while the meter is the tenth. This gives us a formula for calculating the shunt resistance, which is

$$\frac{\text{Resistance of the meter}}{\text{No. of times range is multiplied} - 1}$$

If the shunt is to have 9 times the current-carrying capacity of the meter, obviously it will have one-ninth the resistance. This, parallelled with the resistance of the meter, will result in a 10-fold increase in the reading. In mathematical language this is expressed: RM/N-1, where RM is the meter resistance and N is the number of times the range is to be multiplied. In this case:

$$\frac{RM}{N-1} = \frac{100}{10-1} = \frac{100}{9} = 11.1 \text{ ohms}$$

The single-range shunt has many disadvantages. In a multi-range instrument, the meter is not protected when changing ranges unless a shorting type switch is used. Since a different resistance is across the meter for each range, damping of the meter will vary. This means that for the higher currents, it will become more and more sluggish, the pointer requiring more time till it comes to rest. Any pivot friction or dirt in the jewels or on the springs will show up, causing the meter to stick.

The Ayrton shunt (Fig. 2) consists of several resistances, all connected in series, connected across the meter. The total of all the resistances can be any value consistent with good damping upon the meter movement.

Assume a 400 μa (.4 ma) meter having a resistance of 150 ohms. It is desired to build a multi-range ammeter having full scale ranges of 3, 15, 60 and 150 ma and 3, 15, and 30 amps. The total circuit resistance is 1350 ohms for all the resistances and 150 ohms for the meter or 1500 ohms.

$$\text{R needed} = \frac{\text{R total}}{\text{N (multiplication factor)}}$$

The multiplication factors for the various ranges would therefore be
x7.5, x37.5, x150, x375, x7,500, x37,500 and x75,000;
the resistances would be—
200 ohms, 40 ohms, 10 ohms, 4 ohms, .2 ohm, .04 ohm, and .02 ohm.

An additional 1150-ohm resistor completes the circuit. The higher shunt resistance is for improved damping. The actual resistances used are 160 ohms, 30 ohms, 6 ohms, 3.8 ohm, .16 ohm, .02 ohm, and .02 ohm, as they are all in series.

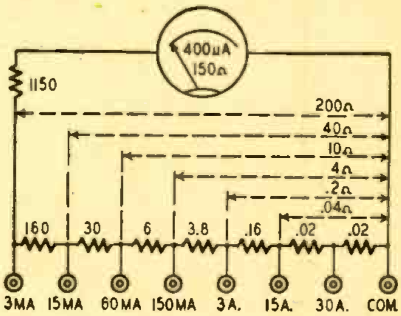


Fig. 2—The Ayrton shunt applied to a meter.

Since the meter "looks into" a resistance of 1350 ohms for *all* ranges, meter damping remains the same throughout.

D'ARSONVAL MOVEMENT AS VOLTMETER

A multiplier resistance is used in conjunction with the meter to measure voltage. If we have a 1-ma meter, having an internal resistance of 100 ohms (100 mv.), and desire to extend the range of the meter to 10 volts, a resistor is added in *series*. The resistor is so chosen that a 9.9 volt drop appears across the resistance and only .1 volt (100 mv) appears across the meter. (See Fig. 3). The resistance of the multiplier would then be:

$$R = \frac{E}{I} = \frac{9.9}{.001} = 9{,}900 \text{ ohms}$$

A multiplier to extend the range of the meter to 100 volts would be:

$$R = \frac{99.9}{.001} = 99{,}900 \text{ ohms}$$

It is customary to disregard meter drop for ranges above 50 volts on all except the highly precise laboratory volt-meters.

Many test equipment manufacturers use series multipliers in place of individual multipliers. A series multiplier to extend our 1-ma 100-ohm meter to 1, 10, and 100 volts would be 900 ohms, 9000 ohms, 90,000 ohms. (Fig. 4) The 900 ohms section is used for the 1 volt range. The 900 ohm and 9,000 ohm resistors are used for the 10-volt range.

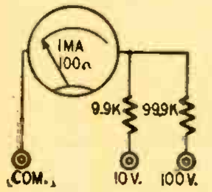


Fig. 3 — A milliammeter hooked up with a pair of voltage-dropping resistors as a two-range voltmeter.

All three are used for the 100-volt range.

When measuring a.c. voltage with a D'arsonval or any other meter that does not respond to a.c., a means must be employed to convert the a.c. to d.c. Several methods are employed.

Thermocouples are used when the frequency range varies and precisions is of prime importance. Rectifiers (thermionic), copper-oxide, copper-sulfide,

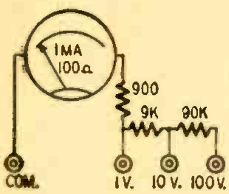


Fig. 4 — A voltmeter with the resistors hooked up in series.

selenium, germanium are used where cost is important.

Copper-oxide rectifiers are the most common rectifiers in use today for changing a.c. to d.c. in instruments. Copper sulfide and selenium are also used, and all circuits described can use either of these rectifiers in place of the copper-oxide.

The rectifier can be connected several ways. The simplest method is to insert it in series with one of the leads of the d.c. meter. There are several disadvantages. The meter scale would be far from linear. The ohms-per-volt and calibration of the meter would be different for each range in a multirange instrument. These changes are caused by the varying load presented to the rectifier by the various multipliers and by the ratio of multiplier resistance to inverse resistance of the rectifier.

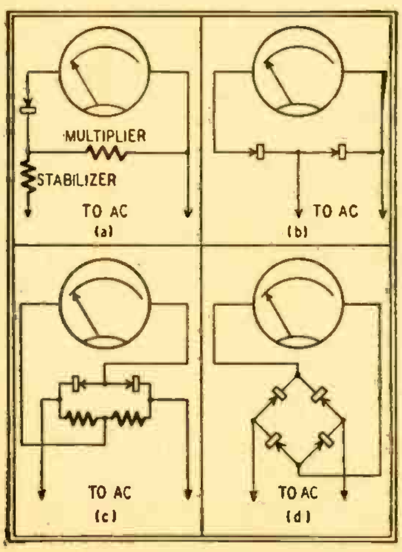


Fig. 5—Rectifier circuits described in text.

The simple rectifier arrangement can be greatly improved by inserting a resistor in series with the rectifier and placing both across the meter, with connections as in Fig. 5-a. It is immaterial whether the resistor or the rectifier is in shunt with the multiplier.

The resistor tends to both equalize the load of the rectifier and reduce the inverse current, giving a better scale distribution and the same ohms-per-volt for each range. The resistor should be preferably less than 1,000 ohms. Although higher values give a more linear scale, they also tend to increase the inverse voltage across the rectifier. A better arrangement is to use a second rectifier unit in place of the resistor, as shown in Fig. 5-b. The second rectifier acts as a "short" during the conducting cycle and as a very high resistance during the non-conducting cycle. With such an arrangement, the scale is almost linear and the ohms-per-volt of the meter is increased.

The above are half-wave circuits and are popular in multi-range instruments. Full wave circuits are also used. The full wave version of the first example (Fig. 5-c) has two rectifiers connected back-to-back and two resistances. The full wave version of the second example is the bridge rectifier (Fig. 5-d). The only real advantage of the full wave circuit over the half-wave is the ohms-per-volt, which is greater in the full wave circuit.

OHMMETER CIRCUITS

Two general circuits are used for measuring resistances in radio test equipment. For resistances below 250 ohms, a *shunt* ohmmeter is usually used. For resistances above 100 ohms, the *series* ohmmeter is used.

In the shunt ohmmeter, a meter, resistor, and battery are connected in series and the resistor is adjusted so that the meter reads full scale. The unknown resistance is then placed across the meter (acting as the single-range shunt described previously). The current flowing through the battery and resistor will then divide and flow through both the meter and unknown resistor (Fig. 6) thus causing the meter reading to *decrease*. As an example, assume a meter with a full scale sensitivity of 1 ma and a resistance of 50 ohms. A 1450 ohms resistor used with a 1.5-volt cell will cause the meter to read full scale. If an unknown resistor is placed across the meter and the reading drops to ½ scale, the unknown will be 50 ohms. This is true since ½ of the current (.5 ma) would flow through the meter and ½ through the 50 ohms shunt. The meter would then register only ½ ma. This can be written as a formula

$$\frac{I_2}{I_1 - I_2} \times Rm,$$

when I_1 = full scale current of instrument, I_2 = new scale current with shunt added and Rm = Resistance of meter.

An unknown resistor causing the meter to read ¼ of the scale will therefore be:

$$\frac{.25\text{ ma}}{1\text{ ma} - .25\text{ ma}} \times 50 = 1/3 \times 50 = 16\ 2/3 \text{ ohms.}$$

The shunt ohmmeter scale would therefore have its zero point to the *left* as in

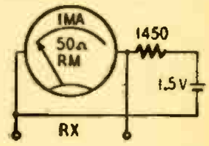


Fig. 6—A shunt ohmmeter, used for measuring low resistance.

voltage and current readings. Such a resistance scale is called a "kick-back" scale since the meter kicks backwards when a resistance is measured. *The shunt ohmmeter is a milliammeter with a variable shunt.*

The series ohmmeter is basically a voltmeter with a variable multiplier. It is more common than the shunt ohmmeter and will read higher resistance values. It consists of a meter, battery, and current-limiting resistor such as used in the shunt ohmmeter, but the unknown resistance is placed in *series*

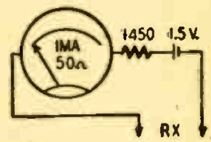


Fig. 7—Simple series ohmmeter circuit, as commonly employed in cheap test equipment.

with the circuit (Fig. 7). If the same 1-ma, 50-ohm meter, 1450-ohm resistor, and 1½-volt battery is used, and the unknown resistor causes the meter to read half-scale, the unknown resistance is equal to the circuit resistance, 1500 ohms. The circuit resistance is composed of the 1450-ohm series resistor and the 50-ohm meter resistance. This can also be written as

$$\frac{E_1 - E_2}{E_2} \times RT,$$

where E_1 is the full scale reading in volts, E_2 is the new scale reading in volts with the unknown resistance added, and RT is the total circuit resistance with the unknown resistance out of the circuit. If the above meter should read 1/3 scale with the unknown resistance in circuit, the resistance would therefore be

$$\frac{1.5 - .5}{.5} \times 1500 = 3000 \text{ ohms.}$$

The series ohmmeter has the zero (*Continued on page* 861)

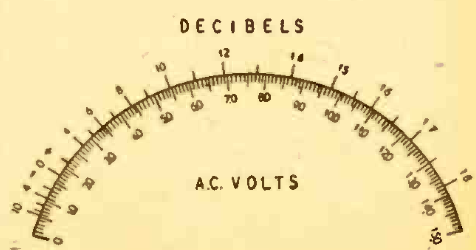
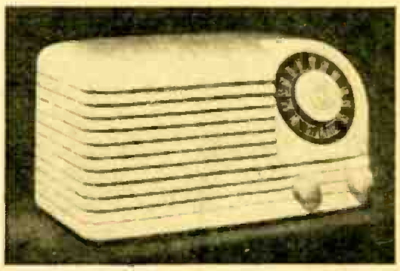


Fig. 8—Decibel adaption chart for voltmeter.

RADIO DATA SHEET 339

OLYMPIC RADIO—Models 6-501, 6-502, 6-503



Frequency Range . . . . 535—1700 K.C.

Power Requirement . . . . 105—125 volts Alternating or Direct current

Power Consumption . . . . 30 Watts

Models 6-501, 6-502, 6-503 are five tube AC or DC operated superheterodyne radio receivers employing a built-in loop antenna which will provide satisfactory reception under all normal conditions. This type of antenna is directional and noise or interference from other stations can be minimized by rotating the receiver. If the receiver is used in locations where signal strength is very low, as in steel buildings, or in locations remote from broadcast stations, an outside antenna may be connected to the screw protruding through the back of the cabinet. A GROUND CONNECTION IS NOT REQUIRED AND MUST NOT BE USED.

REPLACEMENT PARTS

Part No. — Description

CO-107—Capacitor—Electrolytic 40+40/150WV
CV-501—Condenser—2 gang variable tuning condenser
RCM20A101M—Capacitor—100 mmf ± 20% mica
RCM20A221M—Capacitor—220 mmf ± 20% mica
RCM20A331M—Capacitor—330 mmf ± 20% mica
RCP10W2203A—Capacitor—.02 mfd., 200 volts tubular
RCP10W4503A—Capacitor—.05 mfd., 400 volts tubular
RCP10W6103A—Capacitor—.01 mfd., 600 volts tubular
REB106M—Resistor—10 meg., ± 20% ½ watt
REB121K—Resistor—120 ohms ± 10% ½ watt
REB225M—Resistor—2.2 meg., ± 20% ½ watt
REB474M—Resistor—470,000 ohms ± 20% ½ watt
REB822K—Resistor—8200 ohms ± 10% ½ watt
REC221K—Resistor—220 ohms ± 10% 1 watt
SK-110—Speaker—5" Dynamic with output transformer
TR-186—Transformer—1st or 2nd I.F. transformer

NOTES

1. All resistors ± 20% tolerance, ½ watt, unless otherwise specified.
2. All mica condensers ± 20% tolerance.
3. All voltages measured to chassis (B−) with 20,000 ohms-per-volt meter, with volume control full on.

ALIGNMENT PROCEDURE

WHEN SERVICING THIS RECEIVER DO NOT PLACE CHASSIS ON A GROUNDED METALLIC BENCH.

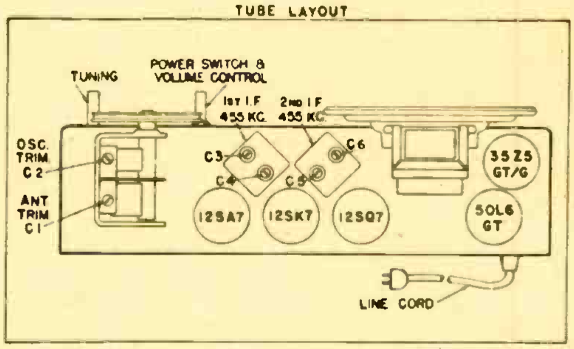
Equipment Required:

Modulated R.F. signal generator; output meter; insulated screw-driver; two .1 mfd 400 volt and one 50 mmfd 400 volt condensers.

To align the receiver it is necessary to remove the chassis from the cabinet, check that the pointer is horizontal and coincides with the two horizontal reference lines on the dial. In this position the condenser should be completely closed. Connect the output meter and signal generator to the receiver as follows:

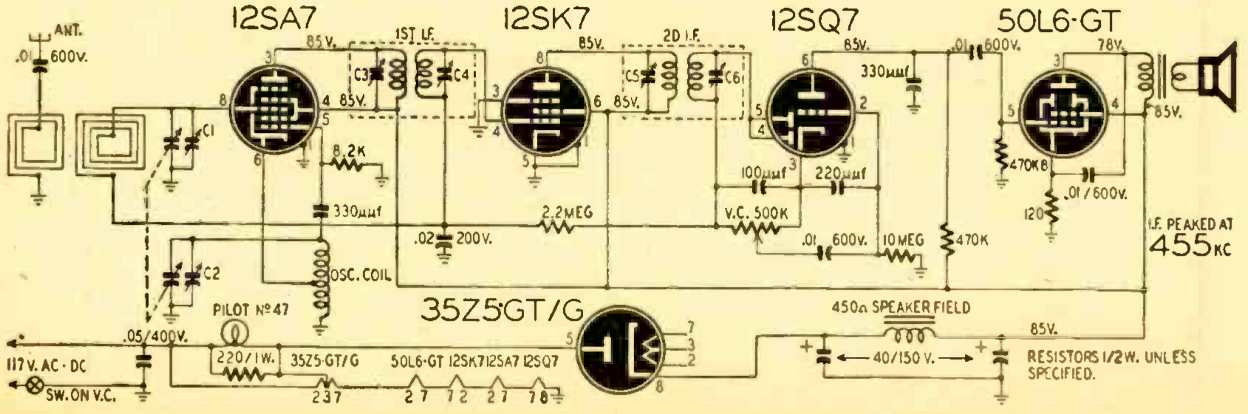
Output meter—Connect across voice coil and turn volume control to maximum. Signal generator—Connect the low side of the signal generator to the receiver chassis through a .1 mfd condenser and keep the output as low as possible, then proceed in the sequence shown on the alignment chart.

TUBE LAYOUT



ALIGNMENT PROCEDURE CHART

Step	Connect High Side of Signal Generator To—	Set Signal Generator To—	Turn Receiver Dial To—	Adjust the Following for Maximum Output. (Keep Signal from Signal Generator as Low as Possible.)
1	Antenna Section Tuning Cond. in Series with .1 mfd Cond.	455 KC.	Full Clockwise Position. (Cond. Plates Fully Open)	C6, C5, C4, C3 and repeat in same order (1st and 2nd I.F. Transformers)
2	Antenna Term.	1700 KC.	1700 KC. (170 on Dial)	C2 (Oscillator)
3	of Antenna Loop in Series with	1400 KC.	Maximum Signal (Approx. 140 on Dial)	C1 (Antenna)
4	50 mmfd Cond.	Repeat Steps 2 and 3		



By MILTON S. KIVER

TELEVISION FOR TODAY

Part IV—Television R.F. and I.F. Stages

AN R.F. STAGE in any superheterodyne receiver is designed to:

1. Increase sensitivity.
2. Increase selectivity.
3. Improve the signal-to-noise ratio.
4. Reject image signals.
5. Reject signals at intermediate frequency.

At the frequencies allocated to television (44-216 mc) we find that the usefulness of an r.f. amplifier is not as great as it would be at the considerably lower broadcast frequencies (550 to 1700 kc). The reason: use of a higher signal frequency coupled with the greater separation between the range of frequencies at which the r.f. amplifier operates as compared to the i.f. frequency.

Consider, for example, item 5. Present RMA standards place the video i.f. at 25.75 mc, while the sound i.f. is 21.25 mc. These signals would hardly be capable of developing sufficient voltages at the receiver input to cause interference in the i.f. channel. The lowest television channel is at 44-50 mc, which is a full 19 mc removed. At the higher frequencies the conditions are even more favorable.

Rejection of image frequencies is important. It is well-known that as long as the intermediate frequency chosen is greater than half the band allotted for transmission, no trouble will be encountered from image frequencies. The thirteen television channels are divided into two groups: those from 44-88 mc and those from 174-216 mc. The width of one band is 44 mc, the other 42. Half of the largest is 22 mc, which is less than the 25.75 mc video i.f. frequency. Hence practically no trouble may be expected from image frequencies.

At high frequencies selectivity contributed by an r.f. stage is low. Fig. 1 illustrates a comparison between the selectivity curves of two receivers, one with, one without an r.f. stage. The only apparent difference occurs at the edges of the band.

The gain of an r.f. stage, in most high-frequency receivers tested, averaged between 5 and 8. A comparable i.f. stage would be capable of a gain of 20 to 30. Hence, from the standpoint of gain alone, an additional i.f. stage would be preferable to an added r.f. stage. It is questionable, too, whether this comparatively small gain would be sufficient to raise an otherwise weak signal to the point where it can produce satisfactory reception. Observers are very sensitive to even slight distortions or poor quality in images. It has been the author's experience that an r.f. stage seldom proved decisive in raising a really weak signal to the point where enjoyable reception became possible.

The foregoing does not infer that no r.f. stages will be incorporated in television receivers. It does mean, however, that the question of whether or not an r.f. stage is to be incorporated must be tempered with the problem on hand. Television is a special design requiring its own solution. An r.f. amplifier will definitely prove helpful in borderline cases, where the additional gain is sufficient to bring the signal in and produce a clear signal. But when the signal is quite weak, an r.f. stage does *not* help it clear the hurdle. In these instances the antenna should either be improved, or else the station forgotten.

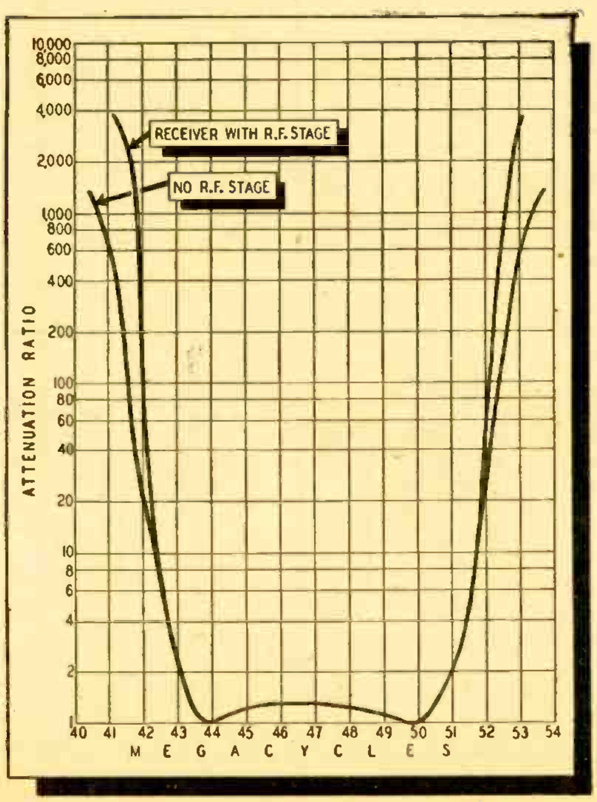


Fig. 1—Increased selectivity due to r.f.

The form of the r.f. stages follows conventional lines. In Fig. 2, we have a typical r.f. stage using any of the newer tubes, such as the 6AU6, the

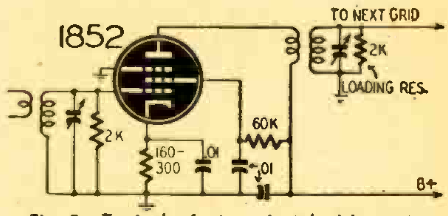


Fig. 2—Typical r.f. stage in television set.

6BA6, 7AG7, or the 6AC7/1852. High G_m and low internal capacitances are the criteria by which such tubes chosen. In fact, these quantities are so important, they are oftentimes combined into a ratio

$$\frac{G_m}{C_{in} + C_{out}}$$

known as the "Figure of Merit."

Because the internal tube capacitance is part of the input tuned circuit, special efforts are made to minimize the inevitable changes that occur in these capacitances with tube operation. One

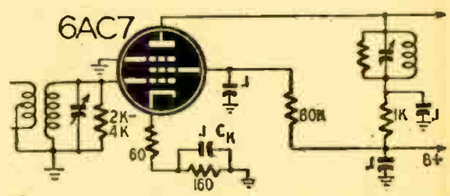


Fig. 3—A small amount of degeneration cuts down the effect of changes in tube capacity.

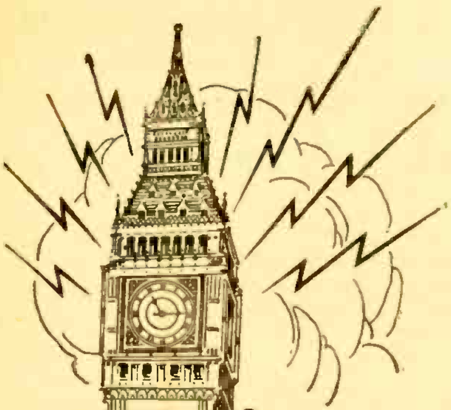
common arrangement is shown in Fig. 3 and consists of a small amount of degeneration introduced by the unbypassed portion of the cathode resistor. In doing this, however, the cathode is no longer directly connected to the condenser C_k and is not at a.c. ground potential. Under these circumstances, the screen condenser and the suppressor grid should be tied directly to ground instead of the cathode itself.

The resistor loading of the tuned circuit flattens out the response, as shown in Fig. 1. Its greatest disadvantage lies in the fact that this likewise decreases the gain. This is the main reason for the low gain of television tuned amplifiers. A tuning circuit, when connected across the output of tube, is essentially in series with the plate resistance of that

(Continued on page 864)

TRANSATLANTIC NEWS

From our European Correspondent, Major Ralph Hallows



IN my last month's notes I mentioned the freak distances sometimes spanned by v.h.f. transmission just now. A remarkable instance occurred here on June 8, when our television service reopened with a broadcast of the victory procession through London. Both sound and vision on frequencies of the order of 42 mc were well received by an amateur enthusiast on a home-built set at Minehead, Somersetshire. Minehead is on the Bristol Channel, over 170 miles from the transmitter at the Alexandra Palace, near London. Between London and Minehead are several ranges of hills and Minehead itself is, one would have thought, heavily screened from the direction of London by the heights of

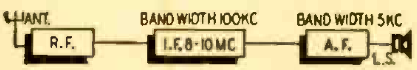


Fig. 1—Diversity reception with one receiver.

Exmoor, at whose foot it lies. There is a lot that we still don't know about the behavior of the meter-waves. Certainly their range may often be a long way beyond the visual horizon, which was once thought to be their limit.

THE TONE-CONTROL PROBLEM

Sometime ago I raised over here the question why in nine out of ten homes one finds the radio receiver operating with the tone control knob turned as far anti-clockwise as it will go. The effect of this in most cases is to cut completely the audio frequencies above about 3,500-4,000 cycles. At first sight the thing is most mysterious. Apart from radio the normal man and woman obviously likes the high-pitched sounds of music. The violinist who does gymnastics in concert hall or music hall on the harmonies of the E string and the soprano who hits high-C are certain to receive rapturous applause. But with his radio set the average listener firmly deprives violinist and soprano of the opportunity of properly hitting any high spots. There must be some scientific reason for this, but no one yet seems to have been able to find it.

The most likely explanation of people's dislike of "top" in radio reproduction is that the effects of many kinds of distortion, particularly harmonic distortion, high-frequency beaming and the results of misaligning preset tuned circuits, are much less distressing when the top is cut. This seems to open a promising field for research and invention, for people want the high audio frequencies, but not as the radio receiver now reproduces them.

STILL PICTURES IN COLOR

The great British telecommunications corporation, Cable & Wireless, conducts world-wide still picture transmission services in addition to its activities in the sphere of telegraphy. It has recently made an outstanding advance in the matter of still pictures in color. Hitherto all such pictures have suffered from one shortcoming which detracted very much from their appeal to the eye. No doubt you have seen many in your illustrated journals and you can hardly have failed to be struck by the undue predominance of greenish-yellow hues in them. The blues, reds and browns are there, but they are to a large extent swamped and the whole picture gives an unpleasing impression of sallowness. I have just lately seen colored stills transmitted between Britain and Australia which are vastly better than anything of the kind produced by any other process. The trouble experienced in the past has been found to be due to what is called the yellow image.

When a still picture in color is transmitted by radio by the four-color process no less than six transmissions of the image have to be made. Four of these are made through colored screens; red, blue, green and yellow. The fifth shows the blacks. The sixth is a kind of key diagram, showing the relative intensity of the tints. From the first five of these the block-maker makes the blocks and with them the printer superimposes one color upon another. Till now a proper balance has been unobtainable, possibly because the yellow tints in the original forced their way, so to speak, on to other images besides the yellow, with the result that the cumulative effect of the successive printings was to give undue emphasis to this color.

V.H.F. DIVERSITY AM TRANSMISSION

A remarkable system of multi-carrier amplitude-modulated radio on frequencies of the order of 100 mc has been developed for the British police and fire fighting services. The first experiments were made with FM, two stations, 28 miles apart being used. Operating on 81.7 mc, with temperature-controlled transmitter crystals, the stations had common modulation applied from a central control point. It was found that there was a large area, the "area of no-capture," in which neither transmitter took complete charge of a mobile receiver and serious distortion of speech took place.

Experiments were therefore made with AM. It was decided not to attempt to synchronize the two carriers, but to

(*Continued on page 873*)

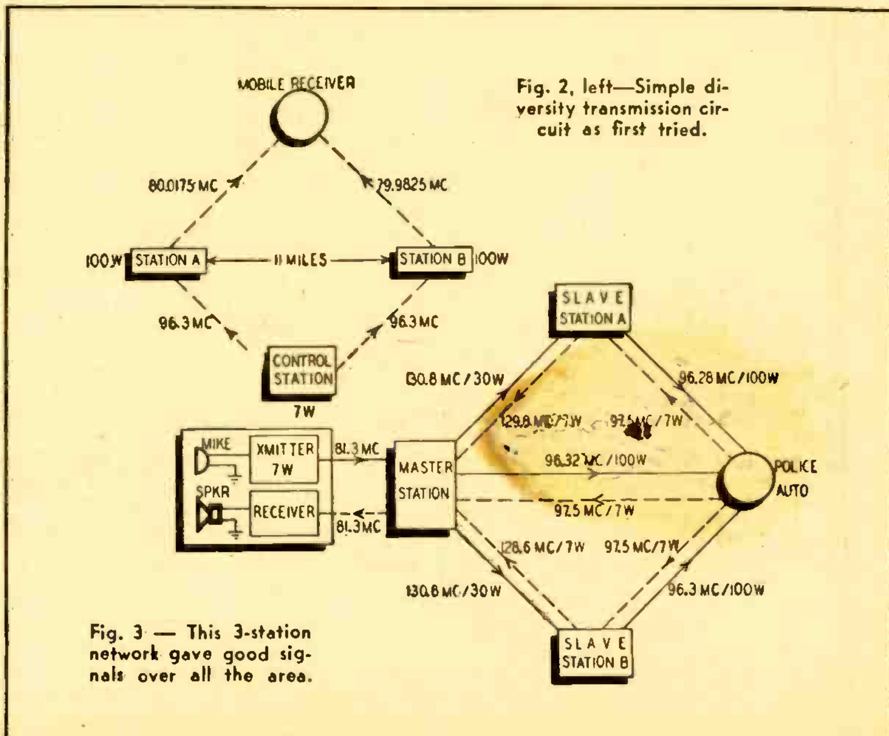


Fig. 2, left—Simple diversity transmission circuit as first tried.

Fig. 3 — This 3-station network gave good signals over all the area.

Edited by ELMER R. FULLER

WORLD-WIDE STATION LIST

FROM Africa the signals of "Radio Dakar" go booming through the ether to the antennas of radio sets the world over. Reports reach the studios daily telling how the station is received in Australia, the British Isles, and the Americas, as well as France, Sweden and the Near East.

For the benefit of those listeners this story has been written by William S. Duggan, Jr., of Goshen, New York; as he saw it in Dakar, at the studios and transmitter site of *Poste Fédéral Radio-Dakar*.

Poste Fédéral Radio-Dakar is supervised and controlled by the French government. Its daily transmissions are confined to the area of Africa known technically as Afrique Occidentale Française. All programs are in the French language, although some discs are cut with English music on them. The studios of the stations are located on the Rue Felix Faure, in the military district of uptown Dakar.

Radio Dakar, using the call letters FGY, operates at present time on two frequencies, namely 25.61 meters (11.715 megacycles) and 43.37 meters (6.917 megacycles) with transmitter powers of 12 kilowatts and 1200 watts respectively. As a general call to all African listeners, the station transmits a carrier wave upon which is superimposed a group of modulated tone signals, which are used to help listeners identify the station. The identification broadcast consists of high-medium-low tones, which are emitted for fifteen minutes prior to the general transmission.

Every general transmission from FGY begins with the playing of the "French Infantry Hymn," which has a duration of three minutes. Transmissions from Radio-Dakar begin each day at 0700 hours GMT (2 am EST), 1200 hours GMT (7 am EST), and 1800 hours GMT (1 pm EST). News in French comes at 0715 to 0730 hours GMT; 1230 to 1245 hours GMT; and from 1930 to 1945 hours GMT. A final

RADIO TERM ILLUSTRATED

"Link Coupling"

broadcast of World Wide news is at 2115 hours GMT. A special programme for the Oualof tribe of Senegal is also broadcast in the service from Radio-Dakar. In tribute to the gallant service of this tribe in the French forces during the 1st World War the program is broadcast at the following times: In French on the 1st Monday of each month at 1235 hours GMT and in the Oualof native tongue on every second Tuesday of the month at 1235 hours GMT.

Transmitter sites for FGY are at Hann, a small village about eight miles from Dakar. The monitoring receiver is a Hallicrafters SX-28 receiver with a Panoramascope of 200 kilocycles bandwidth.

Here is a feature that may be of interest to all of you. Radio-Dakar runs a musical request program every week whose selections are requested by listeners to the service. Those wishing to have their favorite classical or light music played should write to the studios giving the name of the request, along with their name and address. Send all requests to: Musical Request Department; Poste Fédéral Radio-Dakar; Rue Felix Faure; Dakar, Sénégal; Afrique Occidental Française.

All correct reception reports concerning the reception of FGY's signals abroad by listeners are very cordially welcomed and will be verified by letter or postal card. At the present time Radio-Dakar does not have an official printed verification card, but all reports will receive a reply. Please inclose an International Reply Coupon. All reception reports should be addressed to M. LaCroix; Poste Fédéral Radio-Dakar; Rue Felix Faure; Dakar, Sénégal; Afrique Occidental Française.

We wish to thank Mr. Duggan, who was a reporter for this department prior to his service with the armed forces; and the officials of Radio-Dakar, who cooperated with Mr. Duggan in making this information available.

All Schedules are Eastern Standard Time

Location	Station	Frequency	Schedule
EL SALVADOR			
San Salvador	YPSA	10.400	evenings
ENGLAND			
London	GRC	2.880	
London	GRB	6.010	
London	GWS	6.035	
London	GRR	6.070	Central American beam, 8 to 10:15 pm
London	GWM	6.090	
London	GSL	6.110	Near East beam, 11 pm to 12:30 am; Italian beam, 11 pm to 12:30 am
London	GWA	6.125	
London	GRW	6.150	
London	GWK	6.165	
London	GRM	7.120	Australia beam, [illegible] to [illegible]:45 am; New Zealand beam, 1 to 8:45 am
London	GSW	7.230	Indian beam, 9 to 11 pm; Southwestern Pacific beam, 1 to 4 am
London	GWI	7.250	
London	GSU	7.260	North American beam, 7 to 11 pm
London	GRJ	7.320	Northwestern Pacific beam, 11 pm to 12:30 am; Italian beam, 11 pm to 12:30 am; Far Eastern beam, 11 pm to 12:30 am; South American beam, 6 to 10:15 pm; Near East beam, 11 pm to 12:30 am
London	GWF	9.490	
London	GSB	9.510	Near East beam, 11 pm to 12:30 am; 12:15 to 4 pm; South American beam, 4:15 to 10:15 pm; Indian beam, 11 pm to 12:30 am; Ceylon beam, 9 to 11 pm; Middle East beam, 11 pm to 1 am; Italian beam, midnight to 4 am; 12:15 to 4 pm; Southwest Pacific beam, 1 to 4 am
London	GWB	9.550	
London	GSC	9.580	Central American beam, 6 to 10:15 pm; Indian beam, 8 to 9:15 pm
London	GRY	9.600	South African beam, noon to 4 pm; Near East beam, 3 to 4 pm; Far East beam, 11 pm to 2:30 am; Northwest Pacific beam, 11 pm to 1:45 am
London	GWO	9.625	West African beam, 11:30 pm to 1:45 am; 4:15 to 5:45 pm; Mediterranean beam, 12:30 to 1:45 am
London	GVZ	9.640	North American beam, 7 to 11 pm; New Zealand beam, 1 to 5 am
London	GWP	9.660	Far East beam, 8:45 to 10:15 am
London	GRH	9.825	North American beam, 5 to 11 pm; Central and South African beam, 11 pm to 1:45 am; North African beam, 11 pm to 1:45 am
London	GRU	9.915	North African beam, 12:15 to 4 pm; South African beam, 12:15 to 4 pm
London	GRG	11.680	Far East beam, 7 to 9 am; Northwest Pacific beam, 7 to 9:30 am
London	GVW	11.700	Southwest Pacific beam, 1 to 5 am; Indian beam, 11 pm to 1 am; South African beam, 10:30 am to 4 pm; Near East beam, 1 to 4 pm
London	GSD	11.750	South African beam, 12:30 to 3 am; 10:30 am to 4 pm; West African beam, 1 to 3 am; South American beam, 4:15 to 10:15 pm; Central American beam, 4:15 to 9 pm; Mediterranean beam, 1 to 4 am; 6 to 10 am; 10:30 am to 2:30 pm; North African beam, 2 to 4 am; 6 to 10 am; 10:30 am to 4 pm
London	GSN	11.820	West African beam, 3 to 4 pm; New Zealand beam, 1 to 5 am; Australian beam, 1 to 5 am
London	GWQ	11.840	
London	GVX	11.930	North American beam, 5 to 7 am; Far East beam, 11 pm to 4 am; Middle East beam, 12:15 to 2:30 pm
London	GRF	12.095	Near East beam, 1 to 2:15 am; noon to 2:30 pm; Italian beam, 1 to 5 am; 6 to 10 am; 10:30 am to 4:15 pm

(Continued on page 857)

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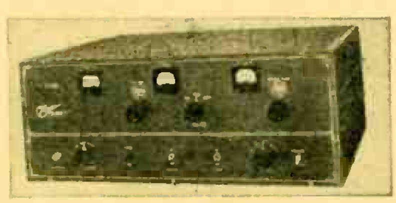
Transmitter Engineering Mfg. Co.
New York, N. Y.

The Temco Model 75-GA transmitter is designed for 75 watt phone—100 watt cw operation on the 3.5, 7, 14, 21 and 28 mc amateur bands.

V.F.O. or crystal control are optional with front-panel switching. The 80-meter v.f.o. and crystal oscillators are followed by doublers and triplers that are switched into the circuit when the band switch is turned to the operating frequency. The intermediate stages have pre-tuned, broadly resonant plate cir-



cuits which do not require tuning. Push-pull-parallel 6L6's are Class AB2 modulators for the TB35 or 3D23 final amplifier. The speech amplifier works from a high impedance crystal or dynamic mike.

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Radio City Products Co., Inc.
New York, N. Y.

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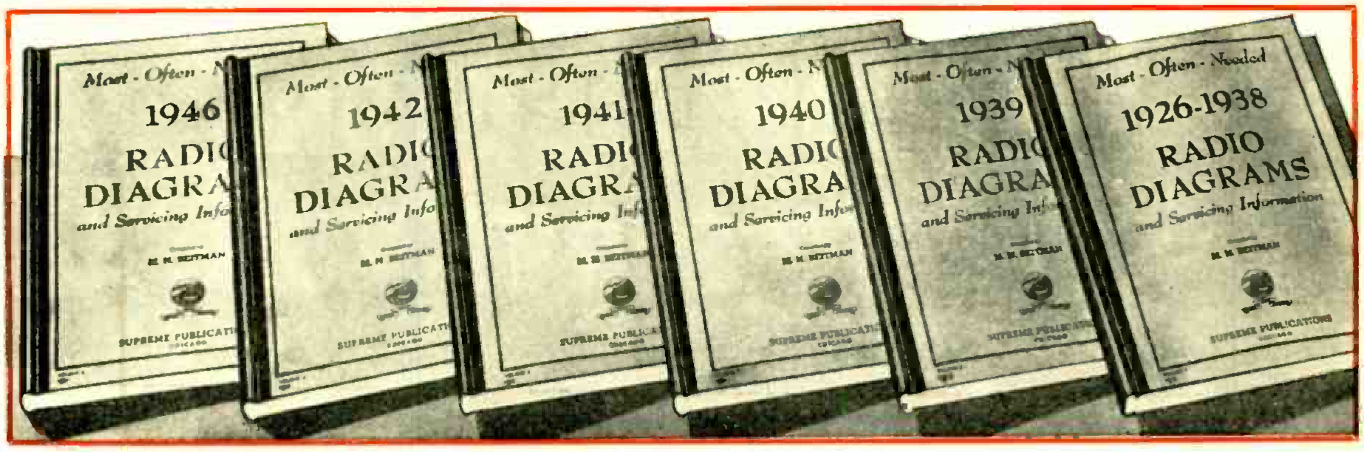

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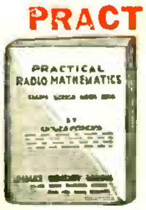

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East Liverpool—Hausfeld Radio
Kent—Kladag Radio Labs.
Lima—The Northwestern Radio Co.
Mansfield—Burroughs Radio
Marion—Bell Radio Supply
Springfield—Standard Radio & Electronic Prod. Co.
Steubenville—D & R Radio Supply
Hausfeld Radio
Toledo—Toledo Radio Specialties
Warren—Radio Specialties
Youngstown—Appliance Wholesalers

OKLAHOMA

Enid—Standard Measuring & Equip. Co.
Oklahoma City—Radio Supply, Inc.
Southern Sales Co.
Tulsa—Radio, Inc.

OREGON

Portland—Bargelt Supply
Harper-Meggee, Inc.
Portland Radio Supply Co.

PENNSYLVANIA

Allentown—Radio Elec. Serv. Co.
Beaver Falls—Reliable Motor Parts Co.
Easton—Radio Elec. Serv. Co.
Erie—John V. Duncombe Co.
Harrisburg—Radio Distributing Co.
Lancaster—Eshelman Supply Co.
George D. Barbey Co.
Norristown—Kratz Bros. Co.
Philadelphia—Almo Radio Company
Consolidated Radio Corp.
Electric Warehouse
Emerson Radio of Pa.
Radio Elec. Serv. Co.
N. W. Cor. 7th & Arch Sts.
5133 Market St.
3145 N. Broad St.
Eugene G. Wile
Pittsburgh—Hamburg Bros.
The John Marshall Co.
Radio Parts Co.
Pottsville—Jones Radio Co.
Reading—George D. Barbey Co.
St. Marys—B & R Electric Co.
Scranton—Broome Dstg. Co., Inc.
Wilkes-Barre—General Radio & Elec. Co.
Radio Service Co.
Williamsport—Williamsport Radio Supply

RHODE ISLAND

Providence—William Dandreta & Co.
W. H. Edwards Co.

SOUTH CAROLINA

Columbia—Dixie Radio Supply Co.

SOUTH DAKOTA

Aberdeen—Danielson & Brost Co.
Sioux Falls—Power City Radio Co.
United Radio Supply

TENNESSEE

Knoxville—Bomar's
Chemcity Radio & Elec. Co.
C. M. McClung & Co.
Memphis—McTyier Radio Supply
Nashville—Currey's Radio Service
Radio & Appliance Corp.

TEXAS

Abilene—R & R Supply Co., Inc.
Amarillo—R & R Supply Co., Inc.
Austin—The Hargis Company
Beaumont—Montague Radio Co.
Corpus Christi—Wicks-DeVilbiss Co.
Electronic Equip. & Engin. Co.
Dallas—All-State Dstg. Co.
Crabtree's Wholesale Radio
Southwest Radio Supply
Wanslow & Co.
Fort Worth—Electronic Equipment Co.
Fort Worth Radio Supply Co.
Houston—A. R. Beyer Company
Lubbock—R & R Supply Co., Inc.
San Antonio—Olsen Radio Supply
Tyler—Lavender Radio Supply Co.
Waco—The Hargis Company
Wichita Falls—Wichita Falls Bat. & Elec.

VIRGINIA

Norfolk—Ashman Distr. Company
Roanoke—Leonard Elec. Sup. Co.
Richmond—Johnston Gasser Co.

WASHINGTON

Bellingham—Waitkus Supply Co.
Seattle—General Radio, Inc.
Harper-Meggee, Inc.
Sunset Electric Co.
Spokane—Harper-Meggee, Inc.
Tacoma—Wible Radio Supply

WEST VIRGINIA

Bluefield—Whitehead Radio Co.
Charleston—Chemcity Radio & Elec. Co.
Hicks Radio Supply
Clarksburg—Trenton Radio Co.
Huntington—Electronic Supply, Inc.
Morgantown—Trenton Radio Co.
Parkersburg—Randle & Hornbrook
Wheeling—Wheeling Radio Supply

WISCONSIN

Green Bay—Neslo Electronic Dstrs.
Madison—Radio Dstrs. of Madison, Wis.
Milwaukee—Radio Parts Co., Inc.

. . *KOOLOHM RESISTORS

*REG. U. S. PAT. OFF.

RADIO STORES SELLING . . . RADIO CRAFT IN YOUR HOME TOWN

ALABAMA
Montgomery
Teague Hardware Co.
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ARIZONA
Phoenix
Radio Specialties & Appl. Co.
401 W. Jackson St.

ARKANSAS
Little Rock
Southern Radio Supply
409 West Third St.

CALIFORNIA
Bakersfield
Bakersfield Radio Supply
2808 Chester Ave.
Hollywood
Yale Radio Electric Co.
6616 Sunset Blvd.
Los Angeles
General News Agency
326 West 5th St.

Papel Bros.
2639 E. 4th St.
San Bernardino
George H. Bagley Co.
1216 D St.
San Diego
Western Radio & Electric Co.
1415 India St.
San Francisco
Associated Radio Dist.
1251 Folsom St.
San Jose
Frank Quement Wholesale Radio
156 W. San Fernando St.
Santa Ana
Radio & Television Equip. Co.
207 Oak St.

COLORADO
Del Norta
Valley Music & Electric Co.
Denver
McGee Radio & Elect. Co.
1330 Broadway

Radio Products Sales Co.
1237 16th St.

CONNECTICUT
Bridgeport
Coastal Radio Service Co.
1559 Stratford Ave.
New Britain
United Radio Supply
53 E. Main St.

DISTRICT OF COLUMBIA
Washington
Capitol Radio Wholesalers
2120-14 St., N.W.
Sun Radio
938 N.W. F St.

FLORIDA
Jacksonville
Radio Parts Co.
712 Main St.

Thurow Distributors, Inc.
806 Main St.
Miami
Thurow Distributors, Inc.
420 S. W. 8th Ave.
Orlando
Thurow Distributors, Inc.
131 South Court St.
Tallahassee
Thurow Distributors, Inc.
213 E. Tennessee
Tampa
Thurow Distributors, Inc.
115-117 So. Franklin St.
West Palm Beach
Thurow Distributors, Inc.
209 No. Olive St.

ILLINOIS
Danville
Allen Electric Co. Radio Supply
109 N. Hazel St.
Chicago
Allied Radio Corp.
833 W. Jackson Blvd.
American Parts, Inc.
610 W. Randolph St.
Concord Radio Corp.
901 W. Jackson Blvd.
Lake Radio Sales Co.
615 W. Randolph St.
Radio Shack
630 W. Randolph St.
Radolek Company
601 W. Randolph St.

INDIANA
Evansville
Castrup's Radio Supplies
1014 W. Franklin St.

Montoux Auto & Machine Co.
517 Locust St.
Hammond
Stanton Radio Supply
521 State St.
South Bend
Commercial Sound & Radio Co.
528 E. Colfax Ave.

IOWA
Burlington
Union Supply Co.
4th & Washington Sts.
Council Bluffs
World Radio Labs.
Dubuque
Boe Distributing Co.
498 N. Grandview
Sioux City
Dukes Radio Co.
114 West 4th St.

Power City Radio Co.
513 7th St.

KANSAS
Pittsburgh
Pittsburgh Radio Supply Co.
103 N. Broadway
Topeka
Acme Radio Supply
516 Quincy St.
Wichita
Interstate Distributors, Inc.
1236 E. Douglas

Radio Supply, Inc.
1125-27 E. Douglas

KENTUCKY
Lexington
Radio Equipment Co.
377 East Main St.

LOUISIANA
Monroe
Hale & McNeil
301 Pine St.
New Orleans
Radio Parts, Inc.
807 Howard Ave.

Walther Bros. Co.
714 Howard Ave.

MAINE
Bangor
Radio Service Laboratory
45 Haymarket Sq.

MARYLAND
Baltimore
Henry O. Berman Co., Inc.
12 E. Lombard St.

Wholesale Radio Parts Co., Inc.
311 W. Baltimore St.

MASSACHUSETTS
Boston
Sager Electrical Supply Co.
201 Congress St.
Melrose
Melrose Sales Co.
407 Franklin St.
New Bedford
C. E. Beckman Co.
Commercial St.
Springfield
Springfield Radio Co., Inc.
405 Dwight St.
Worcester
Radio Electronic Sales Co.
46 Chandler St.

MICHIGAN
Ann Arbor
Purchase Radio & Camera Shop
605 Church St.
Detroit
Hershel Radio
5249 Grand River Ave.

Radio Supply & Eng'er'ng Co., Inc.
129 Selden Ave.
Flint
Radio Tube Mdse Co.
508 Clifford
Jackson
Fulton Radio Supply Co.
707 S. Blackstone St.
Lansing
Electric Products Sales Co.
427 E. Michigan Ave.
Saginaw
Orem Distributing Co.
801 E. Genesee Ave.

Radio Parts Co.
234 S. Second St.

MINNESOTA
Duluth
Northwest Radio
109 E. First St.

MISSOURI
Cape Girardeau
Suedakum Electronic Supply Co.
902 S. Sprigg St.

NEBRASKA
Omaha
Alco Radio, Inc.
411 Cuming St.
All-State Distributing Co.
2857 Farnam St.
Radio Equipment Co.
2820-22 Farnum St.

NEW HAMPSHIRE
Concord
Evans Radio
18 N. Main

NEW JERSEY
Bridgeton
Joe's Radio Shop
67-69 S. Pearl
Newark
Radio Wire Television, Inc.
24 Central Ave.

Variety Electric Co.
601 Broad St.
Trenton
Carl B. Williams
25 S. Warren St.

NEW YORK
Binghamton
Broome Dist. Co.
221 Washington St.
Brooklyn
Green Radio Distributors
482 Sutter Ave.

Hornbeam Distributing Co.
1639 Bedford Ave.
Buffalo
Dymac, Inc.
2929-31 Main St.

Genesee Radio & Parts Co.
205 E. Genesee St.
Jamaica
Peerless Radio Dist. Co.
92-32 Merrick Rd.
Middletown
Roskin Bros., Inc.
23 W. Main St.
Mount Vernon
Davis Radio Dist. Co.
66-70 E. 3rd St.
New York City
Federated Purchaser, Inc.
80 Park Place
Grand Central Radio, Inc.
124 E. 44th St.
Harrison Radio Corp.
12 West Broadway
Harvey Radio Co.
105 W. 43rd St.
Niagara Radio Supply Corp.
160 Greenwich St.
Radio Wire Television, Inc.
100 Sixth Ave.
TAB
6 Church St.
Rochester
Masline Radio & Electric Equipment
192-196 Clinton Ave., N.
Syracuse
Broome Dist. Co.
912 Erie Blvd. E.

Syracuse Radio Supply
238-40 W. Willow St.

NORTH CAROLINA
Charlotte
Henry V. Dick & Co., Inc.
311 E. 5th St.
Goldsboro
Signal Radio Supply
124 S. James St.

OHIO
Cincinnati
Radio & Refrigeration Supply
1220-6 Jackson St.
Cleveland
Northern Ohio Labs.
2073 West 85th St.
Radio Surplus Co.
648 Prospect Ave.
Winterradio, Inc.
1468 W. 25th St.
Dayton
Standard Radio & Elect. Prods.
135 E. Second St.
Steubenville
D. & R. Radio Supply
156 S. 3rd St.

OKLAHOMA
Oklahoma City
Radio Supply, Inc.
724 N. Hudson, Box 597

PENNSYLVANIA
Altoona
Hollenback's Radio Supply
2221 8th Ave.
Kennedy Radio Supply
1500 Fifth Ave.
Beaver Falls
Reliable Motor Parts Co.
1700 7th Ave.
Erie
Jordan Electronic Co.
201 W. 4th St.
Harrisburg
D. & H. Distributing Co., Inc.
311 S. Cameron St.
Lancaster
Eshelman Supply Co.
110 N. Water St.
Philadelphia
Flanagan Radio Corp.
N.E. Cor. 7th & Chestnut Sts.
M & H Sporting Goods Co.
512 Market St.
Radio Electronics Service Co.
7th & Arch Sts.
Reading
Geo. D. Barbey Co.
432 Walnut St.
Scranton
Broome Dist. Co.
26 Lackawanna Ave.
Sharon
Heiges Bros., Inc.
73 Central Way
York
J. R. S. Distributors
646 W. Market St.

SOUTH DAKOTA
Sioux Falls
Power City Radio Co.
209 So. First Ave.

United Radio Supply
211 W. 10th St.

TENNESSEE
Nashville
Frost Electric Inc.
1922 West End Ave.

TEXAS
Dallas
Southwest Radio Supply
1820 N. Harwood
Fort Worth
Ft. Worth Radio Supply Co.
1201 Commerce

The Electronic Equip. Co.
301 E. 5th St.
Houston
R.C. & L.F. Hall
1015 Caroline St.
Laredo
Radio & Electronics Supply Co.
1219 Lincoln St.
Lubbock
R. & R. Supply Co., Inc.
706 Main St.
San Antonio
R. L. Ross Co.
118 Seventh St.
Tyler
Radio Service Supply Co.
111 University Place
Waco
The Hargis Co., Inc.
1305 Austin Ave.

UTAH
Salt Lake City
O'Loughlin's Radio Supply Co.
113 East Broadway

Radio Supply Co.
45 East 4 South

Standard Supply Co.
531 So. State St.

VIRGINIA
Norfolk
Radio Parts Dist. Co.
128 W. Olney Rd.

Radio Supply Co.
711 Granby St.

WASHINGTON
Bellingham
Waitkus Supply Co.
110 Grand Ave.
Seattle
Harper-Megee
960 Republican St.
Spokane
Columbia Electric & Mfg. Co.
P.O. Box 1441 S. 123 Wall St.

Inland Radio Co.
W. 923 First Ave.
Tacoma
C. & G. Radio Supply Co.
714 St. Helens Ave.

A. T. Stewart Co.
743 Broadway

WEST VIRGINIA
Clarksburg
Trenton Radio Co.
791-93 W. Pike St.
East Charleston
Hicks Radio Supply
10 Virginia St.
Parkersburg
John A. Cox Radio Supplies
554 7 St.

WISCONSIN
Appleton
Valley Radio Distributors
518 N. Appleton St.
Hudson
J. H. Larson Co.
109 Walnut St.
Madison
Satterfield Radio Supply Inc.
326 W. Gorham St.
Milwaukee
Acme Radio Supply Corp.
510 N. State St.

Central Radio Parts Co.
1723 West Fond Du Lac Ave.
Racine
Standard Radio Parts Co.
1244 State St.

WYOMING
Casper
Golden Power Oil & Supply Co.
260 S. Center
Cheyenne
Houge Radio & Supply Co.
2008 Carey Ave.

DEALERS: If you are not receiving RADIO-CRAFT, please ask for our Special Consignment Proposition.

NOW AVAILABLE FOR IMMEDIATE SHIPMENT!

The New Model 670

SUPER-METER

A Combination

VOLT-OHM MILLIAMMETER plus CAPACITY REACTANCE INDUCTANCE and DECIBEL MEASUREMENTS

Added Feature:

The Model 670 includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

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 Amperes

RESISTANCE: 0 to 500/100,000 ohms 0 to 10 Megohms
CAPACITY: .001 to .2 Mfd. .1 to 4 Mfd. (Quality test for electrolytics)
REACTANCE: 700 to 27,000 Ohms 13,000 Ohms to 3 Megohms
INDUCTANCE: 1.75 to 70 Henries 35 to 8,000 Henries
DECIBELS: —10 to +18 +10 to +38 +30 to +58

The Model 670 comes housed in a rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 5½" x 7½" x 3".

$28.40 NET

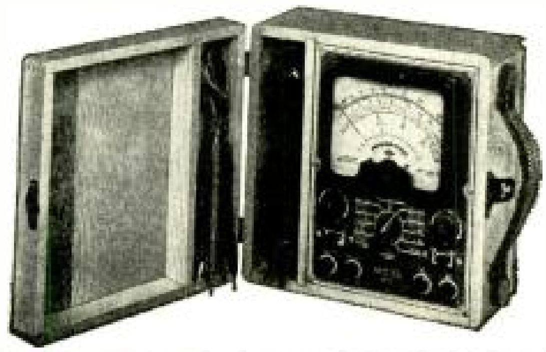
Please place your order with your regular radio parts jobber. If your local jobber cannot supply you, kindly write for a list of jobbers in your State who do distribute our Instruments or send your order directly to us.

Model 670P

The Model 670P is identical to the Model 670 described in detail except housed in a hand-rubbed, portable oak cabinet complete with cover.

The Model 670P comes complete with test leads and all operating instructions.

$35.75 NET



SUPERIOR INSTRUMENTS CO.

Dept. R 227 FULTON ST., NEW YORK 7, N. Y.

IS TELEVISION REALLY HERE?

(Continued from page 821)

mission—as is the case with radio broadcast today—we need a minimum of 1,500 television transmitters. It does not appear that such a program could be possibly realized within even ten years from today. Until such time, mass production of television receivers, to run into the millions, does not seem feasible.

It is true that Westinghouse has proposed their so-called *Stratovision*, whereby a small number of television transmitters, cruising continuously in the stratosphere could blanket the entire country. This, however, is as yet a mere proposal. It is not known if such a scheme is feasible technically and whether or not it could be soon realized. If and when it is and has proven its worth, then, the total number of transmitters and the ten-year estimate mentioned could be cut to a great extent.

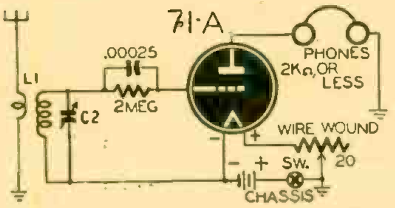
For the present, only a few large centers in this country will conceivably be served by television. The programs will have to be more or less mediocre because highly expensive productions must remain completely out of the picture. The reason: *no advertiser is going to spend millions or even hundreds of thousands of dollars to broadcast to a few thousand television receivers.* Today

(Continued on page 855)

RADIO-ELECTRONIC CIRCUITS

MONO-BATTERY RADIO

This simple receiver does not work well on distant stations but "locals" are pulled in with plenty of volume. Several different tubes have been tried but the 71-A seems to give the best results. No B battery is used and the plate is operated at ground potential. Although the 71-A operates normally with 5 volts on the filament, optimum performance is obtained with only 3 volts.



The tuning condenser and coil may be salvaged from an old broadcast receiver.

EUGENE SKINNER,
Wilton, N. Dak.

(Note: Operation and performance of this unusual circuit will probably be similar to that of a crystal receiver. We would be interested in receiving comments from readers who build this set. *—Editor)*

NOVEL RADIO-INTERCOM

A small home receiver may be converted to a handy intercommunicator unit with the addition of a few simple parts.

The receiver has a conventional second detector and output circuit. The only additional necessary parts are an output transformer, PM speaker, three switches, and a three-conductor line.

The switch on the remote speaker serves to switch on the a.c. to the set. Considerable hum is heard due to running a.c. in the remote line, but this hum serves as an alarm to let us know that we are being called. Before beginning conversation, the set switch may be turned on and the remote one turned off, which will eliminate the hum.

With the s.p.d.t switch, the unit may be used either as a radio or an intercom. To keep the volume full on in case we are called by the remote station, I used a separate set switch and volume control instead of a volume control switch attached.

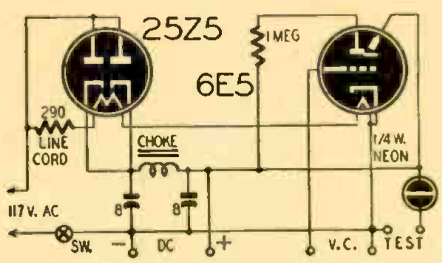
BOB M. MANNING, W8LXA,
Cleveland, Ohio

(The wire that carries the line voltage should be well insulated to prevent short circuits.*—Editor)*

> RADIO-CRAFT *welcomes new and original radio or electronic circuits. Hook-ups which show no advance on or advantages over previously published circuits are not interesting to us. Send in your latest hook-ups—*RADIO-CRAFT *will extend a one-year subscription for each one accepted. Pencil diagrams —with short descriptions of the circuit—will be acceptable, but must be clearly drawn on a good-sized sheet.*

TESTER

Here is a simple output indicator, condenser tester and low voltage power supply that may be constructed very easily.



Condensers are tested by connecting them across the high-voltage leads in series with a small neon bulb. A shorted condenser will cause a steady glow. Good condensers will cause regular intermittent flashes. The frequency of the flashes is determined by the capacity of the condenser. An open condenser will not produce any flashes.

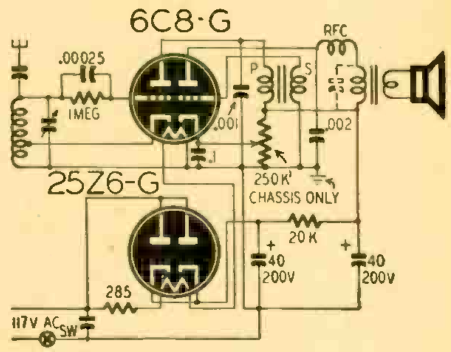
Terminals V and C are connected across the voice coil of a receiver under test and indicate relative audio output.

If a tapped resistor is connected across the positive and negative terminals, the power supply may be used to substitute for B batteries.

NORMAN BROWN,
Whittier, Calif.

KIERSTAD REVISION

I built the reflex radio, described by Mr. Kierstad, on page 355 of the March, 1945 issue and had fairly good results



with the 6A8G detector. Later, I accidentally put a 6C8G in the socket in place of the 6A8G. I got the surprise of my life when the set played with about five times as much volume as when the original tube was used.

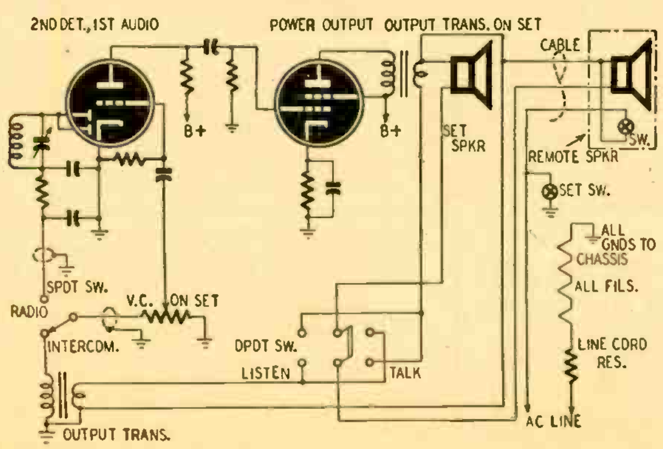
HUGO HEMILLA,
Tarzwell, Ont.

32-VOLT RADIO

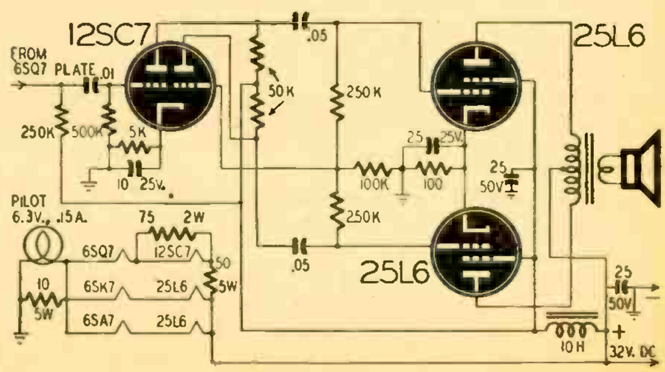
Recently I followed the method described by Mr. Embree, in the June 1945 issue, for converting a 2-volt battery set to operate from a 32-volt d.c. line. I tried the 25L6 transformer coupled to a pair of push-pull 25L6's. The volume was low and the tone quality was poor. Using the circuit shown, I replaced the driver and transformer with a 12SC7 phase inverter. The performance of the set showed marked improvement.

A 50-ohm resistor was placed in series with the filament of the 12SC7 to drop the voltage and a 75-ohm resistor connected across the filament to carry half of the filament current.

ELMER ARMSTRONG,
Smeaton, Sask.



Left—Radio-intercom.
Right—Phase inverter.



IS TELEVISION REALLY HERE?

(Continued from page 853)

there is no real television audience in existence and there is not much likelihood that there will be one for a number of years to come. So much for a few of the complex problems that confront television today.

Again, this is not the whole story. There is for instance the high present cost of television receivers. To sell these by the tens of millions, the price must be low enough to appeal to the great general public in this country. Today the lowest price of video receivers is around $200.00, and for this amount of money you do not get much.

For a really acceptable televisor that throws a fair size clear image, the price is in the neighborhood of $500.* Remember, television receivers are complex. To have both sight and sound you really must have two sets in one; one for video, the other for sound. This alone increases the price a great deal.

It seems improbable at the present state of the television art that the American public would soon be able to absorb 54 million television receivers—even at $200 a set—a quantity necessary to support continuous daily, expensive and elaborate television programs to parallel the high quality broadcast programs current today.

In our estimation, the present *fundamental* television technique is not the final word in the art. *The popular price televisor will not arrive until our entire conception of television has been radically changed.* The means current today are not what television will be in years to come.

We have made this clear editorially for many years past. It is certain that the ultimate solution will not be the present day scanning cathode-ray tube.

We quote from our editorial in the February, 1934, issue of RADIO-CRAFT:

> "This scanning idea, to my mind, is all wrong and totally unnecessary. When the final television invention comes along, one which may be likened to the radio tube of today as compared with the radio crystal of yore, it will be found that the scanning idea is conspicuous by its absence.
>
> "Some thirty million years ago, nature invented the first real television machine which, so far, has not been duplicated by man. I refer, of course, to the animal eye, which has been in existence on this planet for millions of years, and is open for study by all television aspirants.
>
> "The animal eye (which, of course, includes the human eye) is almost a perfect television receiver and transmitter. Not only does it receive an image from the outside world by means of light rays and then transmit it through the optic nerve to the brain, but it goes the television engineer several steps better; because in the first place, the eye gets along marvelously well WITHOUT ANY SCANNING MECHANISM, but the image is received and transmitted in colors as well."

What was said above in 1934 still holds true now, if the television industry is to succeed as has the broadcast industry.

Basically, television as we know it today is technically unsound. Shortly after the year 1800 there was an "automobile" running in the streets in London. It made about two or three miles an hour and was built by James Watt of steam-engine fame. It was as big as a good-sized room, but nevertheless it was an "automobile." It was totally impractical and nothing came of it until Gottlieb Daimler perfected the gasoline internal combustion engine. Then, in 1887, his automobile became the first practical self-propelled road vehicle.

We have always been strong in our belief in television, and are certain that it is here to stay. However, it will slowly evolve as did radio. Nor do we believe that there is a short cut to country-wide, popular television on the horizon.

We wish to emphasize the point that what has been said here pertains *only* to broadcast television and programs *received in the home.* It does not refer to television in the theatre; television in department stores; and television for other commercial purposes, where the high cost of a receiver does not matter. Such specialized receivers are not bought by the millions and therefore are in a class by themselves.

*Dumont, one of the foremost television manufacturers, is selling telecelvers for $1600 and $2400, immediate delivery, and "taking orders" for their "cheap" $600 set, according to recent New York City newspaper advertisements.

TRY THIS ONE

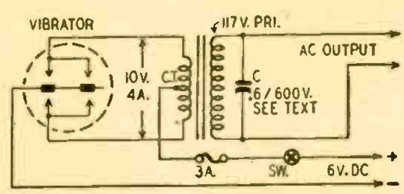
INVERTER FOR SHAVER

Here is a simple inverter that may be used with a 6-volt storage battery to run a 110-volt motor-driven electric shaver.

High voltage is supplied by a 10-volt, 4-ampere filament transformer with its windings connected in reverse. The secondary is connected across the fixed contacts of a vibrator. The primary is used to supply 117-volt a.c. to the shaver. The capacity of the buffer condenser, C, will differ from the value shown when other vibrators are used. Various values of capacity are tried for minimum sparking at the vibrator points. A synchronous vibrator with contacts wired in parallel will operate more efficiently and with less sparking than the non-synchronous type of vibrator.

The voltage output is 125 with no load and 118 volts with full load of 9 watts. The input draws 2 amperes no-load and 2.5 amperes under load (approximately 10 watts for the average shaver).

It is doubtful if this converter will



work with a vibrator-type shaver as the output frequency is in the vicinity of 115 c.p.s.

JAMES A. EASTHAM,
Indianapolis, Ind.

> RADIO-CRAFT wants original kinks from its readers, and will award a one year subscription for each one published. To be accepted, ideas must be new and useful. Send your pet short-cut or new idea in today!

EMERGENCY IRON

Soldering by the carbon arc method has been described previously and needs no further explanation. In tight and inaccessible places I find the following method useful.

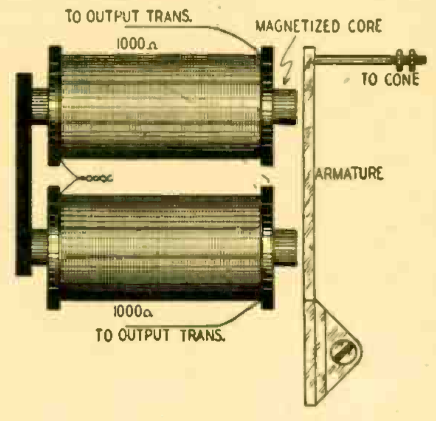
Connect two leads, with alligator clips on each end, to 5 volts a.c. Insert a small hard carbon motor brush in one clip. Connect the other clip to the solder several inches from the end. Touch the brush and solder to the joint to be soldered. For best results, the brush and solder should not make direct contact with each other.

ALBERT SPARKS,
Oklahoma City, Okla.

LOUDSPEAKER

While thumbing through the October issue of RADIO-CRAFT I saw Mr. Youngman's description of a door buzzer made from an old loudspeaker. The editor's note—suggesting that a radioman would prefer to reverse the process—reminded me of a small speaker that I once constructed from an old door buzzer.

I removed the core from the coils and replaced it with short lengths of spring



steel wire. This wire was then magnetized. The coils were rewound with fine wire to a resistance of about 2000 ohms. A small rod was soldered to the armature and fastened to an old speaker cone. Obviously, the armature adjusting screw was not needed so was removed.

RONALD G. BERLYN,
Ballarat, Australia

DIAL CORDS

Dial cords are often hard to replace on receivers that use a number of pulleys placed in almost inaccessible positions. The method described here may be used, in many of these cases, for a quick and accurate replacement on problem receivers.

Attach two pieces of cord to the proper places on the dial drum. Thread the free ends around the pulleys and bring them out to a point where they may be tied with a square knot. Saturate the knot with coil dope or Duco cement and clip the ends.

OTTO WOOLLEY,
Colo. Springs, Colo.

(Note: The knot should be small enough to run freely in the pulleys so that it will not jam or throw the cord off the track.—*Editor)*

COOL RESISTORS

Hollow high-wattage resistors run much cooler when mounted on a long brass screw fastened to the chassis.

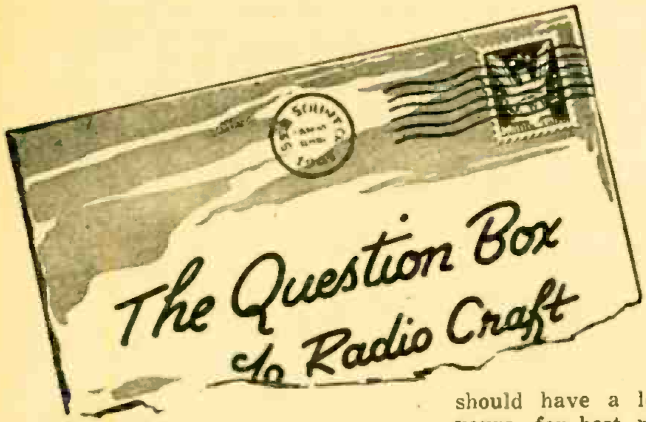
PETER S. WALTNER,
Inglewood, Calif.

WORLD-WIDE STATION LIST

(Continued from page 842)

Location	Station	Frequency and Schedule	
London	GWG	15.110	West African beam, 1 to 4 pm; Far East beam, 1 to 8:30 am; Southwestern Pacific beam, 1 to 5 am; Northwestern Pacific beam, 1 to 10:15 am
London	GSF	15.140	West African beam, 2:30 to 4:15 pm; Indian beam, 12:30 to 4 am; 5 to 10:15 am
London	GSO	15.180	Italian beam, 4 to 10 am; Central American beam, 4 to 5:45 pm; Near East beam, 12:30 to 5 am; 6 to 10 am; 10.30 am to 2:30 pm
London	GSI	15.260	South African beam, 10:30 am to 2 pm
London	GWR	15.300	Near East beam, 5 to 6 am; South American beam, 3 to 5:45 pm; Middle East beam, 12:30 to 1:45 am
London	GSP	15.310	North American beam, 4:15 pm to 7:45 pm; 6 to 8:15 am; Australian beam, 1 to 5 am; New Zealand beam, 1 to 5 am
London	GRE	15.375	
London	GRD	15.450	African beam, 10:30 am to 2:30 pm
London	GVP	17.700	Middle East beam, 1 to 5 am; 6 to 10 am; 10:30 am to 12:15 pm
London	GRA	17.715	New Zealand and Australian beam, 2:30 to 5 am
London	GVQ	17:730	Near East beam, 6 am to noon; Central American beam, noon to 4 pm; 6 to 8:30 am; Far East beam, 2 to 6 am; Indian beam, 2 to 5 am; Southwest Pacific beam, 2 to 5 am
London	GSG	17.790	New Zealand beam, 2:30 to 5 am
London	GSV	17.810	South African beam, 1 to 4 am; Indian beam, 5 to 10:15 pm; West African beam, 2 to 4 am
London	GPP	17.870	Northwest Pacific beam, 1 to 5 am; 6 to 8:15 am; South African beam, 10:30 am to 12:45 pm
London	GRQ	18.025	South African beam, 5 to 9 am; 10 am to 12:15 pm; West African beam, 5 to 9 am; 10 am to 2:30 pm
London	GVO	18.080	North American beam, 8 am to 6:45 pm; South American beam, noon to 4:15 pm
London	GSH	21.470	South African beam, 5 to 10:15 am; Near East beam, 5 to 10:15 am; West African beam, 5 to 10:15 am
London	GSJ	21.530	Indian beam, 5 to 8:15 am
London	GST	21.550	
London	GRZ	21.640	Central American beam, 8:30 to 10:15 am
London	GVS	21.710	South American beam, 6 to 10:15 am
London	GVT	21.750	
London	GSQ	25.750	
London	GSK	26.100	South African beam, 6:15 to 10:15 am; West African beam, 6:15 to 10:15 am
London	GSR	26.400	
London	GSS	26.550	
ETHIOPIA			
Addis Ababa		4.965	10:30 to 11:30 am
FIJI ISLANDS			
Suva	VPD2	6.130	Sundays, 1 to 5 am; other days, 3 to 4 pm
FINLAND			
Lahiti	OIX5	17.800	8 am to 12:30 pm
FRANCE			
Paris		9.520	North American beam, 12:30 to 12:45 am; 1 tq 1:15 am

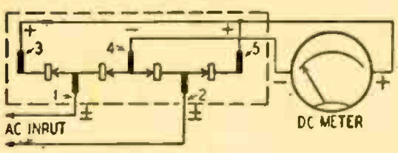
(Continued on page 862)



The Question Box is again undertaking to answer a limited number of questions. Queries will be answered by mail and those of general interest will be printed in the magazine. A fee of 50c will be charged for simple questions requiring no schematics. Write for estimate on such questions as may require diagrams or considerable research.

METER RECTIFIER

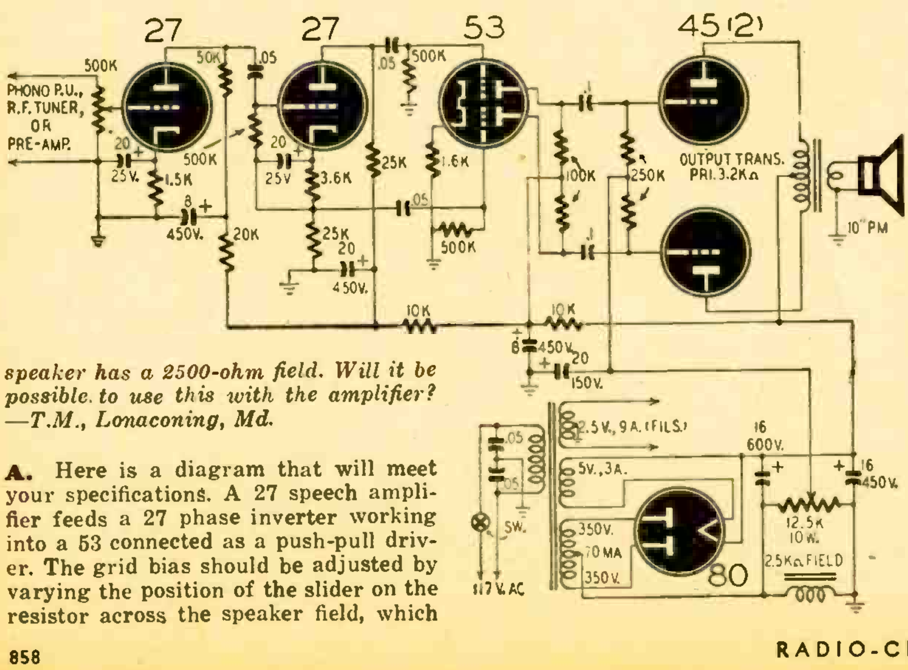
? *I have purchased a copper-oxide rectifier to use with my d.c. meter but have received no instructions for connecting it into the meter circuit. This rectifier has five terminals and is designed to pass 20 ma at 4 volts a.c. Please print a diagram showing how this device is connected to the meter.—C.C.M., Cleveland, Ohio.*



A. A meter-rectifier circuit is shown in the accompanying diagram. The a.c. terminals are usually the ones on either side of the center terminal. In many rectifiers, the end terminals will be connected internally and there will only be four terminals on the unit. The a.c. terminals may be identified with an ohmmeter. The resistance between these terminals will be very high regardless of the polarity of test leads.

P. A. AMPLIFIER

? *Please print a diagram of a medium power public address amplifier using a pair of push-pull 45's in the output stage. I have two 27's and a 53 that I would like to use in other stages. My speaker has a 2500-ohm field. Will it be possible to use this with the amplifier?—T.M., Lonaconing, Md.*



A. Here is a diagram that will meet your specifications. A 27 speech amplifier feeds a 27 phase inverter working into a 53 connected as a push-pull driver. The grid bias should be adjusted by varying the position of the slider on the resistor across the speaker field, which should have a lower resistance than yours, for best results.

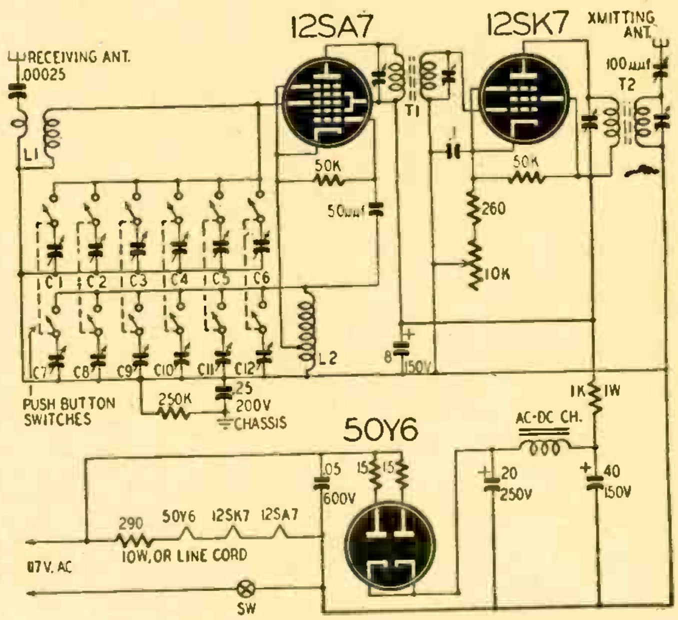
This amplifier will work well with a phonograph pickup or r.f. tuner but it is recommended that a preamplifier be used when working from a crystal or dynamic microphone.

WIRELESS TUNER

? *I would like to have a diagram of a wireless push-button tuner to use with my broadcast receiver. I would like to operate this device from an a.c.-d.c. power supply so that it can be built as compactly as possible.—E.S.C., Collingdale, Penna.*

A. The diagram shown should meet your requirements. It is equipped with six push - buttons which will allow you to tune in any one of six - pre - selected stations.

T1 and T2 are standard i.f. transformers which may be tuned to frequencies between 550 and 600 kc. It may be necessary to remove several turns of wire from each of the coils or reduce the size of the i.f. tuning condensers to reach this range with some transformers. When using this tuner to select stations from a remote point, the receiver should be tuned to the same frequency as the i.f. coils.



32-VOLT D.C. TRANSFORMER

? *Please publish winding data for a power transformer to supply 90 volts from a 32-volt d.c. storage battery. I plan to use a 32-volt synchronous vibrator.—E.R., Mandan, N. D.*

A. You may wind your own transformer on a 1-inch square core as follows: Primary, 300 turns, center-tapped, No. 28 enamel wire. The secondary is wound with 1020 turns, center-tapped, No. 32 to No. 34 enamel wire. This design will give 40 to 50 milliamperes at the rated voltage. If the voltage is too high a resistor may be placed in the B-plus lead or a choke-input filter used.

Note well that the "window" must be large enough to hold the windings, something often overlooked by a beginner.

A reference article, "Practical Transformer Design," appeared in the Sept.-Oct. 1942 issue of RADIO-CRAFT. It described how to calculate core sizes for given wattages, estimating the window space needed, and how actually to put the windings on the form.

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK

Founder

Modern Electrics	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Radio-Craft	1929
Short-Wave Craft	1930
Wireless Association of America	1908

Some of the larger libraries in the country still have copies of MODERN ELECTRICS on file for interested readers.

From the September, 1911, issue of MODERN ELECTRICS.

Wireless On the Motor Boat, by *Richard H. Foster.*

High Powered Condensers, by *Frank C. Perkins.*

Improvement on Loose-Coupled Tuning Coils, by *P. Mertz.*

Helix Insulation, Water Resistor, and Battery Economizing, by *E. Jay Quinby.*

Another System of Wireless Telegraphy and Telephony, by *John B. Brady.*

A Sending Condenser, by *H. V. Roome.*

The Legality of "Wireless Tapping," by *Stanley McClatchie.*

Ducretet Rotary Spark Gap. Long Range Potentiometer. Transmitting Pictures Wirelessly. A Novel (variable) Condenser. High Pitch Spark Producer, by *Robert E. Smith.*

Increasing Sensitiveness of (headphone) Receivers, by *Earl Clifford.*

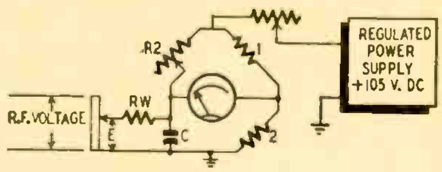
NEW RADIO-ELECTRONIC PATENTS

Edited by I. QUEEN

UHF MEASUREMENT

Ralph W. George, Riverhead, N. Y.
Patent No. 2,399,481

THE measurement of u.h.f. voltage is a very difficult process. At the microwave frequencies, an accurate measurement is not generally possible with conventional apparatus. The invention described here requires only a special wire element and an ordinary bridge circuit and power supply. It is effective up to several thousand megacycles.



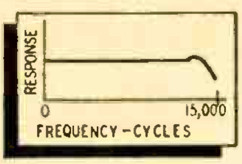
One arm of the bridge is a platinum or wollaston wire only ⅛" long and .1 mil in diameter, having an approximate resistance of 73 ohms at room temperature. The arms 1 and 2 are fixed resistors and R2 is adjustable. The condenser C serves to by-pass the r.f. currents so that they do not enter other parts of the bridge. A regulated power supply is desirable to energize the bridge.

To operate the circuit, the bridge is first balanced with no r.f. through RW. When the current is turned on, it heats the small platinum wire and therefore causes its resistance to increase, unbalancing the bridge. In order to determine the exact value of voltage, a known source of d.c. is substituted for the r.f. and its potential is adjusted until the same deflection is obtained on the microammeter. The two voltages are then equal.

HIGH FIDELITY AMPLIFIER

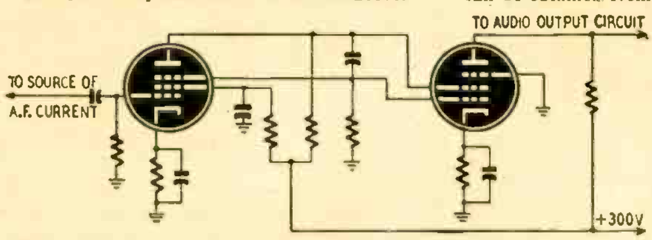
James B. Crawley, Camden, N. J.
Patent No. 2,400,919

THIS is an unusual 2-tube amplifier which shows excellent fidelity to almost 15,000 cycles per second.



The first tube is direct coupled to the screen-grid of the second in addition to capacitance coupling to the control-grid. Degenerative feedback is accomplished through the same condenser by coupling the plate and suppressor of the first tube. Further negative feedback results because the screen of the second tube is not by-passed to ground. Note that these effects are secured without using additional components beyond those generally required for other amplifiers.

A typical response curve is shown above.



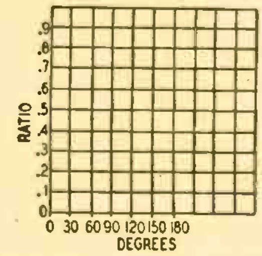
STANDING WAVE INDICATION

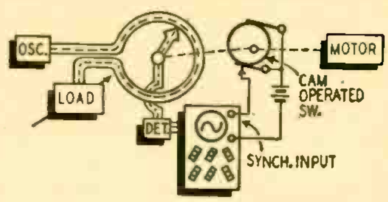
Donald W. Peterson, Princeton, N. J.
Patent No. 2,400,597

THE most important measurement which concerns antenna design is that of standing wave ratios. An impedance mismatch results in the existence of standing waves along the transmission line. Therefore, it is necessary to reduce them for maximum power output. One possible method consists of using a v.t.v.m. arranged to slide along the line while the ratio of maximum-to-minimum-voltage is noted. This is a very inconvenient method, especially with coaxial line.

To simplify the process, a portion of the coaxial line is arranged in circular form. A movable arm containing a probe contacts the internal conductor and feeds the voltage to a detector, whose output is indicated as a vertical deflection on an oscilloscope. The variable arm is operated by a motor which also controls a switching cam as shown.

During each revolution of the arm, the cam switch is closed once. This provides the horizontal synchronizing pulse which starts the horizontal deflection. As a result, the pattern shows the relative voltage at each point of the circular coaxial line. A celluloid screen marked off in angles as shown makes it convenient to interpret the standing waves. Gain and deflection controls are adjusted until a full wave covers 180 degrees. The pattern may be observed while necessary adjustments are made.

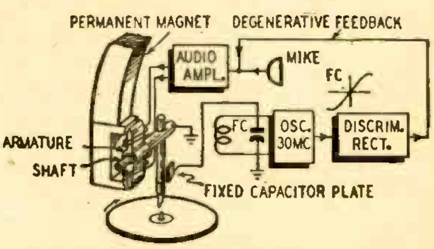




HIGH FIDELITY DISC RECORDING

Henry E. Roys, Indianapolis, Ind.
Patent No. 2,400,953

NEGATIVE feedback is widely used in electrical and mechanical systems for the reduction of distortion. Greatly increased fidelity can be obtained from a disc recording system by the use of negative feedback. For best results it should include not only the amplifier but the vibrating stylus as well.



One possible connection uses a coil in which the stylus induces a voltage to be fed back to the amplifier in proper phase. This has a tendency to cause undesired coupling with the recording coil besides adding mass to the vibrating system, another undesirable feature.

An effective solution is the use of FM to derive the negative feedback voltage. A small capacitor plate is used in conjunction (but not in contact) with the stylus. Vibration of the latter modulates the frequency of a high-frequency oscillator (for example 30 mc.). The modulated output is applied to a discriminator and this audio voltage can be used as negative feedback.

RADIO TEST EQUIPMENT

(Continued from page 838)

point at the *right end* of the scale calibration.

DECIBEL READINGS

Most volt-ohm-milliammeters have decibel scales printed on them. Decibel meters are a.c. voltmeters having calibrations that are converted from a.c. voltage readings developed across a specified impedance line and having a stated reference level to decibel equivalents. These readings are usually based on the reference level: Zero Decibels = .006 watts (6 milliwatts) into a 500-ohm impedance line. If the line impedance is other than 500 ohms or if the reference level should be other than 6 milliwatts, *these readings are valueless.*

Fig. 8 is a chart for adapting any a.c. meter having a 15-volt, 150-volt, or 1500-volt a.c. range to a decibel meter: For 15-volt range read db directly. For 150-volt range add + 20 db to db scale. For 1500-volt range add + 40 db to db scale.

The author has endeavored to describe the workings of volt-ohm-milliammeters so that anyone with a knowledge of electrical theory and terms may understand them. The workings of more complex test equipment such as signal generators, signal tracers and vacuum tube voltmeters, have been amply presented in previous articles in this magazine, and in books published on these subjects.

WORLD-WIDE STATION LIST

(Continued from page 857)

Location	Station	Frequency	Schedule
Paris		9.540	midnight to 12:15 am; 12:30 to 12:45 am; 1 to 1:15 am
Paris		11.845	8 to 9:45 pm; 10 to 10:45 pm; 11 to 11:45 pm; midnight to 3 am; noon to 5 pm; 5:30 to 7:30 pm
Paris		15.350	6 to 8 am
Paris		17.765	6 to 8 am
FRENCH EQUATORIAL AFRICA			
Brazzaville	FZI	6.023	4 to 8 pm; midnight to 1:30 am
Brazzaville	FZI	9.440	11 am to 8 pm; midnight to 2:30 am
Brazzaville	FZI	11.970	11 am to 6:45 pm; midnight to 2:30 am
Brazzaville	FZI	15.595	4:45 to 8 am
Brazzaville	FZI	17.527	midnight to 2:30 am; 4:45 to 7:45 am; 11 am to 5 pm
FRENCH WEST AFRICA			
Dakar		8.840	afternoons till 4:30 pm
GERMANY			
Munich		6.160	11 pm to 2 am
Munich		7.265	11 pm to 2 am; noon to 4 pm
GREECE			
Athens	SVM	9.930	heard 1 to 6 pm
GUADELOUPE			
Pointe-a-Pitre	GRAH	7.215	6 to 7:30 pm
GUAM	KU5Q	9.140	heard at 7 am
Guam	KU5Q	9.330	8 am
Guam	KUIG	10.510	heard calling NBC around 5:30 pm
Guam	KU5Q	12.255	5 am; 7 pm to midnight
Guam	KU5Q	15.920	7 pm to midnight
GUATEMALA			
Guatemala City	TG2	6.220	6 to 11 pm
Guatemala City	TGWB	6.465	8 am to noon; 6:30 pm to 1 am
Guatemala City	TGWA	9.685	Sunday evenings
Guatemala City	TGWA	15.170	daytime transmissions
HAITI			
Port au Prince	HHCM	6.165	5 to 8:30 am; 11 am to 2 pm; 5 to 9 pm
Port au Prince	HHBM	9.660	5 to 8:30 am; 11 am to 2 pm; 5 to 9 pm
HAWAII			
Honolulu	KRHO	6.120	Oriental beam, 4 to 9:45 am
Honolulu	KRHO	17.800	Philippine beam, 4 to 11:30 am
HONDURAS			
La Ceiba	HRD2	6.235	7:30 to 10 pm
San Pedro Sula	HRPI	6.357	6 to 7:30 am; 6:30 to 10:30 pm
Tagucigalpa	HRN	5.875	8 to 10 am; 6 to 11 pm
HONG KONG			
Victoria	ZBW	9.495	4:30 to 8:30 am
HUNGARY			
Budapest	HAT4	9.125	
ICELAND			
Reykjavik	TFJ	12.265	8 to 9 am; 3 to 6:30 pm
INDIA			
Delhi	VUD3	3.340	11 to 11:45 am
Delhi	VUD3	7.290	7:30 to 10:30 am; 9 to 10 pm
Delhi	VUD8	7.275	6 to 7 am; 11:15 am to 1:15 pm; 6:30 to 7:15 pm; 9 to 10 pm
Delhi	VUD4	9.590	8 to 10:50 pm; 1 to 4 am; 5:30 to 7 am; 7:45 am to 3:45 pm
Delhi	VUD10	9.670	7:20 to 11:30 am
Delhi	VUD3	15.290	6 to 7:15 am
Delhi	VUD10	17.830	5 to 7 am
IRAN			
Teheran	EQB	6.155	9 am to 2:30 pm; 8 to 8:30 pm
Teheran	EQC	9.680	noon to 2:30 pm
IRAQ			
Bagdad	HNF	9.800	8 am to 3 pm
IRELAND			
Athlone		9.595	4:10 to 4:30 pm
ITALY			
Milan	AFRS	6.135	11:30 am to 4:30 pm
JAPAN			
Tokyo	JZI	9.535	6 to 7:15 am
Tokyo	JVW2	9.675	2 to 5 am; 5:30 to 7:15 am; 7:30 to 9:40 am; 9:55 to 11:40 am; noon to 1:40 pm; 4:30 to 6:45 pm
Tokyo	JVW3	11.725	heard at 1 pm
Tokyo	JZJ	11.800	8 to 9 am
Tokyo	JVU3	11.897	5:45 to 11:30 am
Tokyo		15.105	heard at 7:30 pm
Tokyo	JZK	15.160	heard at 7:30 pm
Tokyo	JTL3	15.225	5:15 to 7:15 pm
Tokyo	JLP2	15.325	10:45 pm to 3 am
LEBANON			
Beirut	FXE	8.030	11 pm to 5:30 am
LUXEMBOURG	MCH	6.020	midnight to 3:30 am; 5 to 8:30 am; noon to 6 pm
Luxembourg	MCH	9.610	irregular
Luxembourg	MCH	11.115	
MARTINQUE			
Ft. de France		9.705	heard at 5:30 pm
MALAYA			
Singapore		7.220	11:30 pm to 1:30 am; 3:30 to 5 am; 5:30 to 10:35 am
Singapore		9.548	8 to 9:30 am
Singapore		11.855	8 to 9:30 am
MEXICO			
Guadalajara	XEJG	4.820	heard at 8:30 pm
Mexico City	XEBT	6.000	8:45 am to midnight
Mexico City	XEWW	9.500	8 am to 2 am
Mexico City	XERQ	9.540	evenings
Mexico City	XETT	9.555	
Mexico City	XEYU	9.600	late afternoons and evenings
Mexico City	XEQQ	9.680	evenings
Mexico City		11.950	evenings
Mexico City	XEUW	6.023	7 am to 12:45 am
MOROCCO			
Rabat	CNR3	9.082	2 to 5 pm; midnight to 3 am
MOZAMBIQUE			
Marquis	CR7BH	11.718	
NETHERLANDS			
Eindhoven	PCJ	9.590	2 to 3 pm; 8 to 9 pm
NETHERLAND INDIES			
Bandoeng		5.400	early mornings
NEW CALEDONIA			
Noumea	FK8AA	6.205	2:30 to 4 am; 4:30 to 5 am
NEWFOUNDLAND			
St. Johns	VONH	5.970	10 am to 2 pm; 3 to 10 pm
NEW ZEALAND			
Wellington	ZLT7	6.715	4:25 to 4:45 am
NICARAGUA			
Managua	YNDS	6.760	8 to 10 am; 5 pm to midnight
Managua	YNQW	6.910	6 to 10 am; 1 to 11 pm
Managua	YNBH	7.008	6 to 10 pm
NOVA SCOTIA			
Sydney	CJCX	6.010	5 pm to midnight
Halifax	CHNX	6.130	7 am to 11 pm
PALESTINE			
Jerusalem	JCKW	7.220	10:30 pm to 3 pm
PANAMA			
Panama City	HP5H	6.122	6 to 10:30 pm
Panama City	HP5A	11.696	7 am to 11 pm
Panama City	HP5G	11.780	daytimes and evenings
PERU			
Lima	OAX4Z	5.895	4:30 to 11:30 pm
Inca	OAX5C	9.785	evenings
PHILIPPINES			
Manila	PY	9.305	5 to 7 am; 11 to 11:30 pm
Manila	PY2	11.640	6:30 to 7:15 am; evenings
PORTUGAL			
Lisbon	CSX	6.370	3:30 to 7 pm
Lisbon	CSW7	9.735	7 to 8 pm
Lisbon	CSX	11.995	7 to 9 am
Lisbon	CSW	12.070	heard 1:30 to 3 pm

AUDIO MIXER DESIGN

(*Continued from page* 835)

It should be noted here that standard procedure must be followed in all equipment patching, especially if the circuit into which the patch is being inserted is already in use.

Correct procedure is to insert the "cold" end of the patch-cord *first*, that is, to complete all composite patching, and then patch from the composite output *to* the required input circuit, never in the reverse manner. The tip of a patch-cord plug is momentarily shorted as it passes through the grounded frame of the strip jack, and if the opposite end of the cord is energized, the result is unnecessary interruption of the program.

An example of a straightforward control panel is shown on page 835. It is the conventional type used at most average broadcast stations, in which key switches and variable attenuators are used in each mixing position. Beginning at the extreme left of the panel, at least four channels are provided for microphones, a minimum of two for transcription reproducing equipment, one for network, one or more for remotes, and one position left as a master mixer. A line-reversing switch to reverse the input and output of the network amplifier when feeds originate locally may or may not be located on the console, depending on individual needs. Utility, talk-back, line and monitor cue keys are provided as desired. Indicating lamps provide visual indication of control.

The line key energizes a set or bank of relays which connect the program amplifier to the broadcast loop, operate an "On the Air" studio light, and energize a "Standby" light at Master Control. Operating the proper studio key at Master Control lights an indicator lamp in the control room, completes the loop circuit and places the studio "On the Air".

With a Talk-Back key, conversations may be carried on between the studio and control room. This is done only when the studio line key is not energized (at rehearsal times) to avoid the possibility of program cross-talk. In some cases, where the talk-back unit is included as a part of the studio control circuit, the entire talk-back unit is rendered inactive by operation of the studio line key, and remains so as long as the studio is "On the Air". In other systems, a patch-cord is used to complete the talk-back circuit, and proper usage is left to the discretion of the operator.

The more complex control boards employed in larger stations and in network studios often make use of automatic interlock switching circuits, by means of which any number of separate or composite programs may be pre-set and automatically switched in at the proper time. Individual cue or monitor positions are provided whereby program levels, quality, and the required amount of line equalization may be quickly determined prior to air time.

TELEVISION FOR TODAY

(*Continued from page 840*)

tube. See Fig. 4. With a low value shunting resistor, Z_l of the expression:

$$Gain = G_m \times Z_l$$

becomes low and with it, the gain. Incidentally, this equation demonstrates why high G_m values are desirable.

Sometimes designers use elaborate interstage coupling networks to achieve the desired selectivity without lowering the gain by excessive resistor loading. Two such possible coupling units between the r.f. stage and the mixer are shown in Fig. 5. The variable condensers in these tuning circuits are of the trimmer variety, pre-set by the manufacturer. For each station a separate unit is connected into the circuit by the station selector, which may be of the push-button or rotary type. Tuning of the type employed on the majority of sound receivers is manifestly impossible for television with its 6 mc bandwidth. Imagine the confusion of a layman trying to center the station with 6 mc to play around in. Hence the pre-set push-button or rotary type of tuning. Fig. 6, printed by courtesy of the

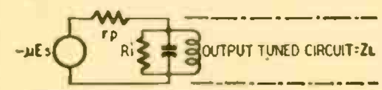


Fig. 4—Equivalent of tube output circuit.

American Television Laboratories, shows the switching arrangement of a television receiver.

CONVERTERS AND MIXERS

To take advantage of the benefits of the superheterodyne, it is necessary to convert the incoming signal to the lower intermediate frequency. For this we have *converters*, where the mixing and the oscillator voltage generation are confined to one tube, or *mixers*, with a separate oscillator. If we attempt to use any of the conventional pentagrid converters (6A7, 6A8, 6D8, 6L7, 6SA7) undesirable interaction occurs between signal and oscillator. This generally becomes noticeable at about 60 mc, with the result that not only does the oscillator output voltage vary, but more im-

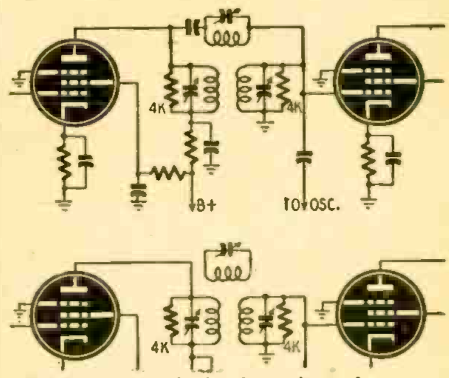


Fig. 5—Two methods of coupling r.f. stages.

portant, the oscillator *frequency*. More desirable, but still not totally satisfactory, is the triode-hexode converter, the 6K8. Here the oscillator voltage is developed in a separate section of the tube (See Fig. 7). This, to some extent, shields the oscillator from the direct influence of the signal.

The best solution is the use of a separate oscillator (generally a triode) and a pentode mixer. Not only does this completely separate the two from each other, but it permits the use of a pentode for a mixer, with a subsequent decrease in noise level. With conventional design, the amount of noise generated in a pentagrid converter, as compared with a pentode, is in the ratio of 4 to 1. Thus, the converter sets a higher minimum level and naturally lowers the sensitivity of a receiver. As far as noise is concerned, triode mixers would represent an even better choice than pentodes, but when we consider the problem of regeneration due to C_{gp}, we find that pentodes are more desirable.

When a separate mixer tube is employed, the injection of the oscillator voltage may be made at the control grid, cathode, screen, or suppressor grids of the pentode. The most likely place is the cathode permitting simultaneous control of both the grid and plate circuits. Another good point of injection is at the control grid, although not as favorable as the cathode. The remaining two grids, screen and suppressor, are seldom used because of the increased driving voltage required. Several typical coupling circuits for control grid and cathode injection are shown in Fig. 8.

TYPES OF OSCILLATORS

Four common circuits have been used for the oscillator in the majority of sets. These are the familiar Hartley; its modification, the electron-coupled Hartley; the tuned-grid tickler oscillator and the Colpitts (or a modification, the ultraudion). In previous commercial models, the 6J5 has been widely used, although any tube possessing low internal shunting capacities, a high value of G_m and ability to function at the higher frequencies is suitable. Triodes are preferred because they require but one regulated voltage; pentodes need two. The switching arrangement in the oscillator section of Fig. 6 is a good example of how various coils and small trimmer condensers are tapped in with each change of frequency. These units are all pre-set and tune the oscillator to the proper frequency for each band.

Great stress is given to oscillator stability, because in a television set, recommended stability of ± 0.01 percent *must be maintained.* Nothing is more annoying than to see the image become distorted due to a shifting oscillator during the course of a broadcast. Because the main tuning control is fixed,

(Continued on page 870)

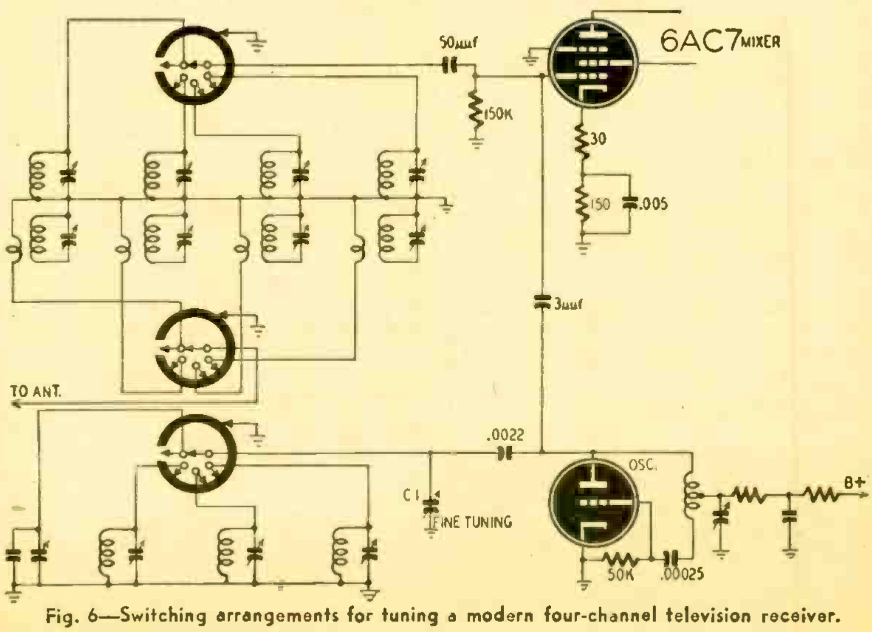


Fig. 6—Switching arrangements for tuning a modern four-channel television receiver.

V.H.F. RECEIVER

(Continued from page 825)

regeneration control, the standby switch, pilot light and the volume control, are drilled in a row along the bottom of the panel one inch up from the lower edge. These should be placed symmetrically to maintain a good front-panel appearance. The holes for two 10-32 oval-head screws that secure the panel to the chassis should be drilled along the same line, one inch in from either side.

A hole 2 inches in diameter is then cut in the panel. This should be centered and 2 7/16 inches from the top edge. The mechanism from an old National Velvet Vernier dial with the dial removed is then installed in this 2-inch hole and secured with four ⅜-inch, 6-32 flat head machine screws. This allows the movable part of the dial to come out flush. A lucite pointer may be attached to this part with the three original screws. The panel then may be given two coats of flat black enamel allowing ample time for drying between coats. An escutcheon plate similar to the one used should now be made of thin sheet brass stock and also given a coat or two of flat black. The dial card (of draftsman's Bristol Board or a good quality index card) should be made of ample

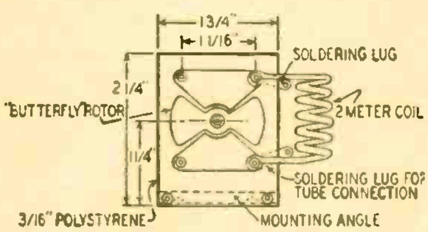
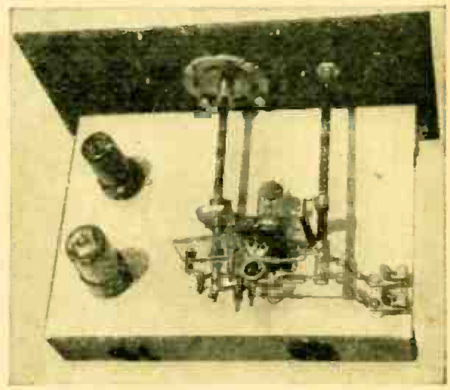


Fig. 2—Details of "butterfly" tuning unit.

size to allow for the swing of the pointer and to match the escutcheon plate. The card we used when trimmed measured 2½x4⅜ inches and the escutcheon was made to match this size. Two or three half-circles may now be drawn on the card for calibration purposes. If carefully handled this home-made dial will present an appearance that will match that of a commercially-made unit and should be presentable in the most finished station.

The chassis should now be prepared by making the socket holes for the two audio tubes on the top and that for the five prong socket on the rear. Two 5/16-inch holes are drilled for two banana jacks on the rear of the chassis near the 6K6 socket, for speaker connections. The detector section construction may well be started by the dismantling of a Cardwell tuning condenser, type ZR-15AS. This is a midget, single bearing rotor type and lends itself well to revision since it is assembled with machine screws and nuts. The original steatite base may be used as a template for drilling a piece of polystyrene for a new base. This material is preferable due to its low loss characteristics at very high frequencies but the steatite might be used if polystyrene is not available. Details of the modification are pretty clearly shown in the photograph. Fig. 2 and Fig. 3 give drilling details and provides a full size pattern for both



This view presents the parts layout clearly.

rotor and stator plates. As shown in Fig. 2, new stator plates were cut out of thin sheet aluminum to get the maximum capacity possible, since we weren't sure how much would be necessary for the coverage desired. This accounts for the difference in the shape of the stator plates as used and the originals. Either may be used.

Using a set of two stator plates and one rotor plate with single spacing, satisfactory bandspread was achieved in our receiver. This combination with the coils as constructed gave ample spread for the two meter band. If the builder plans to use the 1¼ meter band he may prefer to double-space the capacitor and make the coil somewhat larger to get greater bandspread.

The photos and Fig. 2 show how the coils are mounted across the stator plates for short connections. The tube socket is directly behind the coil, mounted on a small aluminum bracket. The antenna coupling asembly is two Fahnestock clips mounted on two small standoff insulators. Flexible leads connect to

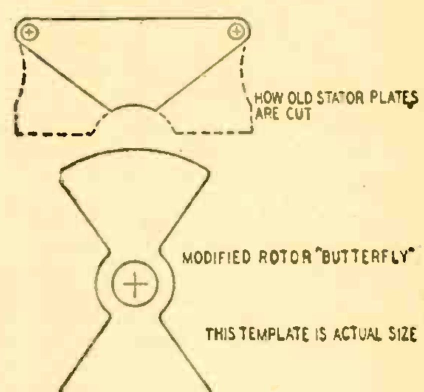


Fig. 3—"Butterfly" capacitor plate patterns.

the movable shaft which holds the two-turn coupling loop. This coupling loop is mounted on a small piece of polystyrene tubing with two small machine screws, and this in turn is mounted on the end of the movable shaft which is a 5⅝-inch length of ¼-inch bakelite rod. In similar fashion the tuning capacitor is coupled to the dial using a 2¾-inch length of the same rod and a Millen flexible coupling made of steatite. By having the tuning assembly at the rear of the chassis body capacity effects are eliminated. The r.f. choke is home-made and is shown in the photo, below the tuning coil. It is made by winding 16 turns of No. 24 enameled wire on a ¼-inch form and removing the form afterward. Tin the ends of the wire and solder it directly to the soldering lug on the grid stator plate.

In wiring it is excellent practice to connect up all heaters first, then the cathodes and then the rest of the audio components. When wiring the detector section, keep in mind that short leads are imperative in very-high-frequency circuits, since only a fraction of an inch here and there will add up to sizeable values of inductance and capacity when the whole circuit is considered. For instance, the plate of the tube is connected to the stator by a ¼-inch wire and the grid is tied to its stator by direct connection to the capacitor and its grid leak.

The coil for the two-meter band is made by winding 6 turns of No. 20 tinned copper wire on a ⅜-inch form and then removing the form. The turns are then spread to occupy about ⅝-inch in length. The 1¼-meter coil is made with

(Continued on following page)

V.H.F. RECEIVER

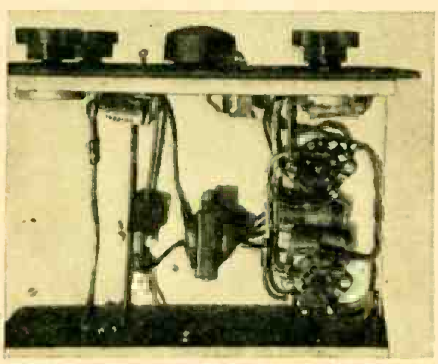
(Continued from page 867)

three turns and spread to approximately ⅝-inch. These will undoubtedly need adjustment when the receiver is calibrated.

The five-prong socket at the rear of the chassis is for the power connections and would be wired as marked in Fig. 1. A spare prong will be noted. Its purpose is for the use of a power supply with a built-in voltage divider. If one of these (or batteries) should be used the detector voltage may be adjusted to approximately 50 at the 75,000-ohm regeneration control, and the 30,000-ohm dropping resistor is eliminated. The external power supply should be a low power unit capable of delivering 200 to 250 volts at 40 to 50 milliamperes. The speaker used should have an output transformer to match the pentode output tube. An inexpensive 3½-inch PM unit gave ample volume and the quality was sufficiently good for speech.

TUNE-UP AND OPERATION

The power supply may be turned on with the standby switch (SW) in the off position to note if the heaters are correctly wired. The speaker must be plugged into the banana jacks before the high voltage is applied to avoid ruining the screen of the 6K6. When switch SW is snapped to the ON position the superregenerative hiss characteristic of this type of receiver should occur at some point as the regeneration control is advanced. If the set will not regenerate smoothly, some experimentation will be necessary. The radio frequency by-pass capacitor, marked ".001 to .006" in the diagram, should be changed until best performance is noted.



There is little apparatus below the chassis.

In our particular case a 0.002 was best but values from 0.001 to 0.006 should be tried. The by-pass capacitor may or may not be necessary. Values from .05 up to 1 or 2 µf might be used to eliminate the noise from the potentiometer rotor. If audio howl is present the optional resistor will have to be used. Use the largest possible value since smaller values reduce the volume appreciably. Values from 1 megohm down to 50,000 ohms may be tried.

When the receiver "soups" satisfactorily, the band to be used will have to be located. With the proper coil connected across the condenser the frequency may be checked by the use of a homemade wavemeter which has been previously calibrated by another receiver already located in the band. Usually some neighboring ham or experimenter will have one of these which he will lend you. This wavemeter should be coupled to the detector coil by bringing them close together. Then tune the wavemeter. When the receiver blocks (goes out of oscillation) the receiver frequency is that of the wavemeter and the reading on the wavemeter dial may be marked on the receiver dial. If the wavemeter is deemed accurate enough the megacycle and half-megacycle points can be marked in.

If no wavemeter is available, the receiver may be roughly calibrated by using Lecher wires to locate the bands and then more closely lined up by listening for marker stations. Data on the construction and use of Lecher wires is outside the scope of this article but was given in the article "144-Mc Transmitter" in the February RADIO-CRAFT. We used a matched impedance type antenna erected at a height of 40 feet above ground, which has given very satisfactory results. There are many types which may be used and we strongly urge the construction of one especially designed for the band that you intend to operate on. An efficient antenna is very necessary on very high frequencies.

While this receiver does not represent the ultimate in its class, perhaps, it should provide good dependable reception and its construction will not present problems too formidable for the average builder.

RADIO-ELECTRONIC QUIZ

How thoroughly have you mastered the contents of this magazine? Try the following quiz as a test:

1. Would it cost more to produce a good television program or a good moving picture? See page 821.
2. What is the maximum bandwidth that can be handled by an amplifier circuit? See page 822.
3. Is the present shape of television screens theoretically the best one? See page 823.
4. Did our enemies as well as ourselves possess night-sight telescopes for military purposes? See page 826.
5. How do English and American phonograph records differ? See page 827.
6. Is a crystal set confined to purely local reception? See page 831.
7. Where would you look for a "pad" in a broadcast station? See page 834.
8. What is an Ayrton shunt? See page 837.
9. To increase the efficiency of a television receiver, would an extra r.f. or an extra i.f. stage be more desirable? See page 840.
10. At what price are television sets now available? See page 855.

TELEVISION FOR TODAY

(Continued from page 865)

a special "Fine Tuning" adjustment has been converted into a front panel control. Its purpose is to counteract small shifts in the oscillator. Electrically it consists merely of a variable condenser across the oscillator tank circuit. See Fig. 6. In the commercial receiver, Fig. 6, the "Fine Tuning" control is C1.

It is current standard practice to place the oscillator frequency *above* the sound and video carriers. By being above both signals, the highest intermediate frequency produced will be that of the video signal. To understand why, remember that the audio carrier is 4.5 mc higher in frequency than the video carrier. For a band of frequencies, say 44-50 mc, the video carrier would be at 45.25 mc. From the video carrier, the picture side bands extend for 4 mc up to 49.25 mc. The audio carrier would then be at 49.75 mc.

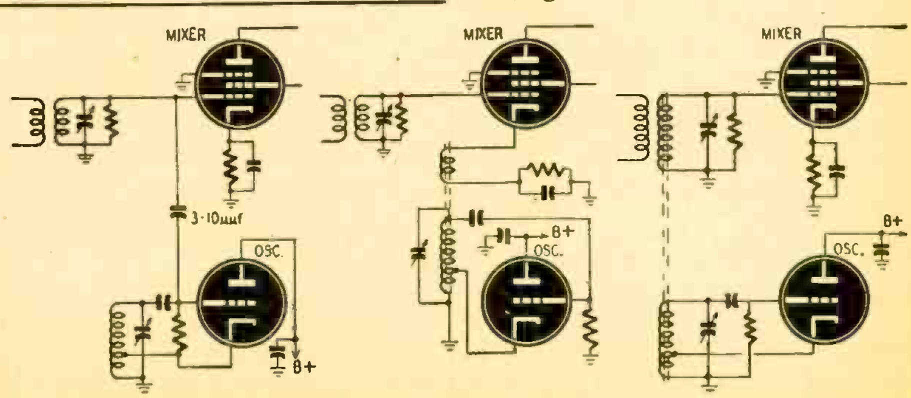


Fig. 8—A number of oscillator-mixer circuits for conversion in v.h.f. superheterodyne sets.

Now suppose the oscillator frequency is 71.00 mc. The mixing of this with the 44-50 mc would produce the following i.f. signals:

1. For the video, the i.f. will range from 21.75 to 25.75 mc. Actually, the i.f.

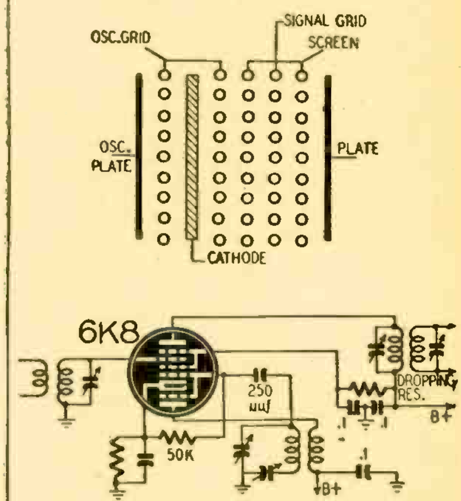


Fig. 7, above—Internal construction of 6K8 converter. Below—Typical 6K8 mixer circuit.

frequencies generated extend to 27 mc. However, the vestigial side band remnants are from 25.75 mc to 27.00 mc and are undesirable. The i.f. bandpass tuning circuits eliminate them.

2. For the sound, the i.f. is centered at 21.25 mc.

The reason for using a higher intermediate frequency for the video voltages arises from the wide band requirements of these signals. The higher the intermediate frequency, the smaller the ratio of

$$\frac{\text{video 4 mc bandwidth}}{\text{intermediate frequency}}$$

and the easier it becomes to design band pass networks possessing sharp end attenuation and higher resistor loading. Consequently the amplifier gain, from the previously noted equation, is higher. It follows, then, that in order to have the video i.f. above the audio i.f. we must place the oscillator *above* the incoming carriers.

NEWSPAPER VS. FACSIMILE

Facsimile demonstrations by Finch Facsimile and J. V. L. Hogan last month called forth sober comment from publications of widely differing points of view. More than a suggestion was made that newspapers might find the new system more than a serious competitor.

The advertising magazine *Tide* reported:

"Last fortnight sober thoughts crossed the mind of many a U. S. publisher as he beheld the commercial launching of a new development in radio, what looked like added proof of this innovation's potentialities as a competitor and, eventually, as an adjunct, to newspapers in the U. S."

The Nation took a more sober and complicated view of the situation. It reported:

"The technical problems are far simpler than the social and economic ones, for if the development of facsimile broadcasting continues . . . city folks as well as those who live on the farms can be supplied with newspapers and other reading material by radio . . . at the trivial cost of the rolls of paper and the electric current . . . as events take place, as history is made, the facsimile machines will produce directly in the home a contemporaneous printed record. No newspapers will be able to compete."

Apparently facsimile is being taken very seriously in some quarters.

ATOM BOMB OVER BIKINI

(Continued from page 824)

er waves—(water, that is!) An automatic clock started the recorders connected with the sounders half an hour before the bomb was scheduled to go off.

Certain other recently-developed and still secret electronic devices were used to record wave height versus time at remote parts of the lagoon and at other atolls such as Eniwetok, Kwajalein, Wotho, and Rongerlap. Two radio repeating wave buoys planted two and four miles from the point of the explosion radioed the wave heights to one of the photographic planes.

Ten simple maximum-water-height indicators were mounted near the water's edge. Each unit consists of a pipe, a contactor strip, and a dry cell. It is equipped with a set of fuses which blow as water passes up the pipe and creates a short-circuit.

RADIO CAMERA CONTROL

The wave measurement group relied heavily on photography for measurable data. It used simultaneous air-ground photographs, stereo-pairs of ground camera and television photos, and right-angle pairs of ground photos. The first test was expected to provide a full-scale test of such matters as shielding of cameras and radios. The analysis of photographs for measuring scientific data (called photogrammetry) depends for its success on stop-watch timing effected by radio controlling links. These radio links consist of transmitters in one of the aircraft. As each control pulse is received, each camera makes one exposure and cycles forward ready for the next pulse.

Two television transmitters were located on towers 2000 feet apart on Bikini and aimed at the target area. Receivers set to the transmitter's frequency were aboard the two photo planes. Special motion picture cameras were focussed on these receiver screens to record the television images permanently. Supplementary receivers set to the same frequency were on the flagship Mt. McKinley and also on the Appalachian.

The seismology group of the oceanographic section was concerned not only with the measurement of the amplitude and character of the earth's vibrations resulting from the bomb, but also hoped to gain some information on the sub-surface structure of the atoll by refraction and reflection measurements similar to those used in electronic geophysical prospecting. According to the best available data, the seismographs recorded absolutely nothing. No announcement has been made as to the information gained on sub-surface structure.

The oceanographic work was carried on by means of current meters similar to anemometers; by means of current poles weighted at the bottom and

(Continued on page 874)

TRANSATLANTIC NEWS

(Continued from page 841)

use carriers with frequencies separated by 35 kc. Both carriers lie within the band width of the r.f. and i.f. stages of the receivers (Fig. 1) without producing audible interaction. The two transmitters, eleven miles apart, used frequencies of 80.0175 and 79.9825 mc—see Fig. 2. A central control station supplied modulation to both by radio links. The first difficulty encountered was interference from auto ignition systems and this led to the development of a noise-limiter so effective that freedom from all types of interference is stated to be as complete as with FM.

Tests showed excellent results. No distortion could be detected in the area covered and in towns and valleys the flutter associated with single-carrier v.h.f. transmissions was hardly noticeable. Both carriers do actually flutter, but not as a rule at the same time. The receiver selects the signal that is the better at any instant and the change-over from one carrier to the other is imperceptible. Throughout the area, signal strength was found to be much greater than with a one-station system.

"Diversity transmission" had proved itself to be as effective as diversity reception and the next step was to use it on a much larger scale. This is illustrated diagrammatically in Fig 3.

Taking the outward paths first, the 7-watt transmissions on 81.30 mc from Police hq. are picked up by a receiver at the main transmitting station which triggers off a 30-watt transmitter working on 130.80 mc. Its signals go to receivers at all three stations where they trigger off 100-watt transmitters working on 96.32 mc (main station), 96.28 mc (slave A) and 96.30 mc (slave B). A 130.60 mc receiver is used at the master station as well as at the slaves in order to equalize the path and to ensure as far as possible that the three 100-watt transmitters are modulated in the same phase.

Receivers in police autos receive all three signals and the results are remarkable. Signal strength is constant over practically the whole wide area covered, even in the deep, narrow valleys, and there are no areas of distortion corresponding to those of no-capture with FM. The frequencies used show surprising penetration of streets, tunnels and even steel-frame buildings. A slight heterodyne whistle is at times to be heard if the 96.28, 96.30 and 96.32 mc carriers are not precisely evenly spaced. This is easily corrected and in any event the whistle is so faint (30-40 db below signal level) that it causes no interference with communication.

On these very high frequencies AM, perhaps rather surprisingly, shows up well in comparison with FM. Natural static is virtually unknown and interference from trams, trolley buses and machinery is very light at 75-82 mc, less still at 95.5-100 mc and almost entirely absent on 128-131 mc. With the special noise-limiter devised AM is as good as FM in the matter of auto ignition interference—the only serious type experienced. One great advantage of AM is the simpler and cheaper nature of the equipment required. It may be that some means of eliminating the area of no-capture with two-carrier FM will be found. Until this is done it seems that for the coverage of police and similar areas and the maintenance throughout them of steady signal strength, v.h.f. diversity AM is the better method.

THE POSTWAR RADIOS

(Continued from page 836)

case, the last zero has been omitted from the dial scale so that 90 on the dial indicates the correct dial setting for receiving a 900-kc station. With the 1-inch direct tuning knob, it is somewhat difficult to tune in a high frequency broadcast station "on the nose."

ATOM BOMB OVER BIKINI

(Continued from page 872)

equipped with yellow pennants, radar targets and lights; dye bombs which diffuse dye at a constant rate through the water; and various devices to measure oxygen, salinity, temperature, diffusivity, and other variables.

A pre-bomb survey of the lagoon was made by one of the scientists who donned a Navy shallow water diving suit equipped with special underwater writing materials—(probably the first recorded use of those *pens* we've heard so much about!)

Operation Crossroads is undoubtedly the first military organization ever to have a "radiological safety officer." This has a sinister sound and radiological hazards *are* sinister. The normal channels of your five senses give no warning of the danger since radioactivity can neither be seen, heard, smelled, felt, nor tasted. When you do become aware of it, physical degeneration has already started. You can then do nothing but wait for the end.

The majority of the dangers caused by the bomb itself are of extremely short duration and occur within a range of 7000 yards. Danger from blast, heat, and radiation was avoided by requiring both ships and aircraft to be at least ten miles away at the time of detonation. Damage to the eyes of observers was prevented by the use of high-neutral-density goggles. Persons without goggles were warned not to look directly at the blast, to turn away, or to shield their eyes with their arms. After the first flash, they were permitted to view the rising incandescent column with the naked eye. One sailor who ignored these warnings and attempted to view the explosion without goggles was removed from the ship, temporarily blinded. He was probably the first American casualty of atomic bombs.

Of the two remaining primary hazards, radiation and radioactivity, the latter presented the more serious problem. Radiation occurs at the time of detonation only, and consists primarily of free neutrons and gamma rays. Within a certain range, human or animal life is destroyed by radiation through its attack on blood-forming cells, the initiation of serious internal hemorrhages, and through burns or the slow oozing of the blood into the flesh. Since radiation is localized, personnel was completely protected against it by the distance from the detonation.

This is not true of the radiological hazard, which is the emanation of alpha particles and beta and gamma rays from minute fragments of the bomb and surrounding matter. Among the elements in sea water, sodium, chlorine, iodine, bromine, and potassium all become radioactive with different half-life periods running from a few seconds to many hours.

The degree of radioactive hazard was measured by Geiger-Mueller counters

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LINK-COUPLED CRYSTAL SET

(Continued from page 831)

insert L2 inside of L1, about ¼-inch from the ground end of the coil.

Insert L3 inside of L4 in a like manner. The entire set of windings of L2 and L3 should be used as a starter, and should not be changed unless necessary. Place SW1 (on L1) on the next to the last tap *away from the ground end.* Place SW2 on the next tap nearest SW1 but *toward the ground end.* Place SW3, on L4, on a tap to include about three quarters of the length of the coil. (NOTE: While L1 and L4 are exactly alike in physical dimensions the corresponding switches will not necessarily read the same, because the two units are separate and are performing two different functions). SW1 is changed only when a shift is made from one extreme of the set's tuning range to the other. The position of SW2 should normally be between SW1 and ground.

Using your right hand for main tuning and your left for antenna tuning, the main tuning dial, C2, is slowly swung across its arc. If a station is heard, the antenna tuning dial, C1, should be shifted until the signal increases in strength. Unless this occurs the set is not functioning properly. Try a different setting of taps, or move the pickup-coils (on link line) to the extreme ends of their big brothers.

The best way to search out the elusive dx is to get the set fired up as well as possible on a nearby signal; then move L2 and L3 OUT slightly from their big brothers in order to increase the selectivity, moving both the tuning dials AWAY from the local. Once you hear a dx station you should try everything in the books to bring its signal strength up. Increase the coupling between circuits, try different taps, and rotate the main dials individually until you have the station centered. The main object is to drag the dx out into the open while shoving the locals into a hole. The author can tune across the band and pick out dx at will, as long as it's coming through at all. Have a little patience, keep a log, and you, too, can pull in the dx like nobody's business!

Parts list for the *Two Timer:* C1 and C2: 365, 450 or 500 μμf. *DO NOT "GANG" . . . use separately!* L1, L2, L3, and L4: See text. Phones: Any good high impedance type. Crystal detector: Any popular mineral detector. SW1, SW2 and SW3: See text. NOTE: No phone condenser is used.

—

An oceanic layer which reflects sonar waves has been discovered in the Pacific. The layer is between 1,000 and 1,500 feet below the surface, rising at night and sinking in the daytime. Scientists believe it may contain suspended matter which reflects back the echoes heard by the sounding apparatus.

ATOM BOMB OVER BIKINI
(Continued from page 874)

and by strips of photographic film placed on board ships and carried by personnel. These film strips were periodically replaced and those that were carried by personnel were checked for radioactivity, which affects film the same way as light does. The Geiger counter consists primarily of a special gas-filled tube with two electrodes connected to a battery. Any radioactive particle entering this tube ionizes the gas and a small electrical impulse is thereby permitted to pass through the tube. This is amplified to a point where it can be indicated either by a dial or by audible "ticks." Counters may be made extremely sensitive or they may be made to operate under conditions of intense radioactivity, in every case serving to measure the intensity.

With these safety precautions carefully observed, no one should have received any injuries from radioactivity. Fifty medical officers underwent an intensive three-months training course which included a flight over the original atomic bomb test site in New Mexico. *Their Geiger counters picked up "ticks" indicating a small amount of continued radioactivity from last July!*

ROBOT PLANES IN ACTION

Radio-controlled drones were used to great advantage in this test. Four "Mother" or control planes controlled four "Babes" or drones. A "Super-mother" or master control plane was rigged so that it could take over the flight of any drone that failed to respond to the signals from its mother. These hovered over the observing ships until the bombing plane made its final run over the target. The instant that the bomb dropped, a lethal cloud of extremely dangerous radioactivity rose, reaching 60,000 feet in about six to ten minutes after the detonation. This was predicted, expected, and prepared for. From what we on the Appalachian saw, the cloud appeared to be about sixteen miles in diameter.

The Babes were impelled toward the cloud by the watchful Mother planes which remained at a safe distance. (In this case, the Mother planes acted contrary to the instincts of a true mother, by sending their Babes into danger while the Mother remained behind to watch the results.) Each plane was to enter the cloud at a different altitude and was to maintain this altitude while in the cloud and upon emergence. An amusing sidelight of this phase was the action of one particularly stubborn little drone that disobeyed the frantic signals from both the Mother and the Super-mother. Nothing seemed to have any effect on this independent drone and a hurried conference was held to decide whether or not to shoot it down. The control crew decided that since the drone had a limited gas supply, it would end up in a watery grave anyway, and so it was permitted to continue its merry way on the course it had set for itself—in the general direction of China!

AUDIO RESPONSE CORRECTION

(*Continued from page* 827)

RESISTANCE-CAPACITY CIRCUITS

Two main types of circuits are employed, those that give a bass boost by attenuating all the higher frequencies to a reduced but finite value and those that reduce the highs, approaching zero response as the frequency increases.

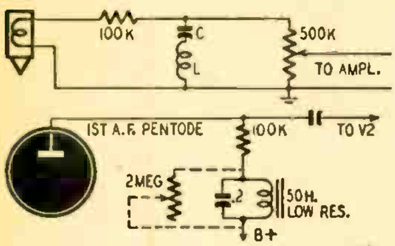


Fig. 6—Tuned acceptor and rejector filters.

The first type can be designed to give a "boost" of any desired rate over any frequency range, but the amounts of boost cannot approach infinity as the loss at high frequencies due to the filter is at least equal to the bass boost produced at very low frequencies. If the pickup has a very low bass resonant frequency, say around 20 cycles, full compensation is needed and the filter must provide a boost of around 6 db per octave. On the other hand, if the pickup head is fairly light and the needle very stiff and difficult to deflect, the bass resonant frequency will be well inside the audible region and little compensation is required. Circuits for both these conditions are shown in Fig. 4.

Now what about the high-frequency end of the spectrum? This end is *never* attenuated in recording and is usually boosted, so the problem is how to attenuate the highs to a reasonable value. If the high boost is progressive, (increasing with frequency) a simple one-section filter such as is shown in Fig. 5-a may meet the case. The resistance may be the plate resistance of the first tube in the amplifier — in which case only the condenser is used—or the filter as shown may be connected directly after a high-impedance magnetic pickup. Sometimes when the pickup is a really good one with a high needle resonance frequency, a multi-section filter may be used to give a sharp cut-off just below the unwanted resonance. The circuit of such a filter is shown in Fig. 5-b, the constants being suitable for a 500-ohm or medium impedance job.

It is very rarely that a boost is required in reproducing the upper highs around 5,000 cycles, but if required, the circuits of Fig. 4 may be used with the series resistor bridged by a small capacity such as a .002 microfarad condenser.

TUNED FILTERS

An "acceptor" or series L-C circuit may be shunted across the output of a pickup or the output of the first tube to absorb energy at some undesired frequency (usually the top resonant frequency) but such circuits are *usually* failures for several reasons.

The designer may omit to take into account the inductance and capacity of the pickup; the filter has too low a "Q" factor (absorbs too little energy at the undesired frequency and too much at neighboring frequencies) the inductance may be large and bulky and may have hum voltages induced in it. Generally the inductance should be very large and the capacity small—a filter composed of a few r.f. chokes and .006 μf condensers is not very helpful and gives a more or less general high-frequency cut. In an ideal system the frequency of the acceptor circuit should be variable because the resonant frequencies of the pickup vary with type of needle and wear of needle as well as with hardness and groove contour of the record.

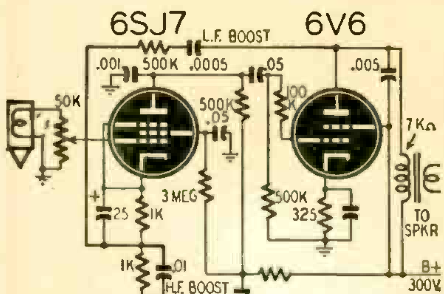


Fig. 7—This circuit uses negative feedback.

Rejector or parallel L-C circuits may be inserted in the load of the first tube to provide a boost around some frequency, usually in the bass, to compensate for attenuation in recording. Again there is the problem of hum pickup. Besides, the introduction of a resonant circuit means that some notes are prolonged.

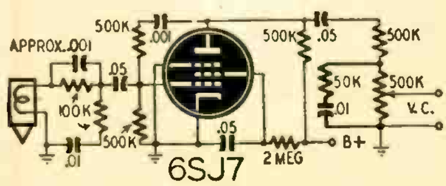


Fig. 8—Negative feedback direct to pickup.

Care must be taken to see that the natural frequency of the L-C circuit is not at or adjacent to the diaphragm resonance of the loudspeaker or the bass resonant frequency of the pickup. The frequency may be changed by trial and error by shunting capacities across the inductance. These bass-boost tuned circuits are usually easier for the amateur to get going than the acceptor "scratch-filter" circuits. To provide a variable control of the bass accentuation a 2-megohm potentiometer may be connected in parallel with the inductance and condenser.

If the tube preceding the tuned cir-

AUDIO RESPONSE CORRECTION

(*Continued from page* 877)

cuit is a pentode the impedance at resonance of the tuned circuit should be at least equal to that of the following grid resistor and at least twice, preferably three or four times, the value of the usual plate load resistor. Typical tuned-circuit filters are shown in Fig. 6.

NEGATIVE FEEDBACK

A simple way of obtaining a boost or accentuation at low or high frequencies is to provide a large degree of negative or inverse feedback and to reduce this feedback at the frequencies to be boosted. Condensers are employed to give this effect. A series condenser restricts the low frequency feedback, giving a bass boost; a condenser connected between the inverse feedback line and ground reduces the feedback at the higher frequencies giving a treble boost. These methods of compensation are largely employed by set designers to make up for deficiencies in loudspeakers and baffles.

In set design, the high frequencies are attenuated due to sideband cutting and considerable compensation is necessary, but in the design of audio amplifiers to follow pickups the problems are different. *If* (mind the IF) any high-frequency boost is needed, it should be limited in value and should occur only in a frequency band well away from the top resonant frequency. If a shunt condenser is employed in the negative feedback network, such a condenser should be very small. Typical values are given in Fig. 7.

More low-frequency compensation is required after a pickup than after a radio tuner, so the series condenser employed to reduce low-frequency feedback will be smaller. The bass boost is sometimes greater than anticipated owing to the feedback becoming positive at very low frequencies. Take care that there is not too much phase change in the amplifier, otherwise excessive feedback may take place at low or high frequencies, resulting in motorboating or a high-pitched whistle or hiss.

A procedure seldom employed but none the less effective is to use negative feedback direct to the pickup, arranging the circuit so that the amount of feedback is proportional to the pickup's impedance. This results in automatic compensation for the pickup resonances, for at these frequencies the impedance is high. Condensers can be placed in the feedback network to give bass boost and high-frequency compensation. To keep the amount of feedback independent of the volume, the volume control may be placed after the first tube, the output of the pickup being reduced to prevent overloading. This is shown in Fig. 8. Enthusiasts who have tried this circuit claim that it makes a cheap magnetic pickup sound like a first class crystal (which means that it is easy to obtain *excessive* bass)!

REBUILDING A TELEVISER

(Continued from page 832)

types of switch to provide 3-pole, 3-position operation where the second and third positions are additive, each in turn to the first position. Capacity is added to the initial capacity for each of the lower frequency channels. If the special switch is unobtainable a 3-pole, 3-position switch can be used with individual capacitors provided to tune each channel. In the first case the highest frequency is adjusted first and each lower one in turn. If the second type of switch is used each channel is adjusted individually.

The oscillator frequencies to provide the proper intermediate frequencies for New York's stations will be: Audio i.f.-8.25 mc, Video 12.75 mc.

Channel 2 54-60 mc—Osc. Freq. 68 mc
Channel 4 66-72 mc—Osc. Freq. 80 mc
Channel 5 76-82 mc—Osc. Freq. 90 mc

An additional i.f. stage and the rebuilding of the audio i.f. as a true FM receiver for the sound channel is another worthwhile improvement.

The circuit for this is shown in Fig. I-1. Note that the added i.f. precedes the existing first video i.f. and is a composite of audio and video i.f. amplification at the intermediate frequencies. The audio is tapped at the same point as in the original circuit. It is now, however, in the plate of the first (composite) i.f. rather than the mixer plate. There follows (I-2) an i.f. stage at 8.25 mc, a limiter and discriminator, and the audio amplifier comprising a voltage amplifier and an output stage. The FM sound channel is essential for postwar television-sound reception.

The removal of the power components from the chassis and their incorporation in a separate unit made room for the addition of the components for the FM audio i.f. system.

A Meissner 4.3 mc i.f. transformer for FM receivers was pressed into service by unwinding turns until the unit tuned to 8.25 mc. The discriminator transformer was constructed from the existing audio i.f. transformer in the kit. The secondary was tapped at the center and coupled from the center-tap with a 50-μμf capacitor to the plate side of the primary. This has proved more than just satisfactory. A photograph of the revised chassis arrangement is shown. The discriminator transformer is shown separately (Fig. 2).

Trap alignment procedure with a composite first i.f. for the audio channel and for the video channel in order to reduce the response of the latter to possible audio i.f. interference from the adjacent or co-channel is as follows:

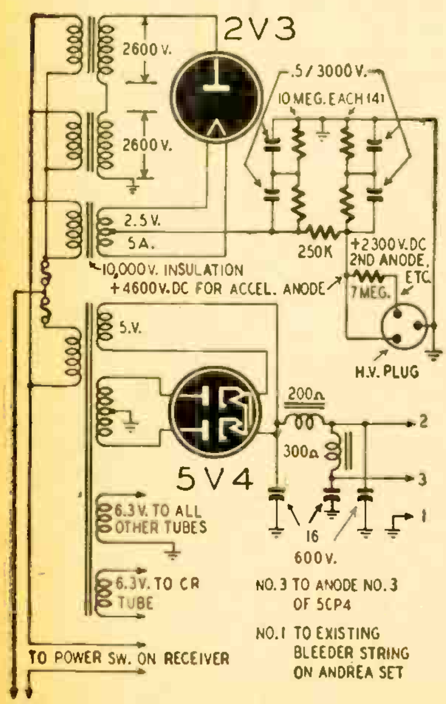
The composite (first) i.f. trap is adjusted for minimum response to 14.25 mc at the video detector load. The 2nd i.f. (video) trap is tuned to 8.25 mc (max. response at FM limiter grid). The 3rd i.f. trap is tuned for minimum response at 14.25 mc, and the 4th i.f. trap is tuned for minimum response (at video detector) to 8.25 mc.

Proper alignment of the discriminator in the audio i.f. system can be made only with suitable instruments, although with great care in tuning, an amplitude-modulated signal generator may be employed. With this the i.f. amplifiers are tuned for maximum output at the intermediate frequency (8.25 mc). The discriminator primary is tuned for maximum response after first detuning the secondary. The secondary is then tuned for minimum response to the a.f. amplitude modulation. There are two peaks. The proper adjustment is the minimum response between the two peaks.

The separate power supply diagram is shown in Fig. 3. Two high-voltage transformers are connected in series to give approximately 4500 v.d.c after rectification for the third anode (intensifier) of the 5CP type tube employed in the author's set. Potentials for second anode, deflection plates and focusing anode are obtained from dropping resistors comprising a bleeder across the high voltage supply. The low-voltage supply is included on the same chassis with high voltage. This high-voltage supply will deliver sufficient potential for tubes as large as 9 or 10 inches diameter. A 7-inch electrostatic deflection C-R tube type 7EP is listed, but we have been unable to obtain one. The larger types require magnetic deflection and will necessitate circuit changes in the sweep amplifier sections.

If higher anode potential is desired without removing components from the existing chassis this may be accomplished by connecting the high-voltage supply additively to the low-voltage

(Continued on page 881)



SEPARATE POWER SUPPLY FOR ANDREA KIT. FOR USE WITH ACCELERATOR TYPE E. S. C.R. TUBES.

Fig. 3—Separate high-voltage power supply.

COMMUNICATIONS

APPEARS DISSATISFIED WITH EDITORIALS

Dear Editor:

This is directed to the attention of whoever writes the "Communications" column—just print it *if* you dare.

After reading the editorials in the last three or four copies of your publication, count me, and at least 40 GI's and hams, off your purchasing list.

Maybe we have been presented in a distorted view but while we are out protecting the necks of your money-hungry manufacturers, we thought we'd be given at least an EQUAL chance with the already established dealers. That opportunity seems to be a small recompense for three years of a man's life or the thousands of our buddies lives—maybe we're asking too much though.—Take for instance the RFC—the GI is getting the same old shaft again. After the government, the state and the big dealers pick over all the good items, the little GI gets what little is left (and believe me gentlemen—it's true, I know from experience).

And maybe I'm a little dense, but perhaps you will explain why manufacturers won't allow a dealer to handle more than one line. I worked in perhaps the largest Ham Shack in the country and we sold competing sets side-by-side. Could it possibly be that with the resulting competition, the prices would come down to where they should be and the manufacturer would make only his normal profit? It seems like a very nice inter-political set-up — something REALLY SMELLS . . .

Thanks again for getting behind the serviceman and cutting his throat—we sure know who is on our side don't we? ? ? ? ?

ROBERT C. FOSTER, W9JWY,
Oak Park, Ill.

HAS LITTLE TROUBLE GETTING MATERIAL

Dear Editor:

I was interested in Mr. Massey's letter in the May issue. Last October, I decided to obtain a good stock of radio parts. I talked to some of the local servicemen and they led me to believe that the serviceman was only able to get an occasional condenser or resistor.

When I presented my problems to the distributors, I found them courteous and willing to cooperate. One distributor told me, "Your appearance is neat and your records seem straight so I think that we will be able to fix you up." I was unable to get a franchise for some of the most popular brands of radios but was able to get a new brand which I believe to be as good as, or better than, the well-known brands.

I found that if the product has a 90-day guarantee, the customer regards it as trustworthy. To date, I have nearly a complete stock of radio parts which I value at $1000. I think that the other servicemen either didn't try hard enough or tried the wrong way.

RAY M. DIRBA,
Wallis, Texas

GETS ONLY TROUBLE—NO MATERIAL

Dear Editor:

I have just finished reading your editorial on page 529 of the May issue. I feel that it is a fair statement regarding the Ex-Serviceman vs. Radio Manufacturer and that it considered both sides of the controversy.

Here is another "squawk." How about the poor experimenter, home set builder and student? I have been trying to buy a two-gang variable condenser, 365 μμf "superhet type" with trimmers, for more than two years. There just aren't any in this area and I have been unsuccessful in getting them in the mail-order houses in Chicago. Some types of tubes are also very scarce.

There are a lot of new sets being built by the manufacturers and *they* have the condensers. Why should all of them be taken by the manufacturer? It is very discouraging not to be able to get vital parts. It makes a fellow want to chuck the whole business out of the window and try some other line.

The only reason that I am writing this at all is that I feel that I am only one of a vast army of students and experimenters who suffer from the same situation. Can something be done to give us fellows just a trickle of the necessary parts?

C. G. LYTLE,
Vancouver, Wash.

HAS GOOD LUCK WITH POSTWAR 2-TUBER

Dear Editor:

You published in your March 1944 issue an article by Homer L. Davidson entitled "A Postwar 2-Tuber," which I built recently. I have so much good luck with it that I use it as much as my SX28. The panel size is 4½ inches wide by 6 inches high and the chassis extends only 4½ inches from the back of the panel. Using this little set on my outside antenna I am able to operate a small speaker. With headphones there are few sizeable stations which cannot be received on it.

KARL HEIN,
Kalamazoo, Michigan.

Civilian Radio Jobs Wanted

FREE WANT-AD SERVICE

By Former Soldiers, Sailors, Marines

Radio-Craft offers its help-wanted columns free for the use of honorably discharged men in the armed services. State the type of position you seek, preferred locality, your experience, education, and other details. Confine ad to 50 words, or less. Supply name and address. Army veterans send section number or photostat of discharge paper. Navy men send photostat of discharge paper. Address RADIO-CRAFT, Classified Ad. Dept., 25 West Broadway, New York 7, N. Y. Your ad will contain a box number and replies will be forwarded to you.

RADIO-RADAR Tech.; 3 yrs. civ. exp., 4 yrs. army radar, all types. J. Finkel. 238 Sutter Ave., Brooklyn 12; DI 6-9282.

RADIO MECH.—Radio school grad. wants job as apprentice. T. J. Fornabia, 418 E. 119th St., New York 35.

RADIO TECH., 26. married; civ. and Army exp. J. Moretti, 4054 Carpenter Ave., N. Y. 66.

ENGINEER, BSME, Penn. State, young, married; exp., des., development; electronics tech. S. Kozuck, 1554 52d St., Brooklyn 19; WA 9-6717.

RADAR TECH. ex-station chief charge of maint. repair; 4 yrs. theory, practice, microwave equip. Box AT-15, %Radio-Craft, 25 West Broadway, New York 7, N. Y.

RADIO SCHOOL GRADUATE. Desires position as radio repairman. Some experience and knowledge of FM. Age 31, married, willing worker. Vet. Morris Zeig. 674 Ashford St., Brooklyn 7, N. Y.

TECHNICIAN-RADAR OPER. 2nd class radio telegraphy and telephone licenses, Army and civilian schooling. 25 yrs. of age. Call FL9-4712 or write 148-09 Northern Blvd., Flushing, N. Y.

RADIO REPAIRMAN, part-time; student; 4 yrs. exp. 1st-c. phone lic. M. Gottlieb, 1745 Rulton Avenue, N. Y. C. 57. LU-8-4375.

RADIO TECH: Civilian, Army exp. radar, electronics; prefer laboratory work. M. Zwerin, 3093 Brighton 4th Street, Brooklyn 24, DE 2-1609.

RADIO TECH: 2 yrs. Navy radar exp.; 3 yrs. coll. elect. eng. H. Haberman, 450 New Lots Avenue, Brooklyn 7.

RADIO REPAIRMAN: Have F.C.C. 2nd-class Commercial License; have 5 yrs. experience on FM & AM equipment. Martin Rubin, 575 Ocean Avenue, Brooklyn 26, N. Y.

TECHNICIAN: 5 yrs. experience. Engineering Student, Laboratory work preferred; references. Elton Nachman, 45 Park Avenue, Mt. Vernon, N. Y.

ELECTRONIC TECH., desires installation, maintenance, development or repair work; license; B.S. H. W. Kohn, 577 Hunterdon Street, Newark 8, N. J. Bigelow 3-1360.

RADIO MECHANIC; 3 yrs. exp.; work radio store; willing learn; chauf. lic. A. Grosso, 252 Mott St., New York 12.

RADIO TECH.—1/c phone, 2/c tel.; grad. RCA; salary secondary to oppty. M. Blumenthal, 208 Beach 91 Street, Rockaway Beach, N. Y.

RADIO, ELECTRICAL Laboratory assistant, Bklyn Tech. grad. (electrical), two years S.C. Communications, familiar tools, drawing. I. Wolf, 61 Leo Ave., Bklyn, N. Y.

TRAINEE—Three years army experience on Electronic equipment. Desire an opportunity in field. Stanley Repeck, 311 Baltic St., Brooklyn 2, N. Y., Box No. SV-1.

RADIO REPAIR, civilian and army exp. RCA graduate. C. Schwartz, 134 Penn St., Bklyn, N. Y. 11.

OPPORTUNITY AD-LETS

Advertisements in this section cost 20 cents a word for each insertion. Name, address and initials must be included at the above rate. Cash should accompany all classified advertisements unless placed by an accredited advertising agency. No advertisement for less than ten words accepted. Ten percent discount six issues, twenty percent for twelve issues. Objectionable or misleading advertisements not accepted. Advertisements for October, 1946, issue must reach us not later than August 23, 1946.
Radio-Craft • 25 W. B'way • New York 7, N. Y.

REBUILDING A TELEVISER

(Continued from page 879)

supply. To perform this operation the "cold" (minus) end of the high-voltage transformer is connected to the B+ end of the low-voltage power supply at point L in the diagram of Fig. 1 (No. 3 pin of the speaker plug). The high-voltage filter condenser is removed from ground and connected to point L and the last 1-meg resistor in the high-voltage bleeder string is removed from ground and connected to the plus of the low-voltage supply at the No. 3 pin of the speaker plug.

The series-connected power supply is shown at J.

Warning: Remember that the voltages used in these supplies are dangerous. Never work on the set with the power turned on.

With a separate power pack, an FM audio section, extra i.f. stage and provision for at least the three channels below 100 mc, the receiver will be comparable to any of the new sets at three times its original cost. If electrostatic deflection kinescopes of 9- or 10-inch diameter become available they can probably be substituted with no change necessary other than socket connections. The larger screen tube may require higher deflection voltages. This would involve additional sweep amplification.

Photographs made directly off the screen of the receiver on which the above changes have been made are shown to

Typical screen pattern before the changeover.

Images are much better with the new hookup.

illustrate the effect of the changes. The "VE" image was made prior to the improvement of the receiver. Hum can be seen in the wavy verticals of the VE characters. The "Today's News" photograph was made recently. Improvement in contrast, detail and absence of the hum components are noticeable.

Automobile radiotelephones will be available to New York subscribers this Fall.

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BOOK REVIEWS

ELECTRONICS FOR ENGINEERS, by John Markus and Vin Zeluff. Published by McGraw-Hill Book Company. Stiff cloth covers, 9x11 inches, 390 pages. Price $6.00.

This book contains a wealth of technical information and data for radio and electronic engineers and engineering students. It is a compilation of 142 papers that have been printed in *Electronics* magazine since April 1930. The articles selected for this book have been in great demand as reference material for engineers.

The material is presented in the form of papers, data sheets, design charts and graphs. There are design charts and graphs covering all phases of communication work as well as electronic heating, mathematics and permanent magnets.

All material of a similar nature has been grouped together in a single chapter for easy reference. There are 28 chapters with the heading at the top of each page, so that it is not necessary to resort to the index to find the necessary references.

WHY SMASH ATOMS? by Arthur K. Solomon, Research Fellow in Physics and Chemistry, Harvard University; Staff Member, Radiation Laboratory, Massachusetts Institute of Technology. Published by Harvard University Press. Size 6½ by 9¼ inches, stiff cloth covers, 204 pages, illustrated. Price $3.00.

The author has presented the subject of atomic reaction in a most interesting and lucid manner—we might almost say in a grand manner. He gives the names of men in science who made important discoveries along the upward path which culminated in the atomic bomb and the dawn of a new era in physics.

One valuable feature of the book is that the important ground work on simple electron and nuclear theory is explained in a clear and interesting style. The first chapter starts with the electron; then we learn something about the nature of the proton, the neutron, the nucleus and atomic number. Following chapters—with beautiful illustrations—are devoted to atom smashers, including the voltage doubler, the Van der Graff electrostatic generator, the Cyclotron and others.

Geiger counters and cloud chambers are explained clearly, as is the subject of uranium fission. Other chapters cover atomic energy, uranium, plutonium, application of nuclear energy in medicine, the atomic bomb, etc.

The excellent line illustrations by Katherine Campbell Duff lend an air of charm and a clear interpretation of the various actions in the new world of nuclear physics. An excellent glossary of atomic energy terms is provided, together with a complete index of the subjects covered in the book.—*H.W.S.*

ELECTRICAL AND RADIO DICTIONARY, by Dunlap and Haan. Published by American Technical Society. Stiff cloth covers, 6 x 8½ inches, 114 pages, plus page index. Price $1.00.

This dictionary of words and terms used in electrical and radio fields is useful to the student or engineer. The words and terms are divided into two sections. In the first, words are defined as they apply to general electricity, in the second, definitions are given as used in radio.

Elsewhere in the book are numerous tables, charts, diagrams, formulas and symbols containing information and data most often sought by the student and engineer.

THE RADIO AMATEUR'S HANDBOOK (Twenty-third Edition—1946), by the Headquarters Staff of the American Radio Relay League. Published by the American Radio Relay League. Hard paper covers, 6½ x 9½ inches, 688 pages. Price $1.00 in continental U.S.A.; $1.50 elsewhere.

The ARRL Handbook, one of the most widely-read radio publications, needs no review or introduction to the radio-minded public. For years it has been a "must" on the bookshelf of radio engineers, operators and experimenters and anyone who has read or owned a copy invariably purchases the latest edition as soon as it leaves the presses.

This, the first peacetime edition in four years, is very similar in many respects to the 1945 edition. The close similarity between these editions is probably caused by lack of amateur experiment and development during the war years. The chapters on WERS and carrier-current communication have been omitted and more space given to material on antenna construction and v.h.f. equipment.

More than 200 pages are devoted to catalog section, listing the complete line of more than one manufacturer. A complete index, 10-pages, adds much to the utility of The Handbook.—*R.F.S.*

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BLACK-LIGHT TELESCOPE

(Continued from page 826)

low current density, fine grain for high resolution, high voltage and vacuum operation, and insensitivity to caesium contamination, willemite has been used as the fluorescent material. In the preparation of the screen material, precautions are observed to insure an efficient screen of fine texture.

Willemite, in water suspension, is placed on the glass surface to be coated. A centrifuge is employed to lay down the phosphor screen and the water is decanted off.

The completed tube, together with an ocular lens and infra-red optics, has unity magnification. Resolution is such as to resolve nearly 400 lines per inch.

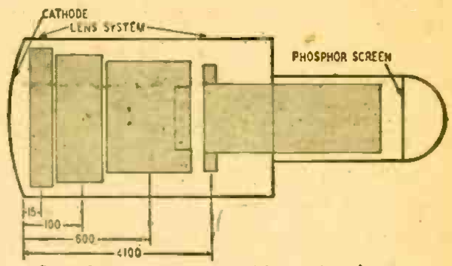
A star of the fifth magnitude may be detected by the tube. This is equivalent to one-tenth of a candle-power at a distance of one mile—a very small amount of infra-red radiation, indeed.

Despite the high operating potential, the 4100-volt power unit is less than two pounds in weight. Two battery-operated models were produced, one using a small vibrator interrupter and one an impulse breaker closely resembling the hairspring assembly of a watch.

Powered by a single storage cell, the size of a flashlight cell, battery life is from one to two hours of operation in the first-mentioned type of supply, 50 hours in the second.

A third model employed a relaxation oscillator as the source of high voltage powered from the 117-volt line, rectified by another product of wartime research, a minute tube consuming but five hundredths of a watt in the filament.

The 1P25 tube being a recently-developed contribution to the art of electronics, mass production of the quantities necessary to supply the needs of our armed forces has presented countless problems in manufacture.



1P25 electron lens assembly, with voltages.

Defective operation occurs if, in the assembly and processing operations, even a slight contamination is introduced in the form of oils or vapors, metallic compounds or dirt. Therefore, extreme precautions toward cleanliness of parts and purity of atmosphere are observed.

Astigmatism in the completed tube appears as the result of misalignment of the electron lens assembly and members of the lens system being slightly out of round. This in turn tends to limit resolution.

However, the engineering staff of the corporation designed equipment and initiated specialized procedures and techniques so that during the war an average of over 1000 tubes per month were supplied by the production division of their vacuum tube laboratories.

In addition, large quantities of the complete unit, consisting of a Schmidt optics system for projection of the infra-red image upon the tube, an ocular lens system for image magnification and power supply, also a product of the engineering division, were supplied by the company. The entire assembly is contained within a sealed nitrogen-filled case for protection against moisture and dirt. Even submersion in water is not detrimental to operation.

A studio for radio and television is one of the features of the modernization plans of New York's Metropolitan Museum of Art, which include reconstruction of the present buildings. Below the studios will be an auditorium seating 1200 people, in which programs can either be originated or received.

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