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RADIO NEWS

APRIL
25c

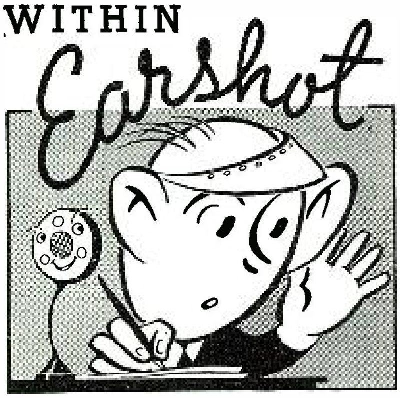
WALLACE BEERY
Radiop • Pilot • Actor

IN THIS ISSUE •

- PRACTICAL CALIBRATOR
- DANGER—HIGH VOLTAGE!
- PRECISION AUDIO GENERATOR
- ELIMINATING AMPLIFIER HUM
- SIMPLE LOOP CONSTRUCTION
- EASY READING MODULATION METER

HOW TO BUILD A "CROWD-STOPPER"

WITHIN Earshot OF THE EDITOR



WE have often been amused by the various "factions" within the radio hobby. They are many and each as far apart as the poles. For instance, there are those who are dyed-in-the-wool hams, the DX Hounds, the tinkerers, experimenters, constructors, engineers, research men and television men. Each says that the other "is wasting his time" and that "he does not get anything out of radio." Yet they all have a common ground. That is the *Hertzian Wave*.

None can say that the man who buys every bit of his equipment ready-made and ready-to-run does not get as much from his "wireless" hobby as the ham who builds each piece and instrument. What can be said is that each gets out of his hobby just what he puts into it. Were this not true the lure would have vanished long ago. So be tolerant of your brother hobbyist. Remember, if everyone had the same way of doing a thing, and did it, this would be a dull world after all.

* * *

TALK about advance. *General Electric Corp.* has a television receiver without a dial. Just push a button, and presto—there's your television program. Wasn't it fortunate that commercial television receivers did not have to go through the same development period which the broadcast receiver did?

* * *

DO not be discouraged, the modern broadcast receiver will *not* be able to pick up television signals, nor those frequency-modulated programs which Maj. Armstrong has been transmitting. If you are contemplating the purchase of a fine broadcast receiver, go right ahead and buy it in full confidence that television will not out-mode it.

While we are on the subject of broadcast receivers, why not get one with a record playing attachment, or get one of the various *Mystery* players. There are many times when you will want to hear a certain piece of music when it is not on the air and that will be easy with the player unit. Again, there are many records which you can purchase, from code-teaching ones to language or music instruction. Do not forget these advantages.

* * *

RECENTLY we were informed that a corporation had announced a new instrument which brought out the finest tones in music from radios or public address systems. This is a welcome addition to the ever growing units which are invented and marketed to increase your pleasure. We guarantee that there is nothing so soul-satisfying as a fine reproduction of a concert or a hot tune (depending which way

(*More Earshot on page* 51)

☆ RADIO NEWS ☆

Including Articles on POPULAR TELEVISION

The Magazine for the radio amateur experimenter, serviceman & dealer

VOL. 21 NO. 4

Contents for April, 1939

FEATURES

DEPARTMENTS

Member of the Audit Bureau of Circulations

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RADIO NEWS 1939 RADIO & TELEVISION DATA BOOK

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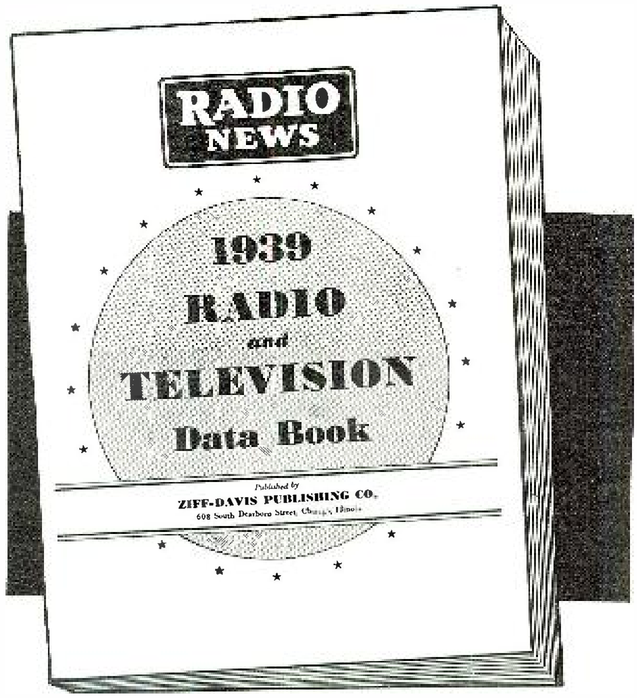

Numerous illustrations, charts, hook ups and diagrams. Many different items and articles, giving complete radio coverage. A wealth of invaluable radio information. Actual size, 8"x11".

EVEN a casual glance at the list of contents will prove, beyond a doubt, that the RADIO NEWS 1939 RADIO AND TELEVISION DATA BOOK is one of the most useful volumes of television and radio ever published. It supplies the hard-to-get information that is invaluable for reference work in every line of radio. YOU need a copy—no matter what your connection with radio. And, you can obtain this great book *absolutely free of charge!* Simply return the coupon below with your remittance of $1.00 for 6 issues of RADIO NEWS, and we will rush a copy to you without any additional cost! If you are already a subscriber and want this book, mail the order blank with your remittance and your present subscription will be extended. Act now—our supply of these valuable books is limited!

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• GADGET SECTION

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Meter Kinks
Increase Voltmeter Utility
Fish-pole Antenna
Plugin Resistors
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These are only a few of the many useful items contained in this comprehensive book.

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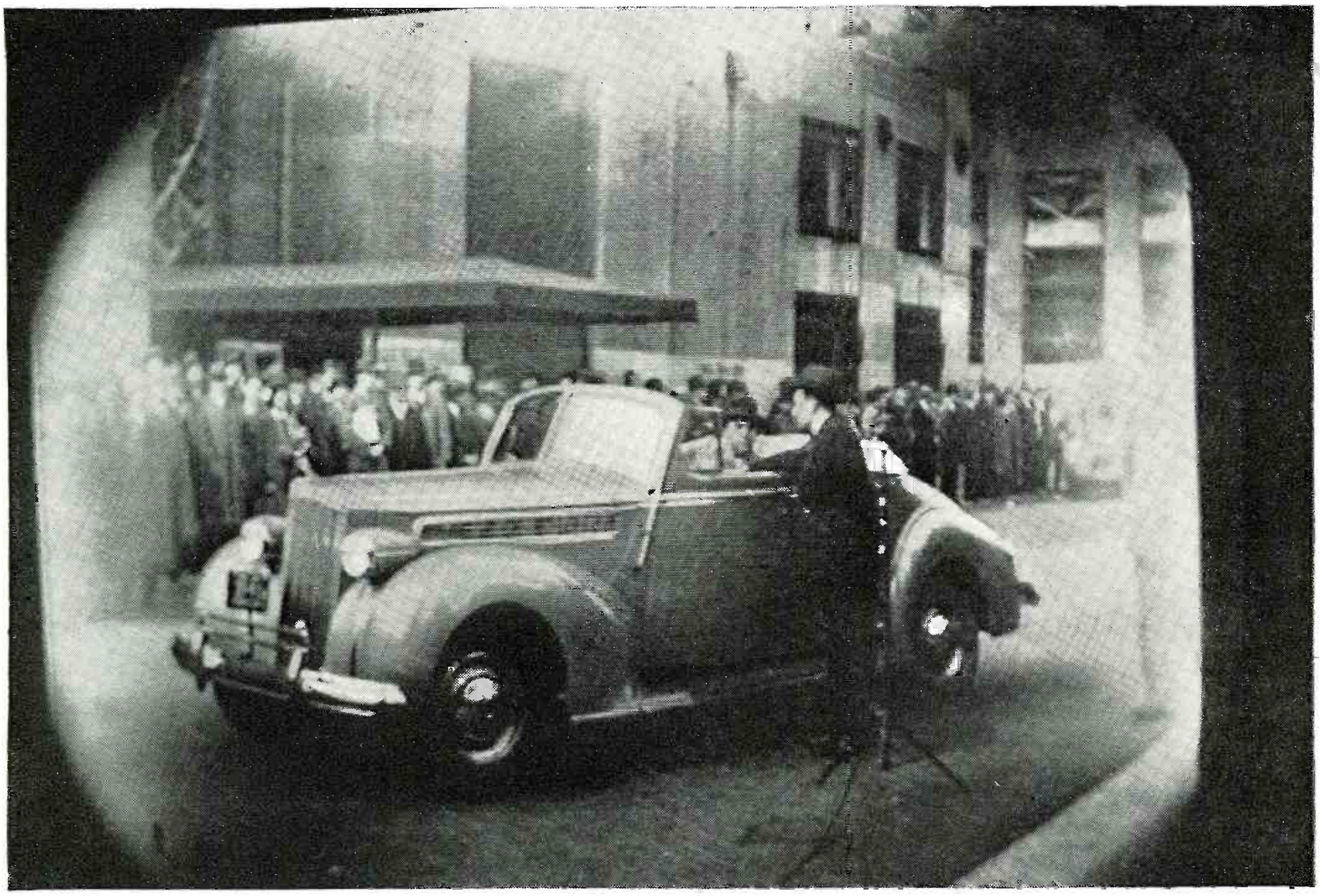
Enclosed find $1. Send me the next six issues of RADIO NEWS and rush a copy of the 1939 RADIO DATA BOOK to me without charge. (If renewal, check here ☐.)

Name ....

Address ....

City .... State.....................
If you are a serviceman please check here ☐.



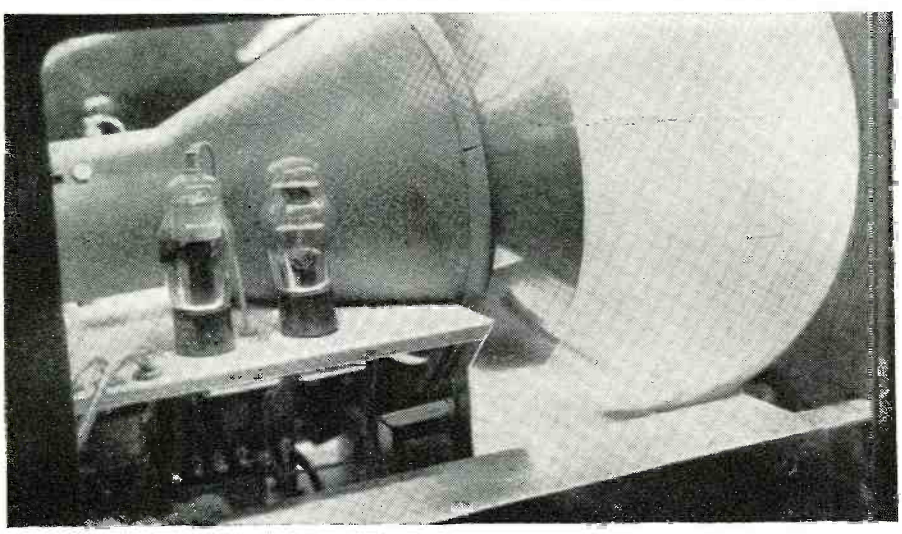
An example of perfect reception which may be expected from a good television skywire.

Building TELEVISION

By M. W. THOMPSON
Television Engineer, Chicago, Illinois.

One of the most important requirements for good television reception, is the antenna.

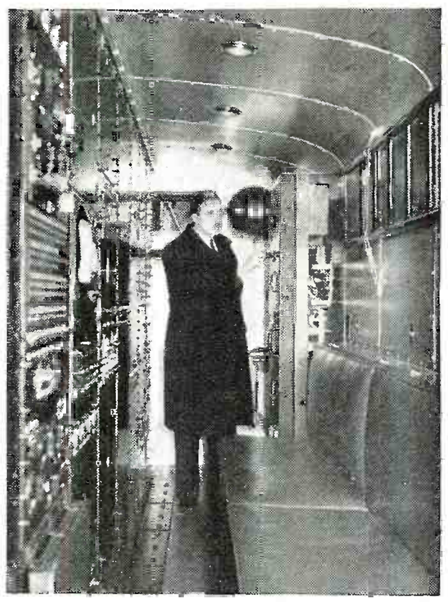
The third lesson in the television series for servicemen.



One of the newer television receivers with a large C-R picture tube.

HAVING, in the first article (RADIO NEWS, Feb. 1938), gone into features of television somewhat new to radio men, and, in the second (RADIO NEWS, Mar. 1939), explored the subject of *Iconoscope* tubes, scanning, amplification, etc., I believe it desirable briefly to consider the characteristics and somewhat unusual behavior of the frequencies assigned to television. While a group of channels between 156 and 294 mc. has been set aside for television use, it appears that, for some time to come, only lower frequency channels in the 44-108 mc. range will be used.

The *NBC* station on the Empire State building, W2XBX, has been given the use of the No. 1 channel, 44 to 50 mc. The *CBS* transmitter, high up in the Chrysler building, W2XAX, will use the No. 2 channel, 50 to 56 mc.



Inside the mobile television truck which is used to pick up spot news.

SKYWIRES

Why do they prefer these to the higher frequency channels? In part, because their effective service areas will be increased somewhat, due to the fact that attenuation, beyond the optical horizon, increases with the frequency. More important, the attenuation caused by large buildings placed close together is considered less for 44 to 56 mc. transmission than for 96 to 108 mc.

The frequencies above about 30 mc. (10 meters) are considerably different in many respects from those below that wavelength. They are not turned back by the ionosphere, and since the sky waves are eliminated, propagation results from the ground wave only. The ground wave, however, also attenuates rapidly beyond the horizon and fading begins to be noticeable. In this ultra-high-frequency zone, there is practically no natural static, but man-made interference is severe.

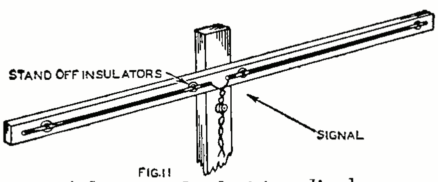
What is known as the "interference pattern" around any receiving location will usually produce some puzzling phenomena. The same antenna that produces a weak, unusable signal at one point on a roof, may very probably put quite an impressive "kick" into the receiver if moved only a few feet right or left, forward or back. It is imperative that one get his little half-wave doublet as high and clear as possible. Such an antenna, located on a one or two story building, down close to heavy traffic, may result in severe fluctuations of signal strength. Automobiles, trucks and elevated trains, if near low antennas, can, and will, cause a constant shift and change in the interference pattern, giving the effect of fading. Elevators and large steel doors can do this also.

The major interference, so far encountered both here and in England, is caused by automobile ignition systems. Airplanes can cause a similar series of clicks in the sound receiver and "snowstorms" in the video reproduction, but this would be most infrequent. Telephone exchanges have a definite, easily-recognizable effect above 30 mc., as do street cars.

In connection with locating one's antenna, bear this in mind: the range of transmission is roughly proportional to the square root of the height of both antennae (the telecaster's *and yours!*); also, the field intensity, at any point within optical distance, is directly proportional to the product of the two antennae elevations. Field intensity is the strength of useful signal arriving at your aerial.

While almost any piece of wire, from a hairpin to a phosphor-bronze hundred footer, will give reception on broadcast frequencies, an ultra-high-frequency (u-h-f) television antenna demands thought and care in its design, location and installation. First, it must be rigid, and neither the antenna or lead-in should sway in the wind.

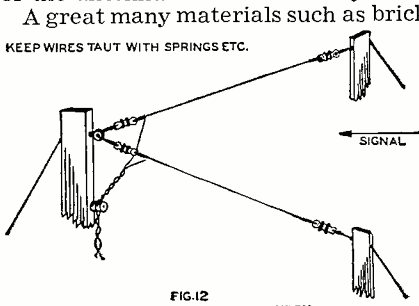
Second, because of reflection of waves from buildings and metal struc-



A horizontal television dipole.

tures, there may be *multi-path reception* at some locations. The signal will arrive (1) directly from the transmitter, (2) as reflected from a small rise in the ground between the station and the receiver, (3) from the side of a nearby large building, or possibly (4) from a gas tank. The result is blurring, double images and other undesirable picture abberations. Changes in the design, location and orientation of the antenna will be necessary.

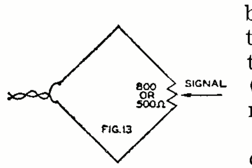
A great many materials such as brick,



A high-gain television "V" antenna.

stone, paving material, etc., are excellent reflectors of television frequencies at certain angles of incidence. Occasionally, where one cannot get a clear "line of sight" path to the transmitting antenna, because of a tall building, it will prove possible to get excellent reception via the reflection from some surface on another nearby structure.

Third, the antenna and its transmission line must be so constructed and terminated that reflections from the receiver end of the system do not bound back to the antenna and there be reflected so that they re-enter as a delayed (reflected) signal.



Diamond antenna.

Multi-path reception is considerably less when using horizontal polarization (doublet or di-pole parallel to ground) than when employing vertical polarization; the horizontal receiving antenna responds less to disturbances from automotive ignition systems. Both transmitting and receiving aerials must be for the same polarization, and the aerials so far erected on the Chrysler and Empire State buildings are for *horizontal* transmission, and *not* vertical as is generally supposed.

A brief explanation of blurring, double-images and cancellation is, perhaps, in order here. In a 12-inch *Kinescope* the spot on the screen travels horizontally at a speed of approximately 2½ miles per second. The radio wave, bringing the television program, travels at 187,000 miles per second, the ratio of these speeds being about one to seventy-five thousand. While the spot is traveling, let us say, 6/100th-inch on the screen, the radio wave will have travelled 400 feet.

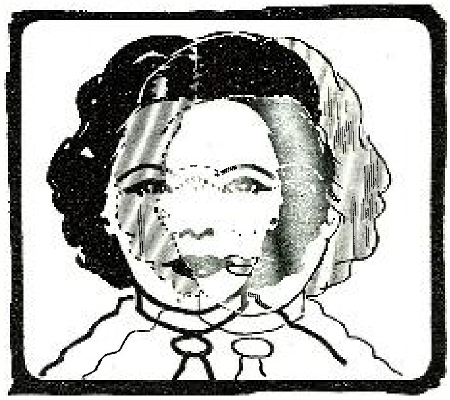
If now, both the direct wave and an equally-strong reflected wave (which has travelled 400 feet further) arrive at your antenna, two images will appear, one displaced (offset) about 1/16th-inch from the other. There will be a blurring of vertical lines, and, possibly, black lines repeated as white, or white as black.

Most of the doublet receiving antennas so far used in television research, and by the amateurs, for u-h-f work, have been made of brass or copper rod or tubing, usually copper tubing with the ends plugged. Recently, telescoping rods have appeared on the market that can be adjusted to various lengths. If copper tubing is used, it is recommended that each half of the doublet be anchored at its inner end, and another supporting bracket be secured near each outer end; quarter or three-eighths inch tubing is suggested (see Figure 11).

Sufficient accuracy in design will be secured if one merely divides 300 by the frequency in mc. to get the wavelength, then multiplies by 39 to put this in inches, divides by 12 to have feet, and divides by 2 for over-all length of a half-wave dipole. If one wished only to get the New York CBS transmissions, the procedure would be: center of the 50-56 mc. channel is 53, and this divided into 300 is 5.66 meters. Multiplied by 39 the result is 220.74, divided by 12 is 18.4 feet, and divided by 2 is 9.2 feet, which would be the proper length for such a dipole (overall). For use with these half-wave doublets, twisted pair transmission line is used, having a surge impedance of 90 to 120 ohms.

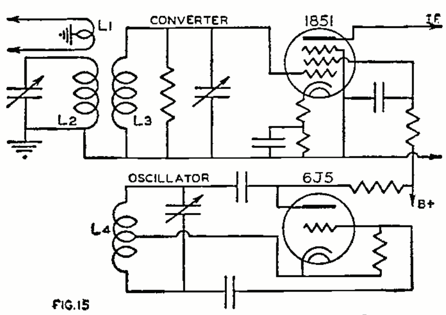
Should one prefer to design only for the adjacent NBC channel, the center frequency of which is 47 mc., the same arithmetic is followed to arrive at a length of 10.37 feet. Obviously, should the television set owner desire to get both channels, he would choose the center point of the 44-56 mc. range, start his calculations from 50 mc. and arrive at 9.75 feet or 9′9″. Leaving a 2-inch gap at the center between rods, each half of the doublet should be 4′9½″ long. Such an antenna should be placed so that it is at right angles to the direction of the transmitter.

For some months, many owners of television sets will have only one transmitter to which they can tune and the situation frequently may be such (due to distance or intervening ob-


How fading television signals look.

stacles) that insufficient signal reaches a doublet for satisfactory operation. For reception from but a single station, a Vee-Beam antenna, each leg of which is a full wave length long, has much to recommend it (see Figure 12).

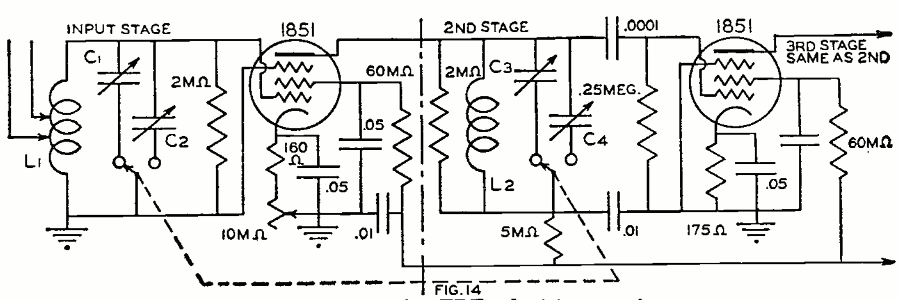
Presuming we wish to receive W2XBX, the NBC station, we cut two wires 20′9″ long (one wave length) and lay them parallel and on a line pointing toward the transmitter. The end of each which is furthest away from W2XBX is secured to a small insulation block corresponding to the



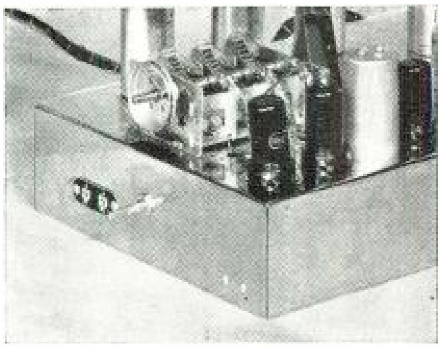
Low-gain input stage to superhet.

center block of a doublet. The end of each wire nearest W2XBX is now moved away from the direction line until the wire *forms a 52° angle* with the line. Thus we have a 104° "V", the open end of which faces the transmitter. Means must be provided for keeping the wires taut. The transmission line couples to the point of the "V."

The better antenna for two or three-channel pick-up, near the borders of the transmitters' effective service ranges, would be a diamond or rhombic (Figure 13). The open ends of two "V's" are brought together, and, at the apex toward the transmitters, one places a 500 to 800-ohm noninductive resistance. Each of the 4 legs is a



The input stage of a TRF television receiver.



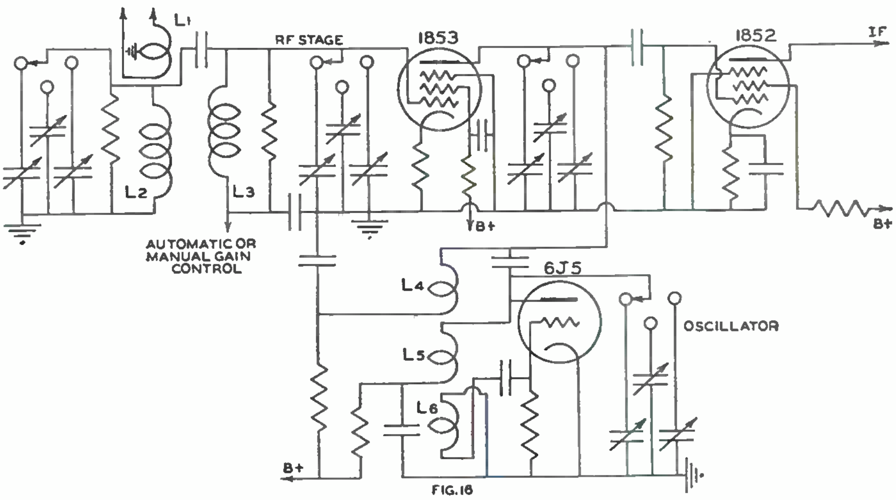
The business end of a TRF job.

wavelength long, the angle at each apex is 104°, the transmission line must present an impedance of 500 to 800 ohms. Other arrays will come into use to meet various conditions; double-doublets show good results. With half-wave doublets it is possible to place "directors" in front of the actual antenna; these can be a taut wire or rod slightly shorter than the antenna. Be-

for many months. For 1939, what telecasting there is will probably be confined to but two channels—the 44-50 and 50-56 megacycles.

This condition lends itself excellently to station pre-selection; construction such that one need only flip a switch or push a button to transfer from station to station. You set the r.f. input, the converter input and the oscillator circuits when the receiver is put into operation, and no more "tuning" is necessary.

While the above discussion has all been in terms of superheterodyne construction it must not be inferred that only "supers" can be used for television reception. If one is looking forward to active participation in this new field primarily as a service man, his thinking should be in terms of superheterodynes. Manufacturers of complete sets are developing their products around this circuit. If one has the means to build a more elaborate receiver, and has considerable test equipment at his



High-gain television superhet receiver input stages.

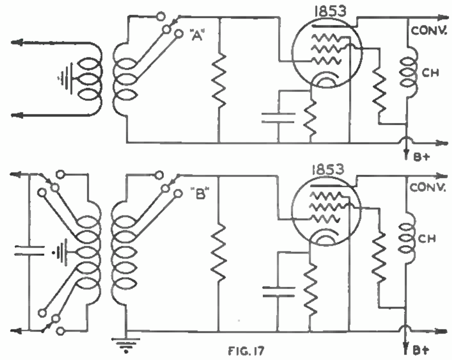
hind the antenna, one places wires or rods equal to, or slightly longer than the aerial proper, and known as "reflectors." So much for antennas.

Since, in television, the limit of the service area is reached rapidly, and there will be many set owners in areas of marginal field strength, radio frequency input circuits will have to be given extremely careful attention, so the remainder of this article will be devoted to them. There is one important point to be brought out at once; whereas in *sound* reception the input circuits must be constructed to be tunable to a large number of channels (broadcasting), or a wide choice of frequencies (amateur), television transmission will be on only *seven* channels

disposal, the thinking should be "super."

On the other hand, if parts' and tube costs must be carefully watched, the good old tuned r.f. circuit of early radio days is a fairly satisfactory answer. A 5-10 meter "ham" receiver (see RADIO NEWS, March, 1939, page 21) will take care of the audio transmission sent out with the video, and a comparatively simple video receiver can be concocted around some easily-made coils and inexpensive resistors. Varying amounts of expenditure between these two extremes will be found in a dozen different possible designs.

Getting into circuits, I wish to point out that, at this point in my series of lessons, comparatively little exact data

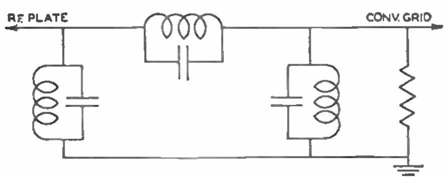


Extra high-gain input.

will be given. Only a small portion of the country, either by area or population, is as yet being served by telecasting stations, and this series is primarily a general picture of television, how it is done, and to prepare the serviceman for the coming lucrative field. If the reader is within the thirty-mile radius of a station, there are kits on the market and "how to build" data is available. Building will be a great deal more interesting, however, if you first learn television thoroughly here, and the reason for unusual design features that might otherwise puzzle you.

In Figure 14 is shown one of the simplest forms of input and tuned r.f. circuits yet to make an appearance for reception of video transmission. Inductances L_1 and L_2 should approximate 6 turns of No. 26 enamel on ½-inch forms, and condensers C_1, C_2, C_3 and C_4 may be 20 mmfd. air trimmers. If larger wire is used and turns are spaced, another turn may be required, or larger capacities.

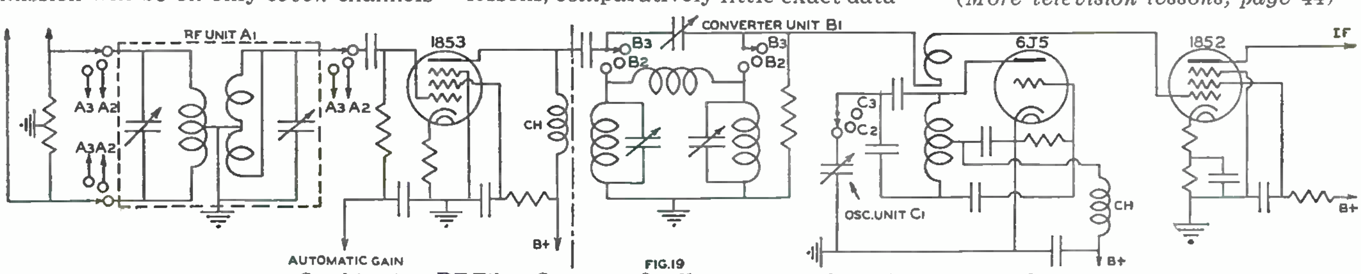
In planning these u-h-f circuits *keep this point in mind:* with a large capacity, the L/C ratio of the tuned circuit and, consequently, the circuit impedance, is low. This results in lowered over-all gain. It is desirable to use as much inductance (in coils) and as little capacity as possible. The range



Band-pass filter.

of 44 to 56 megacycles is a comparatively narrow one; try to build and adjust inductances so that television channels I and II are brought in when condenser plates are about one-eighth to one-fourth in mesh. This goes whether a "super" or a tuned r.f.

(*More television lessons, page* 44)



Combination RF-Filter-Converter-Oscillator stages of a television superhet.

AS I SEE IT!

By JOHN F. RIDER
Dean of the Servicemen

A serviceman has many problems which do not begin and end at his service bench. Mr. Rider gives his valuable view-point on the others.

John F. Rider

(The opinions expressed herein are solely those of the author, and do not necessarily represent those of the Publisher nor Editors of RADIO NEWS.)

Radio Facsimile

WITH all this talk about television, radio facsimile is being pushed into the background, at least during general discussions. Yet, as I see it, it's going to be a mighty potent force and of very vital interest to the radio servicing industry. This is not being said for the sake of filling space. The development of radio facsimile has reached a high order, and unless some people watch their "p's" and "q's," they are due for quite a surprise.

It is true that television offers tremendous possibilities. We are tremendously enthused, but somehow or other, we can still visualize people interested in still pictures and the text that accompanies them. Radio facsimile, from one angle, is the equivalent of the transmission of a miniature newspaper right into the home. Would you say that it is far-fetched to imagine the leading department store in a large community buying time on the air to send the day's bargains into the home for milady's breakfast?

A time clock turns the receiver "on" during the night and "off" when the period of transmission is completed. Maybe the same clock will change the tuning of the receiver to a second facsimile station, and the weather report followed by the station activities for that day are printed. This is followed by spot news, pictures, and perhaps even a "Wanted for hold-up" or "This baby is lost" facsimile broadcast.

The present-day press radio bulletins can be continued as facsimile transmissions with further details in the daily newspapers. The pictures now broadcast from the various parts of the world to the newspapers in the United States can readily be placed upon the air by means of a rebroadcast. People will become more familiar with what is to be found in the various editions of newspapers, and it may lead to greater consumption of newscopy than today without any such form of picture transmission to the public.

The area of transmission of radio facsimile is greater than that of television—the unit price of receivers likewise is less and the nature of the equipment is less complicated—all of which may tend to create widespread interest. Not that we are attempting to present a picture of facsimile displacing television, or even competing with television.... That would be foolish. But it cannot be denied that a facsimile transmitter is less expensive in every respect—hence, it can become the forerunner to television in those localities where television is not destined to appear for quite some time. And then again, what is wrong with the idea of both a radio facsimile receiver as well as a television receiver? Nothing at all—if this so-called modern world *is* really modern.

But who is going to service these receivers? That's a question that requires an answer. If we desired to be accused of reckless thinking, we would shout "today's serviceman". . . . We are fully aware that many men who read these lines will judge by what has happened during the past fifteen years and will say "Aw, we'll get by! That guy Rider is an alarmist."

There is nothing alarming about what we are saying. Of course, men will be found, but—but will they be the men who have spent half their lifetime doing service work or will it be a new crop of men—new men with specialized training? Will it be the independent man? Will it be the jobber's servicemen? The dealer's servicemen? Will each dealer require a complete service department of his own and thus squeeze the independent man out of business?

Let's stop kidding ourselves! Why not look the truth in the eye! Radio servicing is becoming a tough grind because radio development never ceases. It's been a hard life from the financial viewpoint, only because it has been comparatively easy from the technical viewpoint. Now that the technicalities are on the increase, the financial side will also improve. It can't help but improve because the price level of receivers will rise and because the number of men capable of coping with the problems which will arise, will decrease immediately with the introduction of facsimile and television transmission.

There is not a single radio receiver manufacturer interested in radio facsimile and television receivers who does not say that the servicing problem they will be forced to face is keeping them awake at night. I know that you have heard all of this before—year after year, but it can't be helped. There never is an end—no more than there is an end to the research work being carried out in radio laboratories.

It's tough to work in the daytime and study at night—to continue studying, reading—day after day—month after month—year after year, but you picked the servicing business yourself. No one forced you into it. Now that you're in it, there is but one road—forward. There is no standing still. When you stand still, you're going backward—because the world is moving forward.

The Postman Rings Twice

THERE is one thing we would like to know. Really, it is more than just mere curiosity that prompts this query. As a matter of fact, the subject has been discussed more than once among people who are responsible for service meetings.

Why is it that servicemen who attend service meetings seldom, if ever, write a letter to the sponsor of a meeting to express their opinions? Is it because the meetings are of little interest? Or is it because so little is gained from the meeting? Or is it because the men who attend are there for the beer, pretzels and sandwiches.

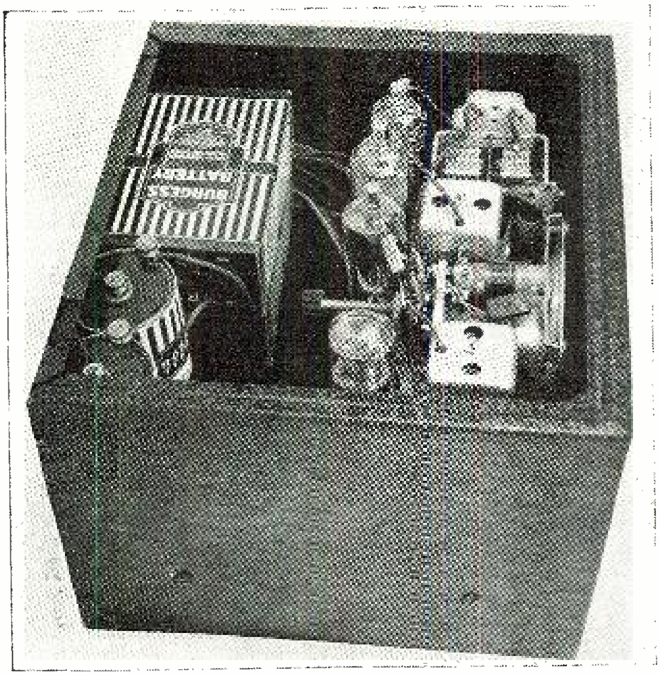
No one expects every person who attends to rush right home and burn the midnight oil writing letters, but don't you think that some evidence of either satisfaction or dissatisfaction is justified? Perhaps you feel that purchasing the sponsor's product is sufficient evidence. You're right; it is evidence of appreciation, but it is so little trouble to write a postcard stating that you enjoyed the meeting or to state that the subject discussed was over

(*Further discussion on page* 49)

3 Ba... M...ge... $ . .

by A. B. CAVENDISH
Savannah, Georgia

Want to know what the weather will be? Convert that cheap little midget for the "long" waves.



The completed conversion for battery operation.

THERE are many radio listeners that do not know what a great amount of information and pleasure may be had by tuning in the long wave band that begins where the broadcast band stops. Activity is to be found on these frequencies day and night, and they include weather-reports from all directions, instructions to fliers as they land, general information and the ever-present beacon signals that guide the planes in flight. A certain amount of romance is to be found in listening in on these transmissions.

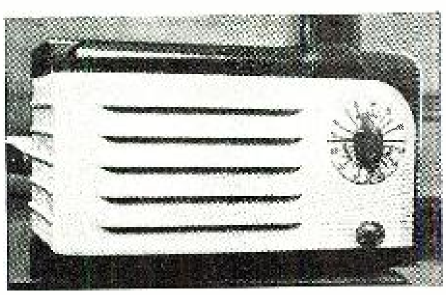
Normally, receivers that are designed for the inclusion of the long-waves, are rather expensive to the listener who can afford only the midget type of set. The serviceman or radio-minded experimenter or listener can adapt many of these sets to include the long-wave bands at low cost. Most all of the parts needed can be salvaged from almost any set and even if new parts are purchased, the cost will be far less than if a set were bought to include these beacon frequencies.

The parts do not have to come from any particular type of set as long as the values will meet the specifications as set forth for this change-over. The older midgets may be used as well as the newer sets, particularly if they have an intermediate frequency of 175 kilocycles (if a super-het), as it is then possible to cover a greater range than those using an i.f. of 456 kc.

The receiver may also be adapted to battery operation so as to be of further use to the user as a portable radio or direction-finder. Some of these little sets operate on short-wave as well as on the broadcast band and these are ideal as a nucleus for the conversion. The receiver selected for analysis is one of typical variety and is a five tube super-het that takes in the broadcast and the 2-6 mc. bands.

The first thing to consider is the tube requirements and the ones chosen will depend upon the original ones used in the receiver. Battery substitutes can be found by referring to the tube manuals and by direct comparison of their characteristics. Tubes are now on the market in the 1½ volt series which may be used to full advantage as to sensitivity, and low plate voltage requirements so no difficulty should be experienced in finding the correct substitutes when making the following changes.

The receiver should be removed from its cabinet for examination in order to determine how much room will be available for the extra parts. Fortunately, the rectifier tube will not be needed so we can figure on this space for a dual-trimmer or other parts we may need in order to complete the conversion. The governing factor as to range we may cover will depend almost entirely upon the i.f. frequency, and the method used in the original receiver in padding the oscillator section of the tuning condenser.



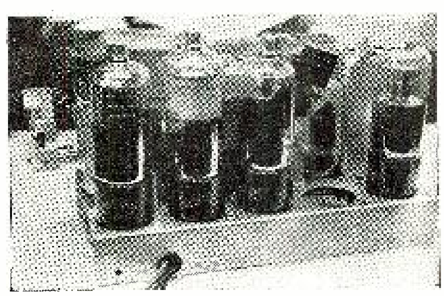
The midget BC set before conversion.

The set shown in the illustration uses a two-gang condenser with cut plates in the osc. section. These plates are arranged so that the tuning between one section and the other will be the same as the i.f. frequency throughout the tuning range and extra padders will not be needed in order to offset the effect of identical condenser sections if they were used. Some of the earlier sets will have condenser sections of the same minimum and maximum capacities and padders will be found that have been adjusted at both the high and low end of rotation.

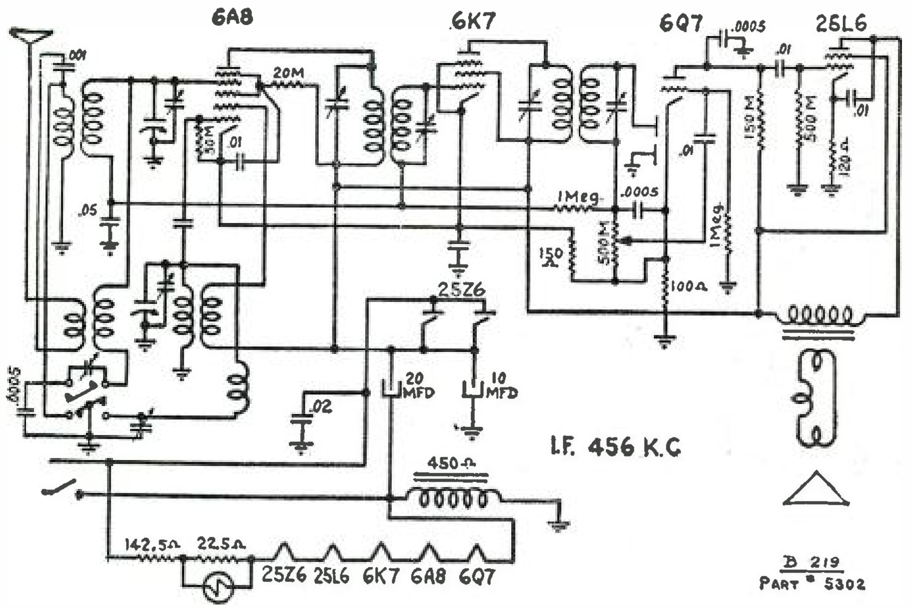
We can only expect to add long-wave tuning up to a certain piont unless we go into adding extra coils on a receiver that uses an i.f. frequency of 456 kc., but we can add enough to receive the beacons that operate just above the broadcast band. On the other hand, if a frequency of 175 kc. is used on our receiver, we can cover the extra frequencies up to about 200 or 250 kc.

All we need to accomplish the desired results are a two-section switch and a dual 200-600 mmfd. padding condenser. The method used in lining up the set is as follows: Connect and wire the extra parts as shown in the illustration or in any similar arrangement that will permit short connections to be made to the tuning condenser.

Locate the station at the low-frequency end of the broadcast band with the switch off and then cut-in the extra padders by means of the switch so that this same station will be found at the high-frequency end of the added long-wave band. Set the padders that are now in circuit to bring the station in at maximum signal strength. Now rotate the tuning condensers and lo-



The completed inside conversion.



Circuit diagram of the original midget receiver.

cate the first beacon that can be received. The added padding will not hold for the additional range, but by adjusting the trimmers to the center of the band, sensitivity will not drop off to any marked degree.

Some receivers have the i.f. transformer cans mounted in a position where the bottom leads may be reached. It is sometimes possible to lower the i.f. frequency to 175 kc. in these 456 kc. units by adding padding condensers in shunt with the trimmers on the transformers but this can only be done where long leads are not required. Circuit instability and oscillation will result if these leads are made too long. A four-gang, two-position switch may be placed at the rear of the chassis to accomplish this extra feature.

It is fortunate that most midgets incorporate the same basic designs, so our method used in converting the receiver shown will hold true for the majority of sets. After we have determined what frequencies we can cover, we may proceed with the change-over to battery operation.

First, all of the tubes are removed and the space formerly occupied by the rectifier will now be available for some of the extra parts. The line-cord resistor and all of the associated power supply parts are removed. If the receiver has automatic volume control it will be best to take it out, for if the set is to be used as a direction-finder, it will be much harder to distinguish the null point due to the action of the a.v.c. as the set is tuned and the loop rotated.

The speaker should also be removed unless it happens to be of the permanent-magnet type that we wish to use. The earlier sets used small magnetic speakers and these may be left in position if they are already provided. Rewire the set to the circuit shown. Extra room will be had that was occupied by the filter condenser, the a.v.c. resistors, line-cord, and certain by-pass condensers so the layman will have easier going in this respect than the person who wired the set in its original form.

Do not disturb the wiring of the tuning circuits, the coils or padders, as much effort will be saved by having the tuning already set upon completion of the change-over. It will be necessary to rewire the filaments to the parallel type of connection for the battery type tubes used. The speaker may be removed from one of the earlier receivers or if better fidelity is wanted, one of the 3" permanent-magnet types can be installed.

It will be necessary to use a "C" battery for bias in the new version and this may be of the small cell type. If screen-grid voltage control is added, a dual-switch should be incorporated so that the "B" battery will not be connected to the potentiometer when the set is not in use. In this way no current can be drawn by the potentiometer acting as a bleeder across the voltage source.

Many of the original parts may be used, but where different values are given, they should be substituted. In most cases the sensitivity will be equal to the original, as the voltages to the tubes will be about the same with the exception of the filaments. So many sets have been sold on the market that it would be impossible to consider all types and circuits in this article. Many of these little sets have been traded in from time to time and the serviceman should have no trouble in finding one in his shop. Some of the mantel type of receivers can also be adapted to battery operation. Tuned-radio-frequency sets are very well adapted to this service, as the problems of tracking are simplified and the range may be extended to include more of the longer wave-lengths.

In mounting the converted receiver, it is best to install the set and batteries in one of the standard metal boxes now on the market. A handle may be provided to add to the portability of the complete unit. A metal box will be best if accurate performance is wanted when the set is being used with a loop antenna for direction-finding.

A good ground is always needed on a battery-operated receiver for peak performance and should be provided wherever possible. If the original antenna is to be used, the full length of the wire must be used as the original coils were designed to work with a given amount of pickup and the circuits were tuned for this amount of wire. A loop antenna may be used and reference to the article on that subject in this issue of RADIO NEWS may be made for complete information.

Sufficient sensitivity may be had from these sets to bring in stations many hundreds of miles away, in fact, both coasts have been heard with good volume on the set illustrated. The improvements in tube design during the past several years have made more compact designs possible than were dreamed of in the past. By using these tubes properly, we can take full advantage of these improvements and enjoy many hours of operation before it is necessary to replace the batteries.

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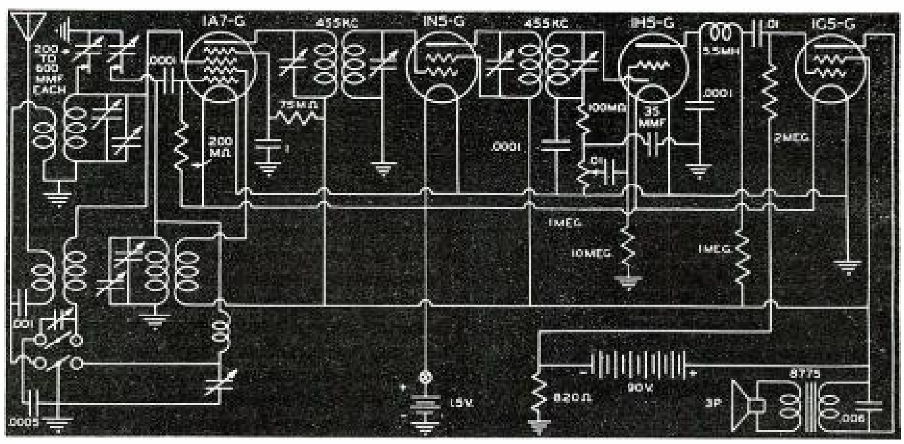


Circuit diagram of the converted midget. Note new values.

Notice the ventilation holes for the resistors underneath.

When high-gain amplifiers are built, there is always the hum problem. The author solves it in an unusually effective way.

by GENE TURNEY, W2APT
E. Elmhurst, L. I., N. Y.

A Flexible Amplifier

WITH many amplifiers that have been built by servicemen, experimenters and amateurs there has been trouble with "hum" and "motorboating." Partly, these ills are caused by poor design and partly by poor execution of a good design. In the amplifier described these troubles have been overcome by careful shielding and by the use of d.c. on the heaters of some of the tubes.

The two high-gain input channels use type 6T7G tubes in a resistance coupled circuit. Since the 6T7G tubes have diode plates which are not used, these plates are grounded.

All possibility of "motorboating" and hum are eliminated in the 6T7G stages through the use of a two section resistance-capacity plate filter comprised of a 250,000 and 50,000 ohm resistor and two 4 microfarad condensers. As previously mentioned, direct current is used on the heater circuit of these tubes; and in order to keep down the filament power, 150 milliampere tubes are employed. Direct current is obtained in the negative return circuit ground of the high-voltage supply.

The second stage in the amplifier serves as an electronic mixer as well as an amplifier. Since there are two channels, two tubes are used, both of them 6L5G's requiring 150 mills filament current which is obtained from the d.c. power supply. By means of switches, the grids of these tubes can be connected either to the phonograph inputs or to the output of the first amplifier tubes. Variable potentiometers are used in the grid circuits to provide control of the volume in either channel. Mixing is thereby obtained as the plates of both tubes are connected in parallel insofar as signal currents are concerned.

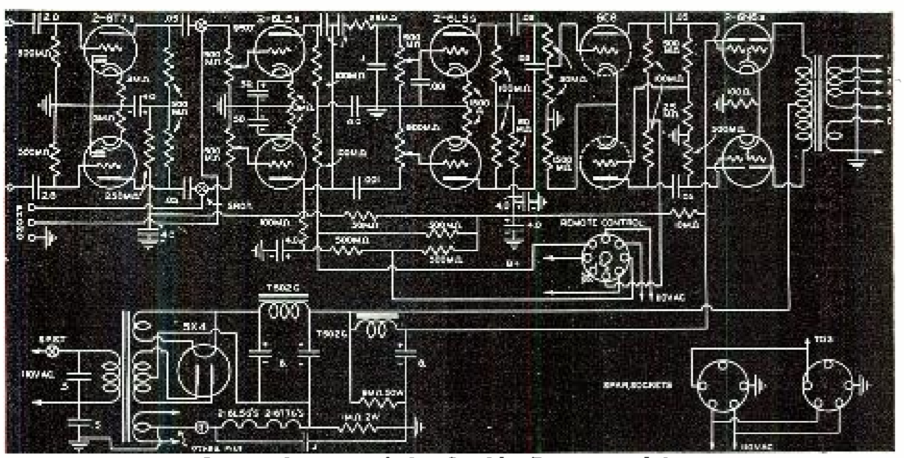
The direct-current circuits of the two mixer tubes are kept separate so that they can be controlled from a remote point. Volume control from a remote point is obtained by varying the voltage on the plates of the mixer tubes.

Because the circuits involved carry only direct currents and none of the signal currents, the remote controller has no effect on the tone or quality of the signal, and the remote controls can be located at any distance desired. When the "wireless" type of remote controller is used, the power for the control unit is obtained from the remote socket and connections are automatically made to the power line for the transfer of the carrier current.

The third stage of the amplifier is made up of the electronic tone corrector, a device which provides individual control of the high and low frequencies. In principle, the circuit is quite simple—in practical operation, very effective.

The outputs of the mixer stage are passed on to the two tone correctors. One of the tone correctors has an input circuit so designed as to bypass all the high frequencies while giving full amplification to the lows. And oppositely, the other tone corrector stage passes all the highs and attenuates the lows. The bass tube (top 6L5G) has a .1 mfd. coupling condenser which passes the bass and a .1 mfd. bypass condenser across the 500,000 ohm control which kills the highs. The .001 mfd. condenser from grid to ground effectively bypasses any highs which might have passed through the input circuits.

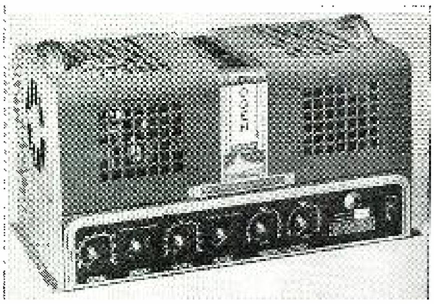
The lower 6L5G tube which is the high-frequency tone corrector has a small coupling condenser of .001 mfd. that passes only the high frequencies,



Circuit diagram of the flexible *Bogen* amplifier.

since its impedance to low frequencies is very high. In operation, the outputs of the two 6L5G tubes are balanced by the operator to provide proper blending of the highs and lows.

Following the tone corrector stage is the final voltage amplifier and phase inverter tube combined in a single 6C8G dual triode tube. One section of the tube is used as a straight voltage amplifier to drive the top 6N6G tube to its full output. The other section of the tube is employed as a phase inverter to supply the other 6N6G



The amplifier with the cover on.

tube with a signal voltage equal to that of the other tube but 180° out of phase for proper push-pull operation.

Since the gain of the 6C8G tube is approximately 21 in the circuit used, it is necessary to reduce the grid input to the phase inverter section of the tube to 1/21 of the output of the amplifier section. This is accomplished through the use of a 500,000 and 25,000 ohm resistor in series. Thus the phase inverter tube delivers the same voltage to the grid of the bottom 6N6G tube as is delivered to the top section. However, due to the tube action, the voltage is 180° out of phase required for p.p. operation.

The output of the 6C8G tubes are coupled to the grids of the input sections of the 6N6G direct-coupled amplifier tubes in push-pull. These output tubes provide an output of 18 watts. Since the tubes are in push-pull, no cathode bypass condenser is required. This is also true of the 6C8G stage. Note that the plate supply to the input section of the 6N6G tube is obtained after the second choke in the power supply in order to keep the hum level at a low value.

An output transformer has impedances of 2, 4, 9, 15, and 500 ohms.

In keeping with good engineering design, each stage in the amplifier is isolated from the others by means of resistance-capacity filters. As a result there is no noticeable hum or instability in spite of the high gain of 125 DB.

The tubes having d.c. on the heaters are wired in series with the pilot light which acts as a fuse and indicator. This 150 milliampere bulb flickers slightly during the amplifier operation and thus acts as an indicator for proper operation. At full output the pilot light is somewhat brighter than at no output because of the added current drawn by the output tubes, but this is normal.

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The VIDEO Reporter

by W. C. DORF

APPROXIMATELY 100,000 television sets will be sold to the American public in 1939. This prediction was made by Mr. Stanton Griffis, of Paramount Pictures, Inc., at the annual conference of the National Board of Review of Motion Pictures, recently held in New York City. Paramount Pictures with the Dumont Labs, manufacturers of television receivers, cathode-ray tubes, and other tele-equipment, have been carrying on considerable research work in the video field, and with their combined resources this statement has more than a mere wish behind it.

It would appear at first glance that this estimated number of television sets for '39 is a highly optimistic prediction in anybody's language. However, it should be remembered that the prophecy was made for the U. S. and if the job is done right, from transmission to reception, with that very important factor of program cost properly niched, the acceleration of sales might be a chartist's dream of a vertical rising line.

Your reporter discussed this question and others with several manufacturers, laymen, experimenters and amateurs and it was both interesting and enlightening to note their relevant remarks. The executives thought that the figure of 100.000 should be divided by 10. The typical radio listener was of the opinion that the received image had to be good, no recurrence of the scanning disc flop of a few years ago, not too many controls and there would be buyers for sight and sound sets, willing to pay from $100 to $250. Experimenters were somewhat indefinite about the whole thing. However, they asked innumerable questions, what was the cost of a so-and-so C.R. tube, who put out the best kit, when would transmission start, and other inquiries—all of which adds up to —what do you think?

CBS Screens Out Electrical "Bugs"

THE monitor room of Columbia's television transmitter, located on the 74th floor of the Chrysler Building, has been completely screened by a double thickness of finely-woven bronze mosquito netting.

The purpose of these screens is to keep electrical rather than flesh-and-blood "bugs" out of the manitor equipment where images and sounds being televised are checked for the last time before leaving the skyscraper's antenna system. The entire room has been acoustically treated as well and provided with double floors, doors, ceilings and walls to protect the delicate equipment inside from extraneous noises which might tend to blur the sound portions of the programs.

Arrangements also have been made so that both sound and picture signals may be monitored, either as they arrive from CBS television studios in the Grand Central Terminal Building across the street, or just before they are radiated from the tower antenna. CBS television experimental licensc is W2XAK; its transmitter is designed to operate with a peak power of 30 kw. and provide primary coverage within a radius of about 40 miles. The sound will be on 55.75 mcs. and the picture between 50-55.25 mcs.

New Tele Lab Speeds Progress

THE National Union Radio Corp. announces a complete television testing laboratory to assist, free of charge, radio set makers in the design and manufacture of their sight receivers. Put in operation under the joint direction of W. M. Perkins and M. G. Nicholson, the television "proving grounds" will be available to gauge the efficiency of circuits and equipment. National Union is designing and building its own scientific apparatus which can test precisely, from all engineering and consumer angles, the practicability of sight and sound receiver models.

Latest Aid to Surgery

THE American Television Corp. reports that the surgical amphitheatre of a prominent Brooklyn hospital will soon be equipped to televise actual surgery so that student observers in the medical gallery can see detailed close-ups of the proceedings.

An electric camera, similar to the type used in regular television broadcasts, will be suspended with the lights over the operating table. The equipment designed by their engineers will pick up complete details of the operating and transmit them by cable to the screens of receiving sets located at various points in the gallery and in the offices of

Cause, top;—result, bottom.

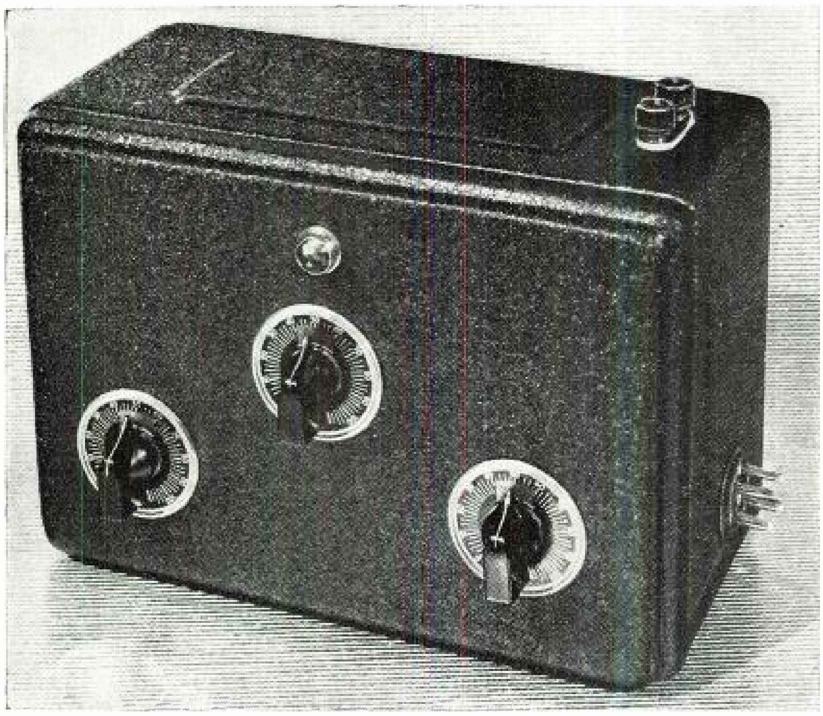
surgeons and consultants on other floors of the hospital. The receiving screen will reveal an image about fifteen inches in width.

The televised impulses of light and shade are not radioed as a broadcast, but are confined by wire to the building in which the camera-to-receiver circuit is completed. Each receiving device, known as the "kinet," is equipped with its own cathode ray tube, on which the image appears, and its individual power supply and tuning controls.

FCC News

RECENTLY an application of the Milwaukee Journal Company to inaugurate an experimental television service to the public, and a proposal for television transmission standards, were referred to the Federal Communications Commission for study

(*Televise further on page 58*)



This serviceman's calibrator is compact and efficient.

A power oscillator which can be used to align receivers and instruments. An excellent sub-standard.

By RAYMOND P. ADAMS
Laguna Beach, California

A Serviceman's Practical Calibrator

THERE are times when the amateur and experimenter finds it advisable to maintain peak operating efficiency in his receiver by re-aligning the i.f. channel and by spot-checking the front-end to assure both accurate r.f. tracking and dial readings precisely related to tunable frequency. Unfortunately, however, the average enthusiast does not own a laboratory-type signal generator which will make a precision line-up possible, and he must either wait until some fortunate circumstance gives him access to an oscillator which will do the trick or have the job done outside. Guess work, or alignment against some received signal or noise level is of course a third possible, perhaps a common, but unquestionably a discredited and inadvisable course of action.

When all is said and done, it is really best policy to have a good oscillator—tunable over an extended range of frequencies, inclusive of the i.f., at hand for use from time to time and whenever the necessity for re-peaking should arise. That's certainly clear enough. But such an instrument, if it is to be really dependable and engineered for long-time precision service, and whether it is a home-constructed or factory-made job, generally runs into considerable money in the construction or acquisition; and, further, it involves, because of its cost and the probable infrequency of its application, a questionably sound investment.

In other words, a costly, high precision signal generator has about the same functional value to the average superheterodyne owner as a ten ton truck to a man who moves his few belongings two or three times a year. It's useful, but only on occasion. What this average owner *should* possess is something far less professional, perhaps much less complete, but in line with his particular requirements.

It should be built to do certain specific and necessary jobs speedily and with the highest possible accuracy. An oscillator which would be easy to construct and which in the building would call for a minimum of radio technical knowledge, which would *primarily* be useful in aligning the i.f. channel to precise operating peak frequency, which would be markedly inexpensive, and which when once completed and in application might be extremely simple to use should be considered. If he had such a job there'd be no reason on earth for him to doubt either its usefulness or the practicability of the less-than-ten-dollar investment for which a precision instrument *can* be actually built.

The Design

The little line-up oscillator which this article describes was built to meet general requirements. It is recommended for duplication by any RADIO NEWS reader who owns and operates a superheterodyne and desires a quick means of re-aligning and checking his receiver, including the i.f. section.

This job requires only a small shield can, three sockets, a few condensers and resistors, a double-pole multi-position switch, a couple of r.f. chokes, three potentiometers, two tubes, and a low cost filter or for high frequency signal output, a transmitter-type crystal for its construction.

The generator produces a signal at the crystal frequency and at crystal harmonics, and this signal may be modulated if we wish. Only four controls are required: the switch, which is on the back panel and whose adjustment need not be changed except when plugging in crystals of widely separated frequencies, the front panel potentiometers which select the output level, degree of modulation, and modulator or audio note. A receptacle on the rear cover permits plug-in connection to a power supply cable. (Any small power pack will provide the 180 volts of "B" and 6.3 volts of "A" potential required for generator operation; or the receiver can be made to provide this power if the receiver's transformer will handle an additional 20 ma. current drain and 1.1 ampere "A" drain.)

(Turn the page, please)

The Circuit

There is nothing at all complex about the circuit; it combines the elemental and dependable Pierce r.f. oscillator layout with a similarly basic and understandable a.f. generator setup, coupling the outputs of both in a mixer and output stage.

Two tubes are employed—a 6N7 and a 6L7. One triode section of the first-mentioned is in the r.f. signal generating circuit, which, to begin with, we shall discuss briefly.

The crystal, cut to the receiver's i.f. or any other desired frequency, is plugged-in to connect between grid and associated plate in the conventional Pierce manner. A one megohm grid leak, tied between the grid and ground, is bridged by either one of two capacitors, as determined by switch selection. A .00025 mfd. mica unit, which provides for oscillation at standard i.f. frequencies; and a .0001 mfd. unit which is generally satisfactory when higher frequency crystals are plugged into the circuit. These condensers may be fixed in value in order to provide for proper grid excitation. As they are fairly critical, it might be wise to employ semi-variable trimmers, adjustable in as wide a range of capacity as possible.

The condensers are related in circuit connection to two plate chokes—60 mhy. and 2.5 mhy.—wired to the switch so that when the .00025 mfd. capacitor is cut in for intermediate frequency signal output, the higher inductance is in service, and so that when the other condenser is connected, the high frequency choke is brought into the plate circuit.

The switch which we have used, by the way, is a five pole affair; it is quite possible to work into five individual grid condensers, and this might be an advisable move (values determined through experiment) when and if optimum excitation is in order for crystals of any frequency value. However, the two recommended capacitors or any others determined through experiment to be proper for the intermediate and the other for high frequency service will be satisfactory.

The number of chokes need not be increased, nor the specified values changed, as these two items will work out satisfactorily. If the oscillator is to provide a signal at the intermediate frequency only, we will need only the .00025 mfd. condenser and 60 mhy. choke—and the switch may be dispensed with.

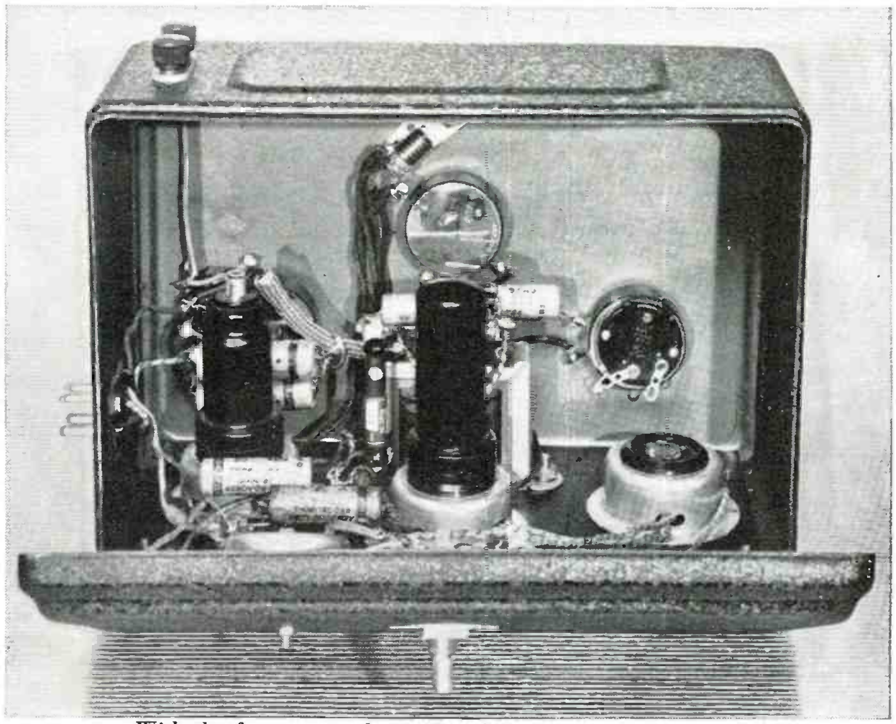
The second section of the 6N7 is used as our a.f. oscillator triode, working in a circuit which normally produces a 400 cycle note. The transformer is a midget output job, designed to match push-pull plates to a speaker voice coil. Parallel plate feed is featured necessarily.

If the single note is all that we need, we may remove the tone control from the panel. However, it is sometimes desirable to effect a selection of higher than 400 cycle a.f. oscillation.

There are two simple methods of doing this. We may depend upon the familiar C and variable R series combination, bridged across the transformer as indicated in the circuit drawing in which case the potentiometer permits a more or less gradual increase in the a.f. frequency over a range determined by the constants employed and at a rate of change determined by these constants and by the taper of the potentiometer; or we may rely upon switch selection of any of several condensers for such bridging. The values used may be connected individually or in parallel—depending upon the type of switch—to produce the desired tones within oscillation limits.

We have deliberately refrained from specifying constants as we feel that individual builders will want to experiment somewhat with available items in working out a suitable a.f. frequency control; but we can say, in any event, that the single capacity in the possible C-R combination case, or the highest capacity in the other will not need to exceed about .05 mfds.

Our output tube is a 6L7. The injector grid is coupled to the r.f. oscillator's plate circuit through the .0001 condenser C3 and the signal or number one grid to the a.f. oscillator circuit by means of the transformer's low impedance or voice coil secondary. The level of a.f. for signal modulation is determined through adjustment of the R7 potentiometer, and overall output level is determined through adjustment of R6. Both R6 and R7 return directly to chassis and ground so that we may effect zero output and zero modulation.

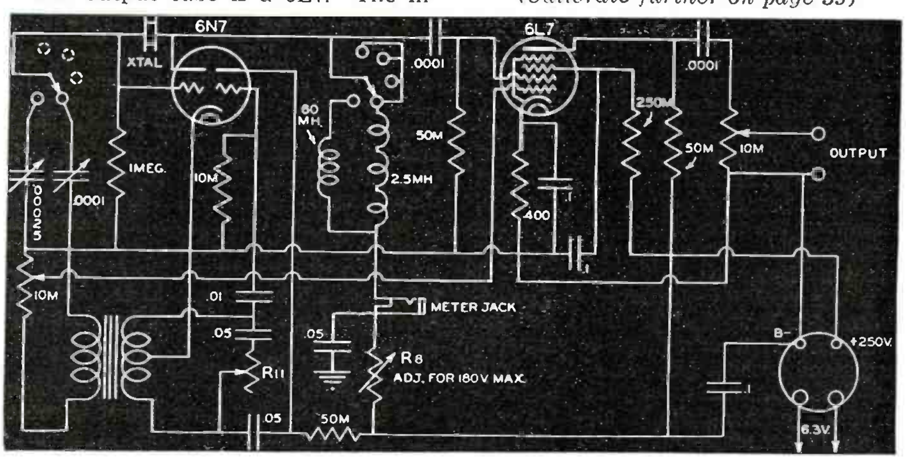


With the front cover down, the placement is easy to get at.

Construction

The oscillator is built into the familiar Crowe type 245 can, which is just the proper size for the job and makes for a very well shielded and good-looking instrument. Modulator, a.f. frequency, and output controls are assembled on the front cover or panel; and the C_1-r.f.c. selector switch and the r.f. plate circuit jack are mounted on the back. The jack, by the way, should be of the closed circuit type, should be completely insulated from the can, and should be of midget construction, as

(Calibrate further on page 59)



A[illegible] ev[illegible]es

by I. QUEEN
Roxbury, Massachusetts

A very simple automatic tuning device can be made from odds and ends found in the usual serviceman's repair shop.

WIDE-AWAKE servicemen are taking full advantage of the opportunity to modernize the older broadcast receivers by adding push-button tuning. This extra source of revenue may be had at low cost to the serviceman as far as obtaining the needed parts are concerned, and the labor charge may be set in proportion to the amount of work involved in making the change-over.

Most of the older sets are provided with sufficient room to add the push-button assembly and the following paragraphs will cover the requirements in the installation and adjustments of the more popular types of units.

Those receivers which do not provide enough room for a push-button assembly may use the selector switch arrangements shown in this article.

The basic idea is the addition on the front panel for a rotary selector switch with sufficient taps automatically to connect different sets of trimmer condensers which have been pre-adjusted for desired stations into the circuit. The change is especially adaptable to sets using two variable condensers. Such sets are, for instance, the popular a.c.-d.c. midget receiver and the superheterodyne without pre-selector stages.

Let us assume that we have a superheterodyne receiver using two variable condensers which may be either ganged or separately tuned. One condenser tunes the oscillator and the other the antenna stage. For the automatic selection of 6 stations, then, a rotary switch is required which has two gangs and 7 positions on each gang. Each gang is then wired up so that it selects a trimmer condenser to tune to the desired station. One position on each gang is left unconnected, so that the set may be dial-tuned when desired for the reception of distant stations.

The trimmer condensers are connected to the different taps as per the diagram. It is to be noted that the existing variable condensers are left in the circuit at all times. They are merely set at some convenient position near their minimum capacity. This is done for several reasons. First, it is more convenient that they remain in the circuit. Second, dial-tuning is always available by turning the rotary switch to the *off* position. Third, drift due to trimmers is minimized because a smaller trimmer is required, and also the size and cost of the trimmers are less. Also in the case of certain superheterodynes which normally have some drift, it is still possible to compensate for it after about 15 minutes of operation by rotating the variable condensers slightly.

For stations up to 300 meters, the mica trimmer condensers can have a maximum value of 35 mmfd., up to 400 meters the value can be 150 mmfd. and above this wave-length the maximum value can be 300 mmfd. These values depend, of course, upon the coils already in the set and the capacity remaining in the circuit by the variable condensers, but the above values will apply in nearly all cases.

A single hole is first drilled in the front panel, where convenient, and the rotary switch is mounted. Such switches can be bought with a very attractive numbered plate and streamlined knob, a maximum diameter of less than 3″ being required on the panel. The trimmers are then wired in. The first position on the switch is left unwired. It is convenient to wire in the other positions according to wavelengths of desired stations but this is not necessary.

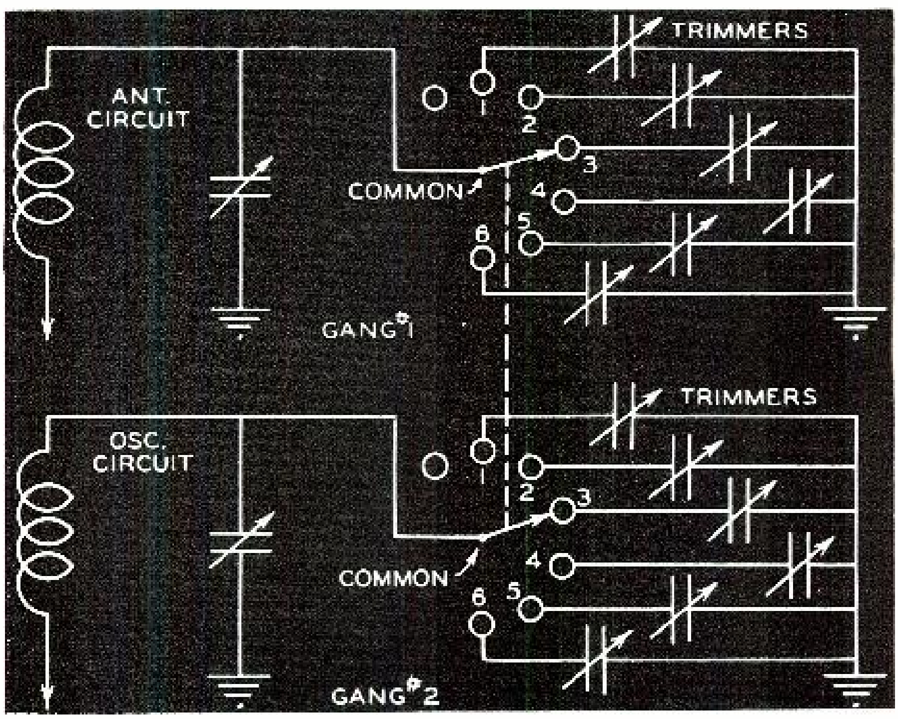
With the variable condensers remaining at their chosen position (near minimum) the trimmers are now adjusted one by one. First, the oscillator trimmer is tuned to maximum and then the antenna circuit trimmer for a given station and so on until all desired stations are received on their desired positions. It may be necessary after all wiring is done to go over the adjustments since the wiring may change the effective capacity of the condensers.

The total cost for parts including switch, plate and knob plus the trimmers (12 are required for 6 stations) should be well under $3.00. It may be possible, as I have found, that where two stations are close to each other (in wavelength) only one trimmer is required in the antenna circuit to tune both, since this circuit usually tunes broadly. In such a case the two adjoining taps on the switch are connected together. A few hours work should be sufficient to wire up such a system and tune the different condensers.

I have modernized several radio receivers in the past few weeks and find the results more than satisfactory. All the advantages of touch tuning are present such as convenience and speed in changing stations, accuracy of tuning (since each station is individually adjusted for maximum in all circuits), etc. At the same time if dial-tuning should ever be desired it is always available by merely changing the rotary to the *off* position.

The choice of which type of tuner (rotary or push-button) will be the

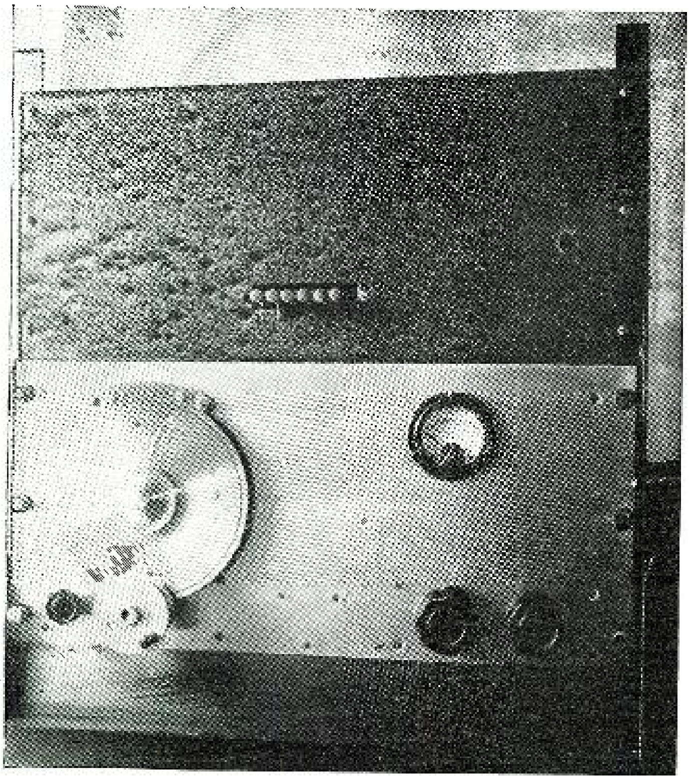
(*Tune in on page* 60, *please*)



Latest Audio Oscillator Developments

By L. FRANK JAMES BURRIS
R.K.O. Engineering Dept., Hollywood, California

For sheer use, no instrument is more valuable than a well engineered and constructed audio signal generator.



The front panel of the precision signal generator.

TO THE radio laboratory technician and sound engineer, there is no more fascinating nor intriguing piece of useful apparatus than the continuously variable audio signal generator. This instrument, in any one of a number of different forms, never fails to solicit a few interesting questions or comments from the bystander or fellow engineer. Hence, in ever-recurrent time intervals we may always expect to at least read of variations and valuable improvements upon this type of instrument.

There are several reasons for the interest found in variable audio signal generators. From the laboratory point of view such generators are invaluable for measurement calculations of coils, condensers, transformers, frequency discrimination networks, and amplifiers and associated apparatus. Otherwise the process of obtaining and maintaining suitable line characteristics of our coast-to-coast telephone and radio broadcast audio channels would be a long, costly and tedious one. Frequency measurements in the audio spectrum or audio-difference frequencies in monitoring radio frequency channels would also be a very difficult task. In the service field there is the ever-increasing necessity of auditorium sound measurements, isolation of speaker and cabinet resonances, and audio parasitic frequencies.

From the experimental point of view, or that of the hobbyist, such an instrument offers a most fertile field of study. The most practical types of circuits utilize the beat frequencies between two radio frequency vacuum tube oscillators to obtain the desired audio frequency.

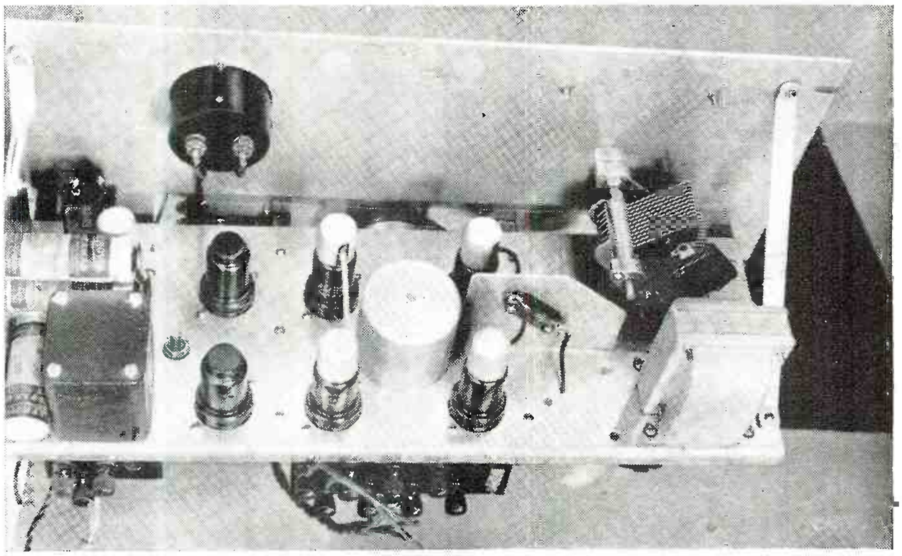
We are then confronted with the problems of designing radio frequency vacuum tube oscillator circuits which are flexible, yet free from frequency drift due to small variations of filament or plate voltage, loading, and ambient atmospheric conditions. Somewhere along the course of action the harmonic radio frequencies must be suppressed, before detection, along with the fundamentals. Aside from shielding and temperature isolation the above features necessitate very rigid mechanical construction of chassis, tuning condenser, tube, coil and fixed condenser components that are subject to atmospheric and temperature variations. Actually we arrive at a one-two-three of (1) freedom from frequency drift, (2) securing near as possible pure sine wave form, and (3) freedom from lock-in effect at the lower audio frequencies.

In dealing with the first of these problems let us consider a few approaches towards the solution by isolating a single vacuum tube radio frequency oscillating circuit, beating a harmonic of it against a radio broadcast carrier while listening in on a conventional receiver and then jotting down on our scratch pad some data concerning causes and effects. We say a *harmonic* of our isolated oscillator because it is well to operate this device in the frequency spectrum between two hundred and three hundred kilocycles, and then a carrier bearing of approximately ten or fifteen radio frequency cycles to each of the audio frequency cycles is had to the highest pitch we wish to generate. Our upper limit in the audio frequency spectrum should be twenty kilocycles, about the highest that the best of ears are able to hear. The lower limit should be about one cycle per second for then we are assured of fine performance above this period.

Now the percentage radio frequency drift will be less if we do not use too high a value of fundamental frequency, for while the radio frequency oscillators are operating at approximately two hundred times the average audio frequency produced (1000 cycles) yet a drift of only one radio frequency cycle in one of the oscillators results in a change of one audio cycle per second. Suppose we take a case with the fixed radio frequency oscillator operating at two hundred kilocycles and adjust the beat frequency for 1000 cycle output. Now consider a drift of the fixed oscillator of five cycles per second over a five minute period. In this case the percentage drift in the radio frequency oscillator is but 0.0025, while the corresponding percentage drift in reference to the audio frequency output would be 0.5. If the beat frequency had been adjusted to a lower value of, say, 25 cycles output the radio frequency percentage drift would have remained the same while the figure for the audio frequency would have jumped to the enormous quantity of 20 percent, an intolerable value or at least one that would necessitate incessant correction of the device if we were to obtain anything near accurate measurements. As will be noted later, the beat frequency in the new device described is not obtained between fundamentals, and at first conveys the impression that the above error would be multiplied. This, however, is not the story.

Since our radio oscillators are of the self-excited variety we may recall that one of the lessons learned in the old amateur shack in regard to oscillator frequency stability and power handling capacity was that of utilizing plenty of capacity in the tank circuit. But here the power in the plate circuit is infinitesimal and the value of capacity may greatly exceed that found by conventional calculation in the case of a class-C amplifier. Also, since it is more convenient to tune the variable radio frequency oscillator by varying the capacity rather than the inductance, it is well to have from five to ten times the capacity in the fixed shunting condensers as that in the variable unit. Then the capacity change over the entire audio range is but 10 to 20 percent of the total amount.

Herein is incorporated the feature of radical departure of design in our new generator, and while the principle has undergone a period of over three years development in the writer's laboratory, this is likely the first time that it is offered for the general experimenter. Radio oscillators feeding a common circuit do not perform well in proximity, a condition discussed later, when operating near the same frequency. It was at first deemed advisable to operate one unit at twice the frequency of the other. The second harmonic of the slower unit was then beaten against the fundamental of the faster unit to obtain the desired audio frequency. The result was so gratifying that the process was carried one step farther. One unit was caused to operate at 1.5 times the frequency of the other and this necessitated beating the second harmonic of the faster unit with the third harmonic of the slower unit. Thus not only the fundamentals but also the lower order harmonics were completely isolated from each other. The completed instrument was coupled to a cathode ray oscilloscope and one could place a straight edge upon the plane of the circular Lissjou figure in the neighborhood of ten cycles per second. This figure could be obtained in the oscilloscope, which is usually hard to adjust. At lower frequencies yielding more complex Lissjou figures, symmetrical complete cross-over figures were revealed to coincide. At five cycles the waveform was shown to begin distorting but a good semblance off the detector circuit was shown to represent a sine wave at less than two cycles per second.



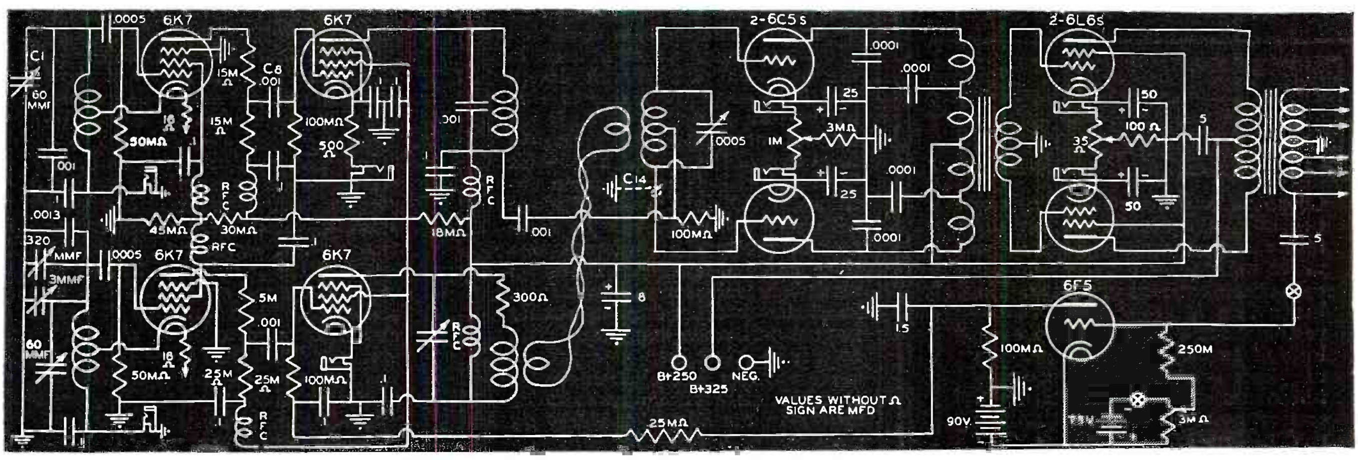
Note the extreme care used in the placement of the component parts.

If a 200 kilocycle base intermediate frequency is to be employed, this type of device calls for a variable radio frequency unit operating at 66,666 cycles per second and a fixed unit which operates at 100,000 cycles per second. The former would be tuned down to 60,000 cycles to allow an audio beat of 20 kilocycles in the output. In order to trim the tuning condenser and spread the lower end of the audio spectrum it is best to utilize an increase of tuning capacity (decreasing radio frequency of the variable unit) to obtain an increase in the audio frequency output. It is well to point out at this time the desirability of obtaining a near *logarithmic* scale for the variable tuning condenser, and if the builder does not wish to purchase one on the market he may construct it by cutting down the rotor on one of the straight line frequency types until the leading edge renders the appearance of a fat scissor blade. A bit of careful cut and try in this direction will yield the result and a condenser of the National 270 degree rotation variety will prove ideal.

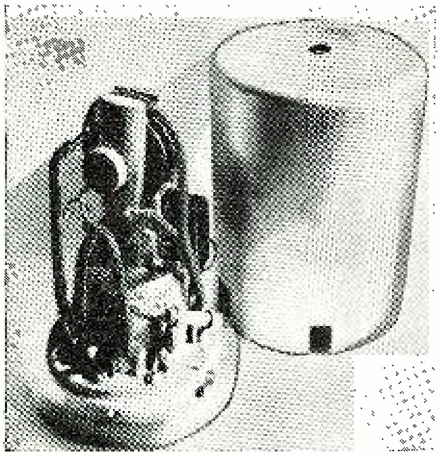
While the shape of the rotor may be accurately calculated the use of calculus in mathematics is made necessary and while this solution would hardly interest the average reader it is omitted here. Before we finish with tuning condensers it bears repeating that the variable unit must be rigidly constructed and secured to the panel and tuning dial with no chance for flexing nor backlash during operation. The fixed and shunting capacities should be of the highest grade silvered mica type. Those which are permanently dehydrated and guaranteed against variation due to normal heat and atmospheric changes are really cheap for this purpose and are generally available.

Having established our radio frequency range and proportional capacitances for the variable unit we may now delve into a bit of calculation in order to arrive at definite figures for the variable and fixed condensers and also for the inductances used in conjunction with these condensers.

For the variable unit, to produce zero beat audio frequency, let the highest operating frequency be



The circuit diagram of the precision signal generator.



The split secondary inductance unit.

$F = 66{,}666.66$ c/sec (1), the lowest operating frequency, $F = 60{,}000$ c/sec (2), where (2) produces an audio frequency of 20 kilocycles.

Let the variable capacity $C_v = 320$uufd (3), obtained by paring the leading edge of a standard 350uufd condenser of the type stated above.

Let C = fixed shunting capacity, to be determined. (4). It is now sufficient to make use of the formula for simple resonance:

$$F = \frac{1}{2n\sqrt{LC}} \quad (5).$$

By squaring both sides of (5) and transposing we have,

$$LC = \frac{1}{(2nF)^2} \quad (6).$$

Now let C_s = shunting fixed capacity (7), which alone produces maximum radio frequency and also the minimum or zero audio frequency.

Then C_1 = total maximum capacity (8), which produces minimum radio frequency and maximum audio frequency of 20 kilocycles.

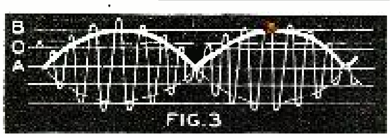
So $C_1 = C_s + 320$uufd (9).

Now, substituting in (6) for

$$C_s, LC_s = \left(\frac{1}{2n66{,}666}\right)^2 \quad (10),$$

and for

$$C_1, LC_1 = \left(\frac{1}{2n60{,}000}\right)^2 \quad (11).$$



Graphical representation of sum of two radio frequencies slightly differing but of same amplitude, as might be impressed upon grid circuit of conventional generator. The heavy line is proportional to the rectified but distorted audio envelope of two cycles as shown. An r.f. phase reversal results at audio internodes and the greater audio area between "O" and "B" causes the median line to be shifted to "X."

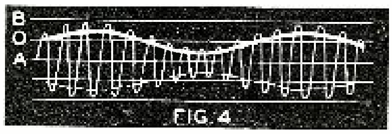
Dividing (10) by (11) to eliminate L,

$$\frac{C_s}{C_1} = \left(\frac{60{,}000}{66{,}666}\right)^2 = (0.9)^2, \text{ or } C_s = 0.81C_1 \quad (12).$$

Then $320\text{uufd} = 0.19C_1$, or $C_1 = \frac{320\text{uufd}}{0.19} = 1685\text{uufd}$ (13).

And from (9) $C_s = 1365$uufd = 0.001365ufd (14).

From this it is seen that we are within our minimum 1 to 5 total ratio for tuning and fixed capacities, a convenient occurrence in this case. If other and unacceptable conditions had resulted we should also have the limiting equation to contend with $C_s = 4C_{var}$ (15) which would become somewhat more involved.



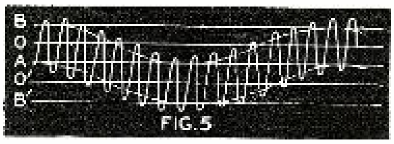
The result as shown in figure 3 when one r.f. sine wave is of much less amplitude than the other. At such low "modulation" values the r.f. phase reversal is not evident and the rectified audio envelope begins to assume the desired sine wave-shape.

Substituting for C_1 in (11) we may now solve for

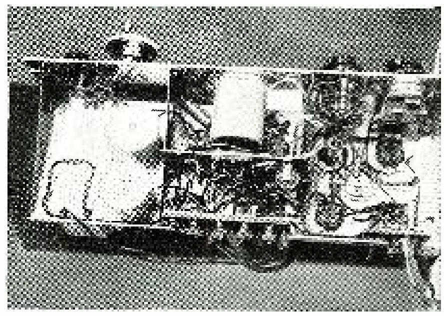
$$L\ \frac{1 \times 1{,}000{,}000}{(2n60{,}000)^2\ .001685} = 0.00418\text{h or } 4.18\text{mh} \quad (16).$$

For the 100 kilocycle fixed oscillator a 0.001mmf fixed condenser is sufficient for stability and this value, substituted in (5) yields L = 0.00254h or 2.54mh (17).

For the 200 kilocycle doubling and tripling transformer coils where the primary capacity is 0.001mfd, the inductance is accordingly found to be 0.635mh, (18), and for the secondary capacity of 0.0005mfd we likewise find the L = 1.27mh (19).



Graphical representation of high "modulation" in balanced sideband detection as employed in the new generator. The in-phase center-fed frequency would be suppressed in the balanced plate circuit except that it is swept from side to side by the link excitation which is 180 degrees out of phase upon one grid from that of the other. The result is that sidebands in the plate circuits are 180 degrees out of phase with each other and may be rectified to produce a push-pull sine wave audio frequency. The same result is experienced with hum from insufficiently filtered plate supply in push-pull audio amplifiers. The hum is in a balanced state and inaudible until grid excitation occurs, at which time ripple components appear in the output and may be measured or heard.

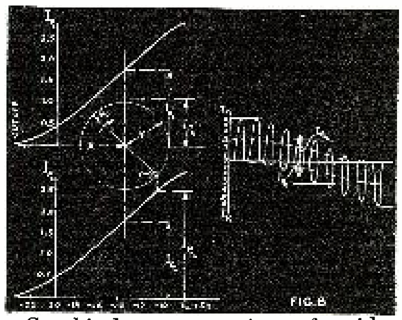


Under side the oscillator chassis.

If stock coils are used, turns may be removed to obtain the proper inductances, and in any case some trimming will have to be resorted to because of tube and stray capacities, overcoupling of transformer, loading, etc. The radio frequency oscillator tuning inductances may be conveniently wound in a close five or six layer bank formation, and it is best to use a cotton and enameled wire not smaller than number 28 or 30 which will be little affected by temperature changes and will have a low value of resistance. This is also quite easily workable.

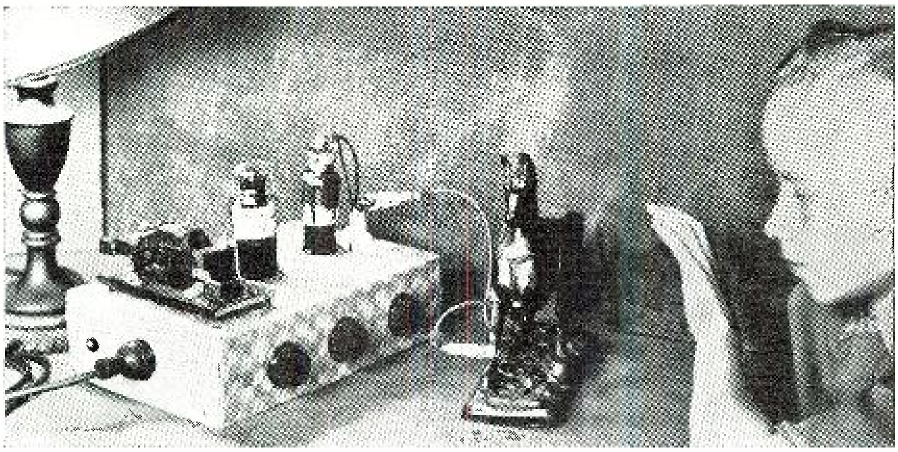
The coils should be impregnated and mounted in a rigid individual shield having no loose or sliding joints to change the absorption field. If steel shields are used, which do not have the temperature co-efficient of copper, the coils may be solidly mounted within, the leads brought out and the joints soldered. The mixing transformer coils are not subject to all these critical conditions to avoid drift so that small universal coils may be used. Since the

(*Raise frequency to page* 63)



Graphical representation of grid and plate circuit action in the balanced detector circuit. Fixed frequency excitation is adjusted to a value "X," from the d.c. cutoff bias region to the center of the straight portion of the curves. The total value of variable frequency excitation voltage across both halves of the detector grid coil is 2Y, equal to the projected straight portion of the curve. Peak values of "Y" are shown to revolve from the peak values of "X." The projected rectified waves for two tubes are shown in the second part of the diagram, where the dashed median line represents the audio waves.

Building a "Crowd Stopper"



Bringing the hand near the metal horse lights the light.

by STANLEY JOHNSON, W9LBV
Columbia, Missouri

Building a good crowd-stopper for the show window, makes a source of additional income.

IN a midwestern city, a group of people gathered before a shop window, watching a toy electric train move around the track. A small boy, standing on the sidewalk, was making the train stop and start by bringing his hand near a metal plate, held with suction cups to the inside of the window pane.

The youngster turned to his father and asked, "What makes it go?"

Father did not reply for a moment, then mumbled something about "there must be somebody behind the curtain" and took the boy's arm and the two of them moved on to less puzzling window displays.

The mechanism of the display was enough to puzzle most fathers. The most obvious guess, a photo-cell, was out of the question since there was no cell, no light source or tell-tale beam of light. Only a metal plate with a piece of wire connected to it.

The secret was a simple unit known as a "capacity relay" which was built with ordinary radio parts. When the input post of the unit is connected to a piece of metal a foot or so square, simply bringing the hand near the metal will trip two relays which will turn on any device operating on 110 volts. No direct physical contact is necessary, the increased capacity which results when a person's body is near the pick-up is sufficient to operate the relays. These in turn operate other electrical display apparatus.

The unit is entirely self-powered, operating from any 110-volt a.c. line. If the builder makes his own relays, the "capacity relay" costs less to build than a two-tube receiver. The radio fan, besides having a lot of fun experimenting with the unit, will find that he can make a nice profit by renting it to merchants for use in window displays.

The "capacity relay" consists of a 6D6 oscillator tube and a type 43 amplifier. A slight change in the plate current of the oscillator, caused by increasing the capacity to it, results in a sharp rise in the plate current of the 43 amplifier, thus closing the first relay (RL-1). This relay operates the second relay (RL-2) which acts as a switch in the 110-volt circuit, turning on a light, starting an electric fan, etc. Filament voltage for the tubes is obtained by means of a dropping resistor built in the line cord in familiar a.c.-d.c. set fashion. No rectification is necessary, the oscillator operating on a.c. current.

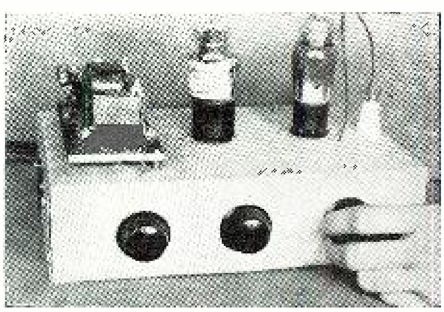
The heart of the unit is the first relay (RL-1). This relay must be quite sensitive, operating on five milliamperes or less. The builder can buy a relay of this type if he prefers, but an excellent one can be made for practically nothing. The one shown in the photographs was made from an old push-pull audio transformer, such as is used between push-pull pentode output tubes and the voice coil of a dynamic speaker. Select one which has a core in the shape of a closed "E." The straight core section is removed, leaving the core open on one side. A paddle-shaped arm of thin metal, preferably a piece of "transformer iron" from an old power transformer, is mounted on a bearing so that in its resting position it is ⅛ inch from the transformer core. Contact points, taken from an auto vibrator (of the type used in auto radios) or made from drops of solder, are mounted on one end of the arm and the other end is counter-balanced with a piece of solder or lead. This weight should be heavy enough so that the arm will balance at the bearing point.

A light spring, strong enough to hold the arm from the core during the "resting" position but not too strong to allow it to move to the core when the plate current rises, completes the relay. The plate of the type 43 tube is connected to one end of the push-pull winding on the transformer and the high voltage to the other end. The center-tap is unused as is the voice coil winding.

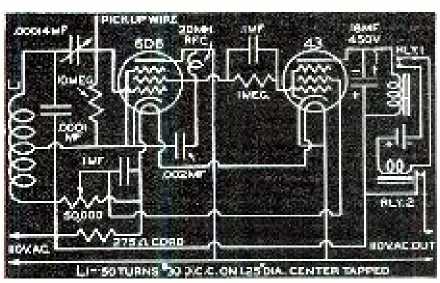
The relay which closes the 110-volt line circuit is made from an old automobile generator cut-out by removing the original winding, which consists of a few turns of heavy wire, and winding the core full of number 30 DCC wire. An amateur type "keying relay" may be used instead. When completed, the relay should close if connected to a dry cell or flashlight battery.

Once the relays are made, the rest

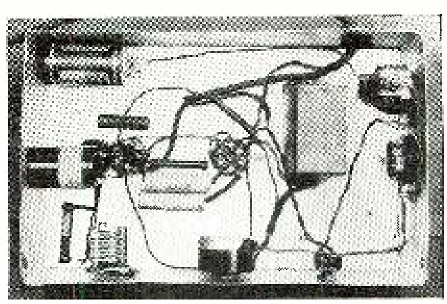
(*Stop them some more on page* 60)



The entire "works."



Circuit diagram of the "crowd-stopper."



Under the chassis.

Serviceman's Experiences

by LEE SHELDON
Chicago, Illinois

Be businesslike in your dealings with your customers, if you would avoid their thinking that you are a gyp.

NEITHER Al nor I shoot such a hot game of pool, but we get over to Buckley's *Beer, Bowling & Billiards* about once a month to play *rotation*. Buck is a steady customer, and Al insists it is good store policy to kick back some business at him, just to maintain reciprocal trade relations. A week doesn't pass when some bowler neglects to pour a highball over the chassis of the midget Buck keeps in the back room; and every so often a cue-ball hops into his record changer, with very beneficial results. Such men are worth knowing.

Anyway, Al and I closed up early one night last week, and went over to shoot some pool. I was in no mood for games; my last customer had been very unpleasant, and his obvious suspicion of our methods had left its mark on me. Business had been bad, and I began to suspect my partner of employing underhanded repair methods to—

"Hey!" shouted Al, poking me with his cue. "I suppose you'd come out of that trance when you got hungry—but let's get the game started!"

"Sorry," I said, holding myself aloof, as usual, instead of going up in the air. "Go ahead—you shoot first."

"Stop kidding," Al said. "That's the first break I've had since we went into business together!"

Gee, how I hate to have a customer suspect us. That fellow I was telling you about owned a big *Bosch,* and he undoubtedly—

"Hey!" Al shouted, at about 70 db. "It's your shot!"

"Oh—er, yes," I responded. "Where am I?"

"In your first and second childhoods," Al replied. "I try to help a person in his first, and pity one in his second. Usually there is an intervening period—but yours overlap!"

"Tut, tut," I remonstrated, and justly. "I mean: where am I on the table?"

"To the rear of the black one," Al informed me, "where you usually are. Mighty symbolic of your mental position, too."

I miscued. While Al was preparing for his next shot, I leaned companionably against the rail—so he wouldn't get lonesome—and voiced my suspicions of him as diplomatically as possible:

"Know what Fletcher said this afternoon when I delivered his *Bosch?* He told me there were nine tubes in the set when I picked it up, but only eight when I delivered it. Fellow who sold it must have told him one tube did the work of two. He counted the tubes several times to make sure, and acted as though we probably stole a socket, to cover up. What do you think of a guy like that?"

Al was leaning way over the table for a difficult shot, and he turned his head to say: "Next time we play pool together, bring your knitting. And now, if you don't mind my slip showing, I'll finish my turn!"

"This is serious," I insisted. "That fellow was downright abusive—told

"I found out what was wrong with your set. There ain't any speaker in here!"

me he would never call *Salutary Sales & Service* back on another job. Have you any idea why he acted that way?"

"Save your business until tomorrow," Al ordered, in a way that made me certain he didn't replace the tubes he had charged for.

"But we've lost a customer," I said, trying to make him see the light. "What have you to say to that?"

"Four-ball in the side pocket," he answered.

The morning paper had an item that concerned honesty, and I clipped it out. Soon as I got to the shop, I said:

"Look here, Al. It says a forgetful serviceman in Toledo used the same shade of paint twice on a chassis, to simulate replacements he actually did not make. The customer, a fast breather, was too impatient to await formal action by the *Better Business Bureau,* and visited the shop with an ax. You've been pretty handy with a brush lately!"

Al didn't answer, and I knew he was guilty. I tried to reason with him: "Wouldn't it be a good idea, Al, to throw away that pint can of burnt hamburger?"

"Burnt *umber*," Al corrected. "No, it wouldn't—I use it for aesthetic and sanitary reasons. For the same reason you should, but probably don't, dust out every console before you restore its vitals. Aside from being an excellent business practice, painting and cleaning are good for the entire community. I have witnessed *some* chassis-pulling which should have been supervised by the Board of Health."

"Bluntly, Al," I said, "have you been making all the replacements you charge for? I have been terribly embarrassed during some of our deliveries lately, when customers asked me to point out new parts. Tell me the truth—were those tubes in the *Bosch* new, or have you been taking to dishonest practices?"

"My boy," Al replied, "the funny noises you make indicate you have reached professional adolescence, and that the time has come when you are ready for adult advice. Let me describe a serviceman who is typical of one type in the profession.

"He is honest, willing, and has a background of experience which would get him—in other pursuits—a better-than-average income. But something holds him down. Let's go with him on one of his calls, and see what the trouble is.

"When he arrives at the customer's house, he walks in like a hungry dog that has over-stayed its furlough. Instead of being confident, he is thinking: 'The customer thinks I'm a gyp, I bet! Maybe I am—charging more for parts than I pay for them. Perhaps he has a parts catalog, and knows all the prices! I hope I don't bid higher than the customer can afford—I might lose the work!' Naturally, the customer senses this feeling, and is prejudiced.

"The repairman works as though he would feel more at ease if his coat collar was up, and by the time the tests are finished, the customer is convinced he has invited a scientific burglar into his home."

"That *Bosch*—", I wedged.

"He quotes a price that is so ridiculously low that he is cheating himself shamelessly, and, although the work on

(*More Experiences on page* 53)

The wattmeter in service presents the answer to many problems.

A Wattmeter For Servicemen

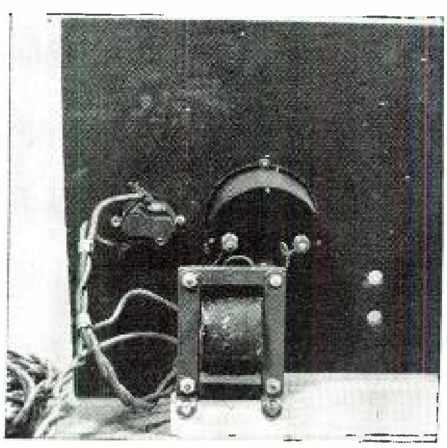
by DENNISON HOUGHTON
Columbia, Missouri

There are times when no other instrument can do the job of a wattmeter. This one is easily made.

MENTION a wattmeter to an average service man and he will have one of two reactions, either "What do I want with a wattmeter" or, if he knows what a useful piece of apparatus a wattmeter can be, "Surely, but I have too much money tied up in equipment now."

However, a wattmeter is a worthwhile addition to any service bench and it does not need to cost a fortune, providing the junk box has a few spare parts in it.

A wattmeter, in case you have never used one, is the logical instrument for the first check in servicing. Most set data charts give the wattage of the set, and if the wattmeter shows too many or too few watts you have a starting point: too many watts, probably a short, perhaps a filter condenser, too few, an open circuit. Furthermore, if the needle of the wattmeter swings over to the pin you know, without waiting for the transformer to smoke and drip insulation on the floor, that it is *not* safe to shoot trouble with the set connected to the 110 volt line. Another useful trick with the wattmeter is to show the customer with a "Scotch soul" that some radios are harder on the light bill than others.



The rear of the wattmeter.

The wattmeter shown in the illustrations consists of an old power transformer, the secondary winding removed and a new winding put on, and a 3 volt a.c. voltmeter. The new winding goes in series with one side of the 110 volt power line, the voltmeter being connected to the old 110 volt primary winding.

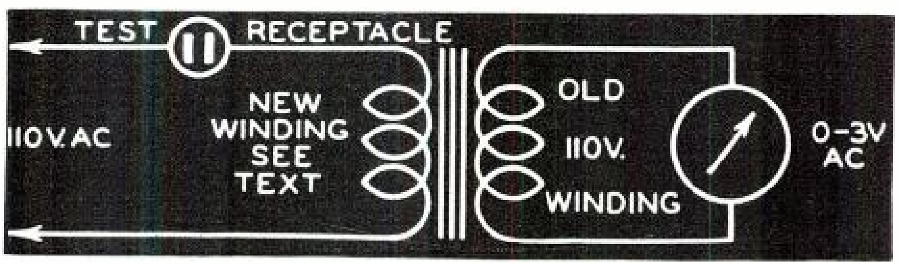
The wattmeter is made up on a panel and baseboard, a 110 volt receptacle being provided on the panel for the plug of the set to be tested. The meter goes on the panel, the transformer behind it.

In winding the transformer, the number of turns on the new winding depends upon current which it will be desired to pull through it. The wattmeter shown has 35 turns of number 16 wire which gives approximately a 125 watt full scale reading on the voltmeter. Larger wire and fewer turns will increase the current capacity of the wattmeter.

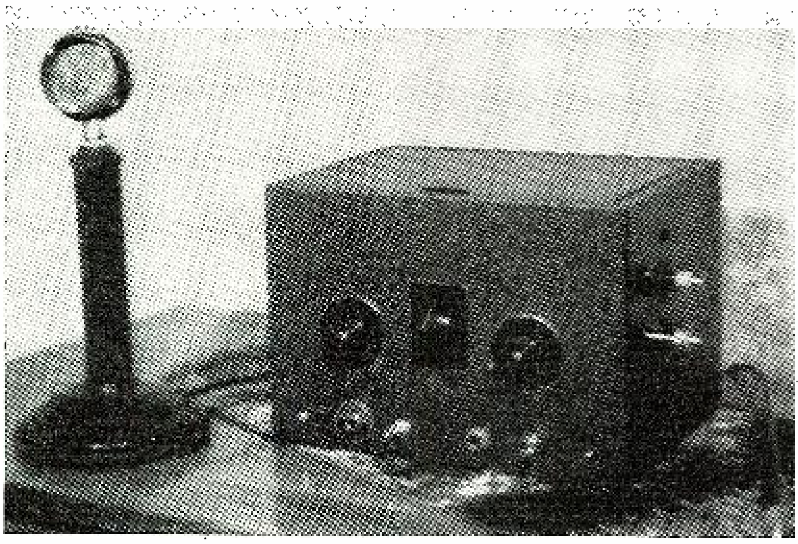
To calibrate the wattmeter, the voltmeter scale is removed or a piece of paper pasted over it. Then a bank of sockets and light bulbs, as shown in one of the photographs, is rigged up to provide a load of known value. With a 25 watt bulb inserted in one of the sockets, the dial is marked 25 at the point to which the needle swings. Adding a 15 watt bulb makes it possible to obtain a reading for 40 watts; similarly other combinations of bulbs allow calibration of the dial, if desired, by 5 watt steps.

The usefulness of the wattmeter is by no means limited to radio work. With slightly different specifications for the transformer, the wattmeter may be used for testing small motors and other electrical equipment. For a 250 watt load, use 15 turns of number 16 wire on the "new" winding: a winding of 7 turns of number 14 will allow a 500 watt load. The actual load on the transformer is slight, hence a small radio power transformer can be used. It may be necessary to use a "heavy duty" radio power transformer in order to have space enough on the core for the winding if made with the heavier wire. The winding specifications are approximate, it may be necessary to vary them slightly in order to obtain the desired full scale reading. As described previously, the lamp banks can be used for calibrating the meter, even under heavy loads. If the meter, under a given load, say five hundred watts, reads less than full scale and it is desired that the dial be calibrated for a 500 watt load, full scale, remove a turn or two from the "new" winding in series with the power line; if it goes off scale, add turns.

For still heavier loads, use less turns of heavy wire, number 12. —30—



Circuit diagram of the inexpensive wattmeter.



The little transmitter set up ready for action.

For a QRR rig that any ham should have in his shack, this flea-powered rig will do surprisingly well. Uses few parts.

by PAUL V. TRICE, W8QHS
Sharon, Pennsylvania

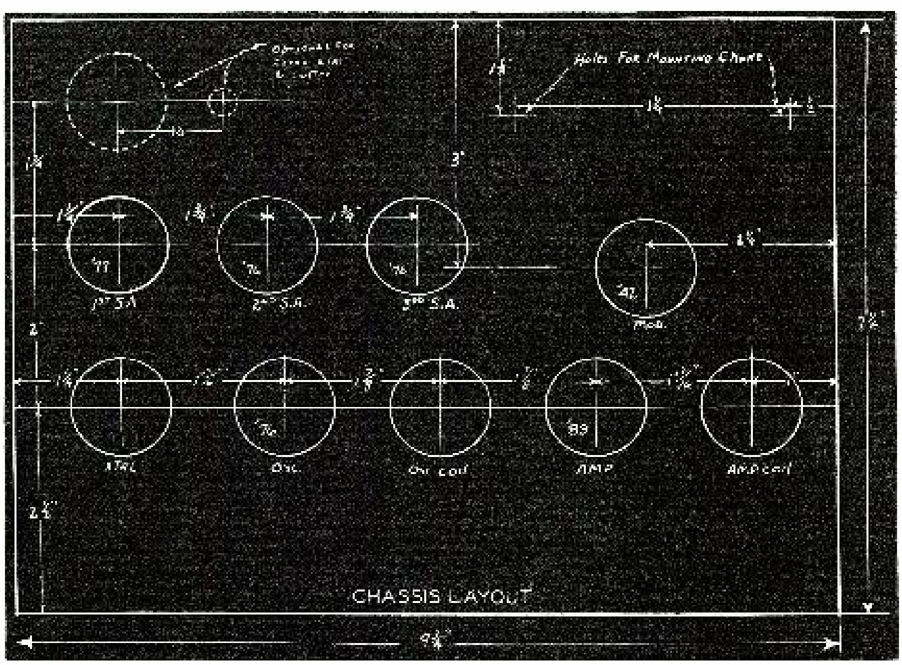
Flea Power on 160 Meters

THE primary purpose of the author trying flea power phone on 160 meters, was to see what comparison there was, if any, between that band and five meters, for local contacts. The local referring to contacts up to 25 miles.

The results were quite convincing, in that they proved, without doubt, that with a given low power input, the all around results are definitely in favor of the low frequency band. These include general coverage and signal strength, ease of construction and operation, adaptability to both phone and c.w. operation and quality of signal. The latter two are noticeably better on 160 meters due, no doubt, to the fact that the broad-tuning, noisy super-regenerative receiver is so extensively used on the high frequencies.

With the recent changes in Amateur Regulations, requiring, among other things, a stable signal on five meters, many amateurs will probably be inclined to transfer their attention to the low frequency bands for local contacts. For such persons, the rig here described will provide a means of continuing their contacts on phone with other local stations.

In this age of high powered transmitters, the ability of QRP rigs to work out is generally questioned. With that same doubt in mind, an experimental flea-powered rig, modelled after several in radio publications, was literally "thrown" together, breadboard style. The only available antenna, a 40 meter Zepp, was used as a Marconi and on many occasions only the dead feeder was used with very good results. These included contacting a station about 50 miles distant and receiving an R7 report during the ensuing QSO, and also being reported by a station over a hundred miles distant. This, with an input not exceeding 3 watts. Reliable contacts up to 30 miles were common and with a larger antenna, this range could probably be extended considerably. This refers to day time contacts as the QRM from high power stations limits the operation after dark. However, even then reliable operation up to 5 or 6 miles can be had.



Since the experimental model gave such gratifying results, it was decided to build a new rig on the same lines as the first except that better parts would be used throughout, in order that, when finished, it would fit in with the rest of the station equipment. It was also decided to use a crystal mike as quality reports on the first rig, using a single button carbon mike, had been discouraging.

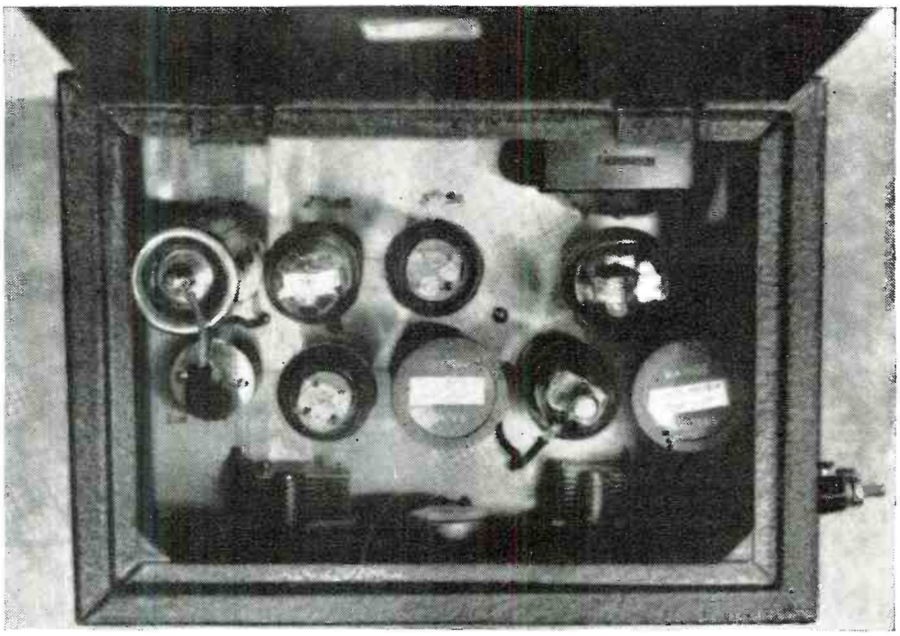
Accordingly, a crackle-finished box 10 x 7¼ x 7 and the metal chassis to fit it were procured and the latter punched as shown in the sketch. The placement of parts on the chassis, as shown, leaves considerable space between the speech tubes and the back of the chassis. This space can be used if desired for mounting an extra crystal socket and crystal switch. If this is included, the operator has a choice of either of two crystals at the flip of the switch. This proves advantageous when QRM is particularly bad on one of the frequencies used. It is desirable to have the extra hole punched for the crystal socket, even though it may not be used at the time, as it will be very difficult to add it later due to the wiring under the chassis. In the rig here described, the socket hole was not punched with the rest and as a result, it will be necessary to remove part of the wiring, in order to have it punched.

After the chassis has been punched, the metal box can be drilled for the variable condensers, gain control, jacks and switches. As there is plenty of room for mounting these, the builder can place them to suit himself or follow the design used here. As can be seen in the front view of the rig, the knob on the left side is for the oscillator and that on the right for the amplifier while the gain control is mounted between the two. The left hand jack is for the crystal mike and the other is for a key, for c.w. operation. The left hand switch is the power switch and the other is used to cut off the filaments of the speech and modulator tubes during c.w. operation. The switches and jacks mount through both the chassis and the metal box and help to brace them together. Two holes can also be drilled or punched on the right side of the box, as shown in the photograph, to take the feed-through insulators for the antenna and ground connections. A small hole is also drilled at the rear of the chassis and box to take the power cable.

Once the punching and drilling have been completed and the parts placed, the wiring can be started. It is a good idea to wire the filaments first as the heavy wire used is then flat against the chassis and it will also aid in making the proper connections to the other points on the sockets. The remainder of the wiring is conventional and will not be discussed here, except that one point should be given attention. All connections should be mechanically strong before being soldered, especially if the rig is to be used for portable work. It makes an ideal portable rig and can readily be adapted to 75 meters.

Although blocking condensers from the plate tank coil are used to couple the rig to the antenna, in the diagram, inductive coupling can be used if desired. A 2" form wound with 10 turns of No. 18 wire can be slipped over the tank coil and tuned as shown, by a variable condenser in the ground lead. Experiments with a loading coil in the antenna proved of little value in local contacts.

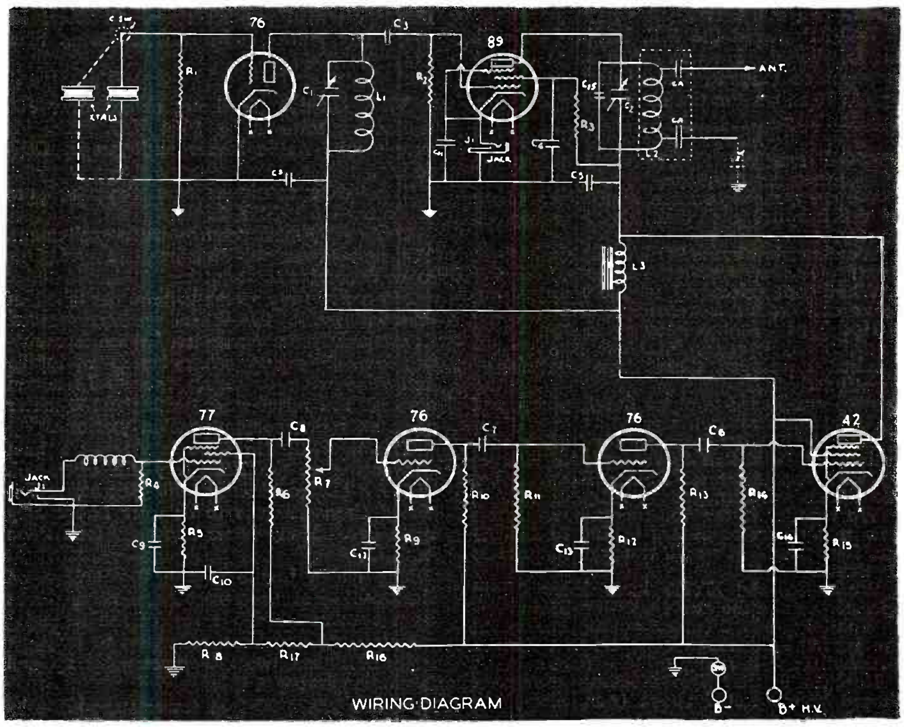
The power supply for the rig should be capable of furnishing 6.3 volts for the filaments and a plate voltage of about 250 volts under load. The one used here was taken from an old broadcast receiver and furnishes both filament and plate voltages. The receiver used 71-As (5 volt filament) and 26s (1½ volt filament) and by connecting these in series 6½ volts can be obtained. This will drop to the 6.3 volts required due to the number of tubes used.



Looking down on the QRR flea-powered rig.

The speech amplifier provides more than sufficient gain and full modulation capability can be obtained with the gain control half way on.

When the rig is completed, it can be checked by placing a single turn of wire in series with a flash light bulb over the oscillator and amplifier coils and tuning till the bulb lights to maximum brilliancy. —30—



R_1—50,000 ohms
R_2—50,000 ohms
R_3—20,000 ohms
R_4—2 megohms
R_5—3500 ohms
R_6—250,000 ohms
R_7—500,000 ohm pot.
R_8—50,000 ohms
R_9—3000 ohms
R_{10}—100,000 ohms
R_{11}—500,000 ohms
R_{12}—3000 ohms
R_{13}—250,000 ohms
R_{14}—500,000 ohms
R_{15}—1500 ohms
R_{16}—50,000 ohms
R_{17}—250,000 ohms
CA—.002 mfd.
C_1—.0001 mfd. (Bud)
C_2—.0001 mfd. (Bud)
C_3—.00005 mfd.
C_4—.001 mfd.
C_5—.001 mfd.
C_6—.1 mfd.
C_7—.1 mfd.
C_8—.1 mfd.
C_9—5 mfd., 25 v.
C_{10}—2 mfd., 400 v.
C_{11}—.1 mfd.
C_{12}—2 mfd., 200 v.
C_{13}—2 mfd., 200 v.
C_{14}—10 mfd. 25 v.
C_{15}—.0001 mfd.
L_1—52 turns No. 18 wire on 1½" form
L_2—42 turns No. 18 wire on 1½" form
L_3—Mod. choke (Thordarson No. T—1892)
SW—Off-on switches
CSW—Crystal switch (optional)

W6NYQ is doing a great job in managing W6USA at the Fair. Frank C. Jones is doing the Consulting Engineering.

Stew Ayres and Fonesca are dickering to use the Whitcomb Hotel S. F. Broadcast Towers (KYA's old towers) for a remote controlled W6USA.

W6TT is doping out a Hugo Curtain beam on his restricted territory. He just must get a few more countries to add to his 76 (verified).

W6TI has the fastest and most prompt QSL Bureau we ever heard of. (Greer is an ex-postmaster—Hi!)

W6QL apparently won the SARRL contest with 2800 points, 17 South Africans worked, in 6 zones. W6AM trailed second with the same number of stations but in 4 zones—2200 points.

We're all glad to hear W6EGH back on the air with his former wallop and DX-ing. Wally has over 100 countries (and the cards for them).

H. W. Dickow, formerly editor of RADIO, almost died with pneumonia but the new serum saved him—high speed talking—new ideas—and all.

W6FFP scared the S.F. Radio Club with his full beard. He was called on to deliver a speech on Russian "Hamiskis."

Bud Bane was on the air working DX during January.

HOW long will 5DEW and 5AOH be on the same frequency?

We are pleased to learn that 9YWT is out of the hospital and wish him a speedy recovery.

Wonder what keeps 9QEA off the air these days? [*Putting this rag to bed!* Ed.]

What ham (class A) wound his new antenna coil around a steampipe. Heh! Heh!

Hot Tip! Better keep your logs up to snuff, fellas, because F.C.C. is sending out franked envelopes these days and asking questions.

Who was heard to claim five hundred grid mills in his xtal oscillator?

Since 9TLO has gone in for higher education, we have had to read plenty to keep up with the latest on Rotary Beams. Bet the BCL's are also getting a break, hi.

We wonder if the 160 meter boys realize how many harmonics are falling in the 3.5 mc. fone band. It's agin the regs if no class A ticket.

We notice the XYL's have fallen off in operation since the new regs went into effect.

Wonder if 9PPL (proud poppa) has taught the junior op. enough code for a ticket or is the little fella going to be a fone-man?

Note to 9DZC: The blocking condenser should be connected above (not below) the RF choke.

That fight (on 14 mc. fone) the other night was a honey, but "cussing" is illegal.

WHO said that Hams don't get anywhere! Here is an impressive list of them working in the B. C. Stations in Chicago: At NBC there is P. J. Moore, W9MV, who is transmission engineer; T. E. Schreyer, W9SBC, Operations Supervisor; Rex Maupin, W9VNW, Orchestra Conductor; Jules Herbervaux, W9SMG, Production Manager; B. G. Swift, W9IVD, Program Dept.; and M. W. Rife, W9IWV, Field Supervisor.

In NBC's Chicago stations there are also in the Studio Dept. W4MK, W8QIG, W9BGI, W9CIU, W9CQI, W9CTN, W9DBT, W9DQM, W9IAH, W9JIR, W9KF, W9KQS, W9QXD.

In the Control Dept. we find W9BG, W9BU, W9CP, W9GN, W9GY, W9RUK, W9WC and W9WS.

In the NBC Chicago Field Dept. there is W9AT, W9FQ, W9TPJ and W9WRB.

The Maintenance Dept. of the Chicago NBC boasts W9AFA, W9GG and W9LEP.

The transmitters of the NBC Chicago stations are tended by W9AL, W9DEJ, W9DQ, W9IHY, W9NBI and W9RDE.

The Mutual Broadcasting System's *WGN* has a few, too. Starting with Chief Engineer Carl Meyers, W9DN; Chief of WGN Transmitter Staff, George Lang, W9CLH; Assistant Chief Engineer Clyde White, W9WEA; and Supervisor Myron Earl, W9WNF, we find these hams working there or at the *Chicago Tribune:* W9RV, W9IUJ, W9ATH, W9NN, W9AVP, W9BBU, W9DLH, W9EOF, W9FJ, W9LC and Ray McNulty who is studying for his ticket.

We would like to know which hams work at what broadcast stations. Send in your lists. We will publish them all. And IS there any station with MORE hams than Chicago NBC?

THE Mission Trail net claims over 100 active stations on 1804 K.C. fone. It sure moves traffic hither and yon in California.

The 9-90's continues as a "griping" rag chew net on 1950 K.C.

These KF6 stations sure cause excitement. The new prefix sub-divisions are giving us more countries to shoot at.

160 meter fone seems to take the brunt of disaster traffic whenever disaster occurs. Consequently the American Legion is assisting financially and otherwise in equipping and organizing to tie in the A. L. actual personalized relief work, with the 160 meter gang as relief communication stations.

The S. F. Radio Club is staging a ham convention at the Fair July 4th week-end. The ARRL combined Pacific-Southwest Division Convention is to be over Labor Day week-end. Many hams can thus take them both in.

The traffic jam over the Bay bridge on the opening of the street car service might have been bettered if a few of the 10 meter mobile gang had been called on to help.

W6DEP has two telephone poles up and is contemplating a third.

W6RO has a 90 foot tower supervised by W6DDS and the gang, but, not content, he just bought and had installed two 90 foot telephone poles in addition.

THE San Diego Radio Club combined Radio Show and Banquet was attended by 240. W6KW as chairman did a great job both in managing the affair and as acting toastmaster.

XE2AH in Tia Juana, Mexico, just over the border, is rebuilding into 1 KW fone with all fixin's.

W6QD has a new QRA with a 200 foot square lot to put a DX antenna on.

W6CUH is so busy at Howard Hughes' plant, he doesn't even ask for the pile of QSL's at the QSL Bureau.

The Santa Ana Radio Club Christmas party was attended by 65 hams.

K6JFD enjoyed his stay on the mainland and now that he's back is putting in a 20 meter fone!

NEWS: 9KGL worked a local station,—1JFG has a rotary beam that really works,—9TIZ is still looking for EL1A's present QTH.

One ham had a complaint of BCL trouble. On examination, the set proved to be a five-tube midget (1492 vintage). Both the detector and TRF stage were oscillating. The *wet* electrolytics were bone *dry* and here's the payoff. The '80 was gone and a '71A had been plugged in its place. Did he fix it? Page *Lee Sheldon!*

Heard on 14 mc. fone, "How does my quality sound, ole man?"—Answer, "It sounds faintly sarcastic, hi!"

Wonder if 3EWN got his feeders thawed out? The DX sure piled in that cold nite, even 9NSK worked a W6.

Ever hear 5BEN/9 tell the story of the "Rockaboars"?

The new crop of SWL cards resemble O.O. notices. Some of the boys have actually sent in letters of apology after receiving one of the new official appearing cards reporting some violation of the regs.

9TC has a fine hobby, he is a bee-keeper. Practical, too, as the Doc won't let him eat sugar.

9FB has a filing system that is the envy of all who know him but we wonder if he could say off-hand just what he was doing on October 15 at 3 p.m., EST.

9AYN finally discovered that fifteen per cent modulation won't work.

9JJR doesn't need an antenna, he was still 5-9 after his skywire fell down.

How does 9BHU manage to work so many w6's with fifty watts?

What's this about 9ETI wiring his rig with string? We knew a guy who tried to solder with a piece of number twelve tinned copper wire.

2HZY comes in on our monitor way out here in Chicago,—"MIM."

9HEZ has deteriorated to 160 where he goes to town on the ex-marine rig.

Bob Zurke, Flash Pianist from Detroit, presently with Bob Crosby's Band, has been QSO with hams all over the U. S. A. on his tour. Too bad he didn't have his rig with him. And Eddie Miller (Whiteman's All-American Sax Man), with the same band, is studying for his ham ticket. Has been reading about radio for 15 years and only now getting to that elusive pasteboard.

Several musicians use a series of "V's" as a signature on the air.

9LLX had his feeders looking like pretzels after that big Chi storm. He's on 160 now and going strong—especially between 1 and 3 a.m. CST.

HOT tip! The FCC is cracking down on SWL's who sign their cards W2 (or 3, 4, 5, 6, etc., as the case may be) SWL. Agin regs. Also they are getting after those DX hounds who have phony calls like W3456789L2, of which they have been many. Good thing, too!

Watch those 56 meg sigs in New York, the CBS has been assigned television frequency 55.5 megs, and they are tough customers with illegal QRM!

9MFI has 300 watts on 160 and works him 'n him 'n him. FB!

W9GN works for NBC!!! hi! (WGN is a Mutual station.)

What has happened to 9DKM?

There is a new junior YL op at 9LBJ. Yclept *Judith Joan.*

Rubber Xtal 9IPS has two or more receiving antennae, and he can switch instantly from one to the other.

9MEL sticks to his fires and ham rig these days.

Who is that 14 mc. out-of-the-band station signing "this is the powerful little 500 watter of Washington, D. C."? The FCC would very much like to know.

And here's to these United States where a ham can concentrate on his rig, instead of being rigged into a concentration camp!

BENCH NOTES

by LEE WARD
Service Manager, San Francisco, California

Some case histories and their remedies are the subjects taken up by the author this month. Follow these good tips.

TODAY, a serviceman's diagrams and reference data must be of such quantity that Dr. Elliott's "five-foot shelf" seems as brief as a Monday morning memo to the milkman. There are, however, many problems standing between customer call and collection which cannot be expressed by circuit diagrams. No matter how elaborate your library, there are times during daily routine when a few words will save you time, business reputation, and money.

When receivers are released, they carry with them latent peculiarities which even the best design engineers and manufacturers cannot foresee. These faults, although they are never listed on a specification sheet, appear later in the form of repairmen's headaches.

BENCH NOTES, then, occasionally offers you technical aspirin; remedial tricks; kinks for the shop; brief illustrative incidents; essential sentences from reader correspondence; in short, any interesting, practical information which should increase your business efficiency.

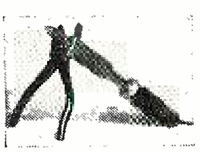
We servicemen are fortunate in having this space made available for our uses. Because of the column confines, a faster pace is necessary, but we should be able to accomplish many worthwhile things in our stride. Since this is OUR column, your correspondence is invited.

How ya doin', fellas?

The Author.

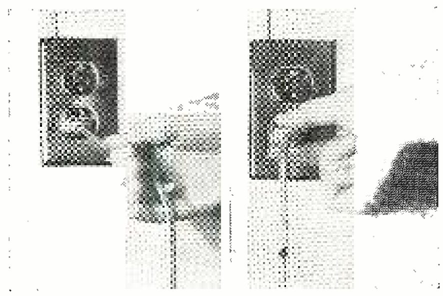
WE find some customers are very narrow minded when we come to use our soldering irons in a living-room; they balk when we lay it on a rug, a shelf, or even on the landlord's floor. Perhaps the smoke makes them unreasonable.

The usual tool kit is too crowded with more important tools, tubes and parts to accommodate an iron holder.



Instead, you can use pliers as shown to make a tripod. Nothing but the handles of the tools touch the floor; very little heat is conducted from the iron, through the handles of the pliers, and to the floor: most of it is dissipated before it gets that far. Flat-nosed side-cutters fit the average size of iron barrel best.

Use both tools when you solder. As you pack up to leave the house, though, don't slip the pliers into your hip pocket!



No! Yes!

Instruct Your Customers

Pull the plug to save the wires! Every time you yank on a power cord, you invite fireworks and future set noises. A common customer fault—tell them of the precaution after each chassis delivery; they will appreciate your thoughtfulness, and you will be teaching them to come to you for future electrical advice.

Small item in business, of course; but things like these, which require no cash investment, pay the highest dividends in future trade.

[*During the last six months several people have been electrocuted by pulling the plug by the wires and at the same time creating a short through their bodies to the ground. Extreme care should be given to this otherwise little-thought-of gesture.... "Just pull the plug out!" Ed.*]

Tone Adjustment

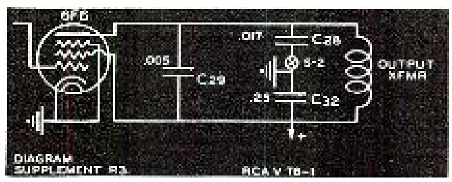
The next time you deliver a repaired *RCAV T6-1* table model or a *C6-2* console, play the set with the speaker installed before you bolt the chassis down. Then disconnect C29. If the customer is pleased with the higher tone which results, leave it in place, but disconnected.

The removal of this condenser from the plate circuit of the output 6F6 lets more highs through without depriving the customer of his choice of the two points afforded by the regular panel tone control adjustment.

If the customer wants still more highs, try lower values in place of the quarter-mike C32. No matter what changes are made here, the operation of S2 and C28 are not affected.

Make sure the trials are made in the customer's home, with the speaker mounted, and with the music at the volume the customer ordinarily uses when he makes his own level adjustment. These are factors which determine tone quality with normal use; and, if the customer is to be permanently satisfied with the final setting, you must simulate every-day acoustical conditions during the test.

This business of quality which changes as the volume is varied is a very tricky characteristic of many sets, and should be considered when a repair is on test in the shop—where walls are better reflectors, and where



no baffle is used. As a result, there may be discrepancies between the shop and the owner's home. Watch especially for low-volume distortion and high hum level in the shop; a receiver on shop test usually runs higher than in the home, and hum is less noticeable.

Thought for the Month

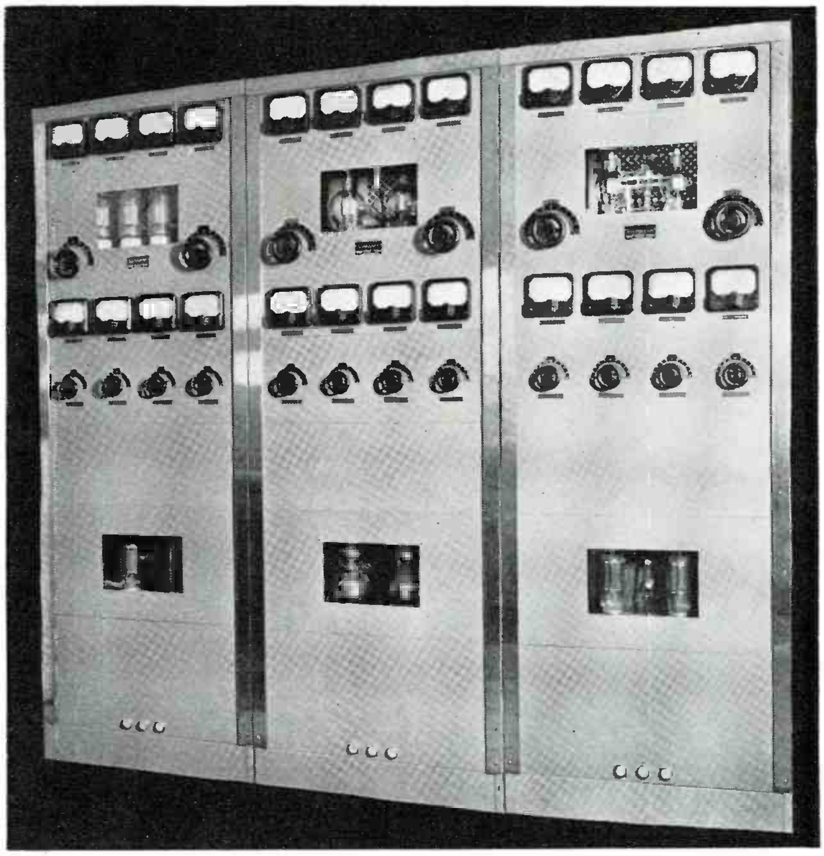
In business, the customer is King; salaam him if you wish—but don't soak him!

Cherchez la Bypass

Many an *AK37* repair job has been lost because the serviceman diagnosed the trouble too quickly, and reported a common filter block short. The customer can hardly be blamed when he hears what has to be done to the set, and decides to discard it instead of having its most expensive component replaced.

Before quoting a price on a *37* (or *36, 40, 42, 44, 52*), take the time to check the speaker output condenser. The gross price to the customer—at the same profit—is lower than that for a filter block, and the difference might mean the difference between getting the job and not getting it.

(*More service tips on page* 61)



MODEL 1 KW RIG

by OLIVER READ, W9ETI
Technical Editor, RADIO NEWS

Presenting the most commercial-like in ham rigs, wholly home constructed.

AMATEUR radio operators can usually be divided into two classes; those who get the greatest amount of satisfaction out of building a neat rig by taking plenty of time in its construction and adjusting the various stages for high efficiency, and those who are content to throw their units together and begin operations as soon as r.f. reaches the antenna (or even before).

Many of them are not interested in how the rig looks to the eye as long as a signal is forthcoming, and the only pride that they may feel regarding their stations is this ability to catch an elusive dx station, particularly if a visitor is in the shack at the time.

Back in the early days of amateur radio, we were given the impression that metal cabinets or chassis were to be avoided in constructing our transmitters. We were led to believe that if we used this type of construction, that all of the soup from the rig would be soaked up by the metal and we would get nowhere by attempting to use it. Perhaps this was all very true when we consider that we were using high capacity tubes and circuits and multi-stage transmitters were yet to make their appearance and we did not know how to shield these stages properly.

The control console and speech amplifier.

Coils are now used which are of much smaller size, condensers are more compact, insulation is very much improved, stand-off insulators and assemblies raise the r.f. units above the metal chassis, flexible condenser couplings are available and many more factors that permit us to use these metal cabinets and bases. More labor is involved in this type of construction, but this is offset many times by the satisfaction of a job well done and a rig that will perform without adding a maze of parasitic suppressors, extra chokes to keep the r.f. out of the microphone and other precautions that are required in phone operation by many rigs.

The past several years has seen a marked reduction in bulky equipment along with the common acceptance of the low C tubes in amateur rigs. It also proved the value of the higher frequencies for everyday use, rather than that of an experimental spectrum to play with. We soon discovered that by keeping the radio frequency power within the stages, and by using more efficient methods of coupling, we could obtain a much higher percentage of efficiency at the antenna and the energy we were trying to conserve would not be shooting around our shacks.

The manufacturers of broadcast and marine transmitting equipment have taught us how to construct units for fool-proof performance, but we have been slow in accepting their basic designs. After many visits to stations in various fields of service, I was definitely sold on their method of construction for my own rigs.

The following paragraphs and illustrations show what has been done to carry out the above theories in amateur transmitting equipment and results have indicated that these are well founded. The rigs have now been in service for many months and no adjustment or retuning has been required during the entire period. Feedback is conspicuous by its absence, either in the r.f. or audio.

As far as amateur transmitters are concerned, there has been little constructional data given along commercial lines. The writer has had occasion to examine many amateur transmitters, and in most cases, the methods used in planning and laying out the various sections has been taken as "a matter of course" and results have been more or less dependent upon the quality of the parts used. On the other hand, several of the stations visited showed that careful consideration had been given to all of the units with the result that these transmit-

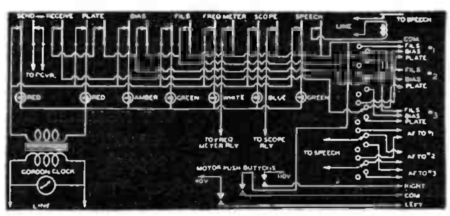


Diagram of the control console.

ters operated with a minimum of adjusting after the rig was once properly tuned.

It is but little more costly when constructing a new transmitter to follow the proven layouts, such as are used by the makers of commercial transmitting equipment. Even if the builder does not care to purchase expensive broadcast type cabinets, he can construct them out of wood and a material such as tempered Masonite and line the insides with sheet metal.

We all have read, with deepest concern, the unfortunate electrocution of several of our fellow amateurs and electricians during recent weeks. We certainly can prevent or reduce this terrible danger in our own shacks by completely enclosing the power units in a closed cabinet and by providing a rear door equipped with interlock switches so that as the door is opened, the primary circuits will be broken.

All of the transmitters shown in the illustrations at the writer's station are so built that safety is provided at all times against possible contact with any high voltage circuits. In addition, all relay circuits operate in cascade so that plate voltage cannot be applied before the filaments are in operation. Both overload and underload relays are used to protect the equipment at all times should the antenna blow down or other unforeseen conditions occur.

In this, the first of three articles which will describe each transmitter individually, we shall cover the 1 kw. 10-20 meter installation at the station with the various control and speech circuits.

Mechanical Design

Each cabinet contains a complete transmitter, both for c.w. and phone operation. The cabinets are of standard dimensions along the commercial sizes. The panels are each 24" long and ⅛" thick and are made of aluminum. The corner styling-strips are of stainless steel and cover all of the mounting screw heads when in place. The mounting holes are spaced the standard distances for both amateur and Western Electric mounting dimensions, so that either type panels may be used. The cabinets are six feet high and 26 inches wide overall.

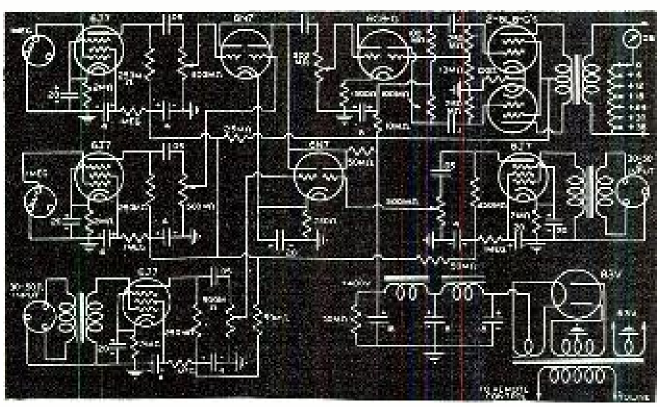
The chassis measures 22" x 16" and side brackets are provided on the inside channels so that each base may be slid into the cabinet from the front, in drawer fashion, and ample support for the weight is had from these heavy brackets. Receptacles are mounted on the rear side of all chassis so that all connections may be made through cables and plugs for all but the meter circuits. Feed-through insulators are mounted for connecting terminals for the meter cables as these carry the high voltages through the ignition cable where the higher insulation breakdown is required.

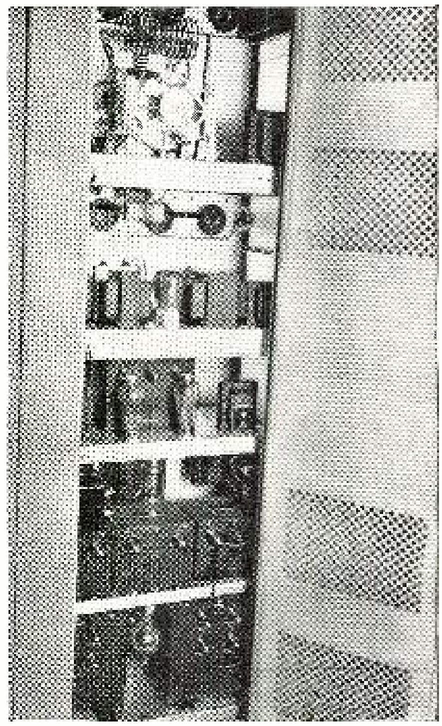
The cabinets and panels are finished in platinum grey wrinkle and may be cleaned when necessary with soap and water. The insides of the cabinets and the backs of the panels are finished with an aluminum spray that is very durable. Plenty of ventilation is provided by means of the large grills in the top and bottoms of the steel doors. Pyrex glass windows are mounted back of the cutouts as shown to help to keep out the dust. In hot weather, it is advisable to either remove these, or to install a small fan in the top of the cabinet to draw out the hot air from within.

Keying of the largest rig is by means of grid-controlled rectifiers in the high-voltage supply. By placing a bias on the tube grids, current will not pass through the tubes until this bias is removed when the key is down. This method has proven to be very satisfactory in high-power operation.

The meters shown in the illustration are: from left to right, Lower panel; Osc. plate current (0-75 d.c. ma.), Doubler plate (0-75 d.c. ma.), Driver plate (0-200 d.c. ma.), and Modulator plate (0-500 d.c. ma.). The top panel contains the following meters: Final filaments (0-10 d.c. ma.), Plate volts (0-2500), Plate current (0-750 d.c. ma.) and Grid current (0-250 d.c. ma.). Filament voltage for the eight pilot lights is taken from a separate transformer that is mounted on the inside channel of the cabinet.

The radio-frequency line-up is as follows: RK49 Jones oscillator, using 40 meter fixed and variable crystals, an RK25 pentode buffer-doubler, working on 20 meters, an Eimac 35T driver on 20 meters, or as a doubler on 10 meters, and a pair of Eimac 250th Hi-mu triodes in the final stage. The external speech equipment at the operating position includes: four type 6J7 mixers and first audio, two 6N7 electronic mixers, a 6N7 in the third stage as a phase inverter, and a pair of type 6L6G's operating class "A" in the output. A 500 ohm line goes to the transmitter cabinet and into a line-to-grid transformer and then to the modulator grids.


Circuit diagram of the speech amplifier.


The rear of the kw rig.

A total of four power supplies are used at the transmitter: one for the final amplifier, one for the modulators, one for the excitor stages, and the bias supplies. The unit for the final high-voltage supply also may be termed a dual-supply as provision is made for supplying the rectified voltage in the form of C bias for the grid-controlled rectifiers. By referring to the schematic diagram, this can be explained in the following manner: A control grid is placed as a valve within the electron stream of the rectifier. When a negative bias is placed on this grid, and if this bias is high, the tube will reach its cut-off point in the same manner that a class C amplifier operates. Now if this bias is removed, the current will be permitted to flow in the rectifiers and plate voltage will appear at the filter.

It is imperative that the key jack or relay be insulated to withstand the full plate voltage of the rectifiers. The bias transformer is one used as a replacement for broadcast receivers and will deliver a few hundred volts to the grids. This value was not found to be critical as long as the voltage is high enough to cause cut-off to the tubes.

Design Data on the 1 kw Unit

The transmitter in the center operates on the amateur 10-20 meter bands and the tank circuits are designed for peak efficiency at these frequencies. In order that the transmitter could be used for a wide range of frequencies within the two bands, it was decided that both variable and spot frequencies be used. The problem of adjusting the variable crystals was solved by using a small tuning motor in conjunction with a selector switch at the transmitter end and by using a slip arrangement and cable drive to the two variable crystals so that as the reversible motor operates, the drive would be transferred to the units in the order chosen for a given coverage. The crystals are so arranged that one outside frequency is connected to the number one position on the selector switch, the next one to the number two position, etc.

As the selector switch reaches the last position, the motion is transferred to the driving pulley on the variable crystal and when the rotation has been completed the cable will continue to turn due to the slipping action. The motor used by the author is a Utah 24 v. reversible tuning device with a special worm reducer to cut down the speed to one r.p.m. The complete control for this crystal section is had from the operating desk as are all the other controls for the complete installation.

Following the commercial designs, crystal control is used only to insure a minimum of frequency drift during operation. The oscillator operates on the crystal frequencies and the output tank is tuned to the center of the band. No further adjustment is required in tuning the tank to the other portions of the band. An RK49 tube is used in the oscillator at low plate voltage to insure stability and provides more than sufficient output to the RK25 doubler. This tube is always used as a frequency multiplier, on both 10 and 20 meters.

The capacity chosen for the doubler tank is best suited for the range covered, and should not be more than the capacity shown. The doubler is entirely conventional and needs no lengthy discussion.

The driver should be able to furnish at least 125 watts for efficient performance to the final amplifier and this can be obtained from the 35T operating at a plate potential of 1500 volts. This triode is an excellent performer at the higher frequencies and was selected for this stage as it met all of the requirements of easy drive, small physical size, ease of neutralization and adaptability to wiring where it is convenient to mount the condensers above the chassis.

A combination of both grid-leak and fixed bias is used on the driver in order to insure protection to the tube should the excitation fail. A split-stator tank should be used in this circuit so that neutralization will hold for both of the bands covered. The tank coil is of the air-wound type with swinging link so that the proper degree of coupling may be had to the following tubes.

Comparisons of several types of links showed the greater amount of r.f. was transferred when using concentric cable between stages than when using twisted pair. Furthermore, the use of this cable permitted the shield to be grounded, and this in turn added further isolation between stages. The concentric was home made from a regular kit and may be constructed to any length desired.

The modulated amplifier operates at one kilowatt input on both bands and uses Eimac 250th triodes. These tubes *idle* at this input and, inasmuch as they only have 2000 volts on the plates, they may be driven to high efficiency in the higher frequencies for phone operation. Much planning was done on this stage in order to keep the lead lengths as short as possible. The use of the propeller type condenser added to the general simplicity of the final, as the neutralizing condensers are a part of the assembly and may be located right next to the tubes where the connecting leads will be shortest.

The tank coil is mounted above the condenser as shown. To be able to make a symmetrical assembly dictated that the front panel controls be laid out to offer the most in eye appeal without upsetting the circuit layout. This was accomplished by the use of flexible cable and pulley drive. One can appreciate the advantage of being able to see the tubes while in operation, especially if the metal plate types are used, as the dissipation within each tube can be estimated and loading can be adjusted so that each plate in a push-pull stage attains the same color. By observing this color of the plates, with reference to the manufacturers' ratings, we may tell whether or not the stage is balanced. The two 250th's in this transmitter operate at exactly the same orange color and intentional misadjustments showed an immediate color change between the two when one tube was loaded heavier than the other.

Variable r.f. coupling is provided by means of a swinging link and the output is fed into 72 ohm concentric cable to the antenna relay and then to the 70-foot antenna cable feeder. Loss at this position was reduced greatly after removing the twisted pair previously used and it was possible to use far less coupling at the transmitter tank than before.

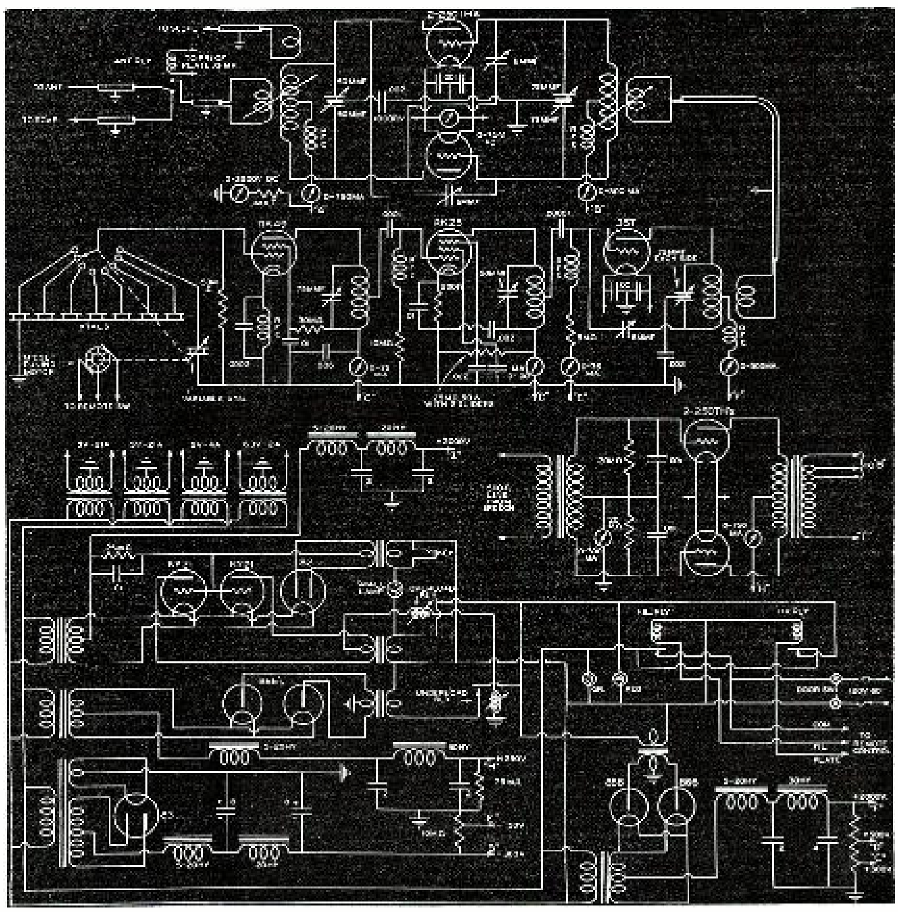
The grid tank condenser mounts underneath the chassis and is driven by means of a flexible cable and shafts. The grid coil is underslung beneath this condenser and is link-coupled to the 35T driver on the exciter chassis.

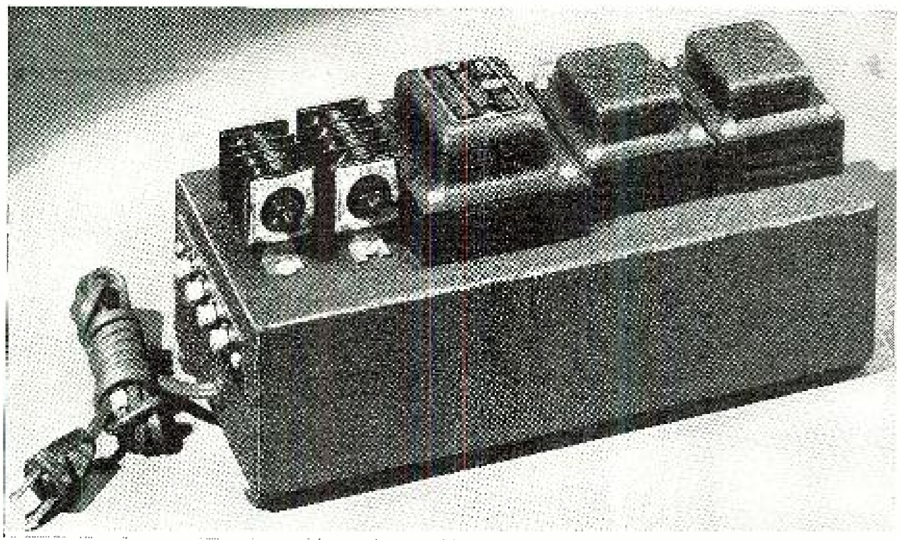
The December 1938 revisions of amateur regulations (FCC Rules and Regulations) state that the operators have means of measuring the input to the final amplifier when running 900 watts or more. This has been met in this transmitter by providing a plate voltmeter which also serves as the bleeder to the power supply. This meter has been checked for accuracy and from its permanent use the input to the rig may instantly be determined in conjunction with the milliameter. Note that eight meters are used on each transmitter to offer proper check of all stages without resorting to a series of jacks or switches. This also follows the design of commercial units, and the flexibility of such a system is only appreciated after using one or two meters for the entire transmitter as is done in many cases. These meters are all of four-inch diameter and are illuminated from the front.

Modulator Equipment

One of the features of this rig is the excellent regulation of plate voltage

(*Please QSY to page* 56)





One of the classes of telephone power packs.

Rural electrification plus the use of the power packs will eliminate the usually unreliable 'phone batteries.

By LOUIS J. GAMACHE, W9RGL
Development Engineer
Standard Transformer Corp.
Chicago, Illinois

Telephone Power Packs

BECAUSE of the dependability of electric power companies, the use of electric power packs to replace storage and dry batteries used for telephone service, for small telephone switchboards and apartment telephones, in factories, and in general office inter-communication systems, there is an increasing demand for information and units to replace the messy and undependable batteries.

In checking the various requirements for different installations it is apparent that no one unit could be constructed satisfactorily for each individual requirement. Therefore, the specific requirements are broken down into groups.

Group number one to be used on 6 volt systems, requires 6 volts d.c. at approximately 2 amperes, filtered to have a ripple of less than 1/5 of 1%, or .012 volts of a.c. ripple. In addition to this d.c., the unit should also supply 8, 12 and 14 volts a.c. for ringing circuits.

Group number two to be used on 12 volt systems, requires 12 volts d.c. at approximately 2 amperes, filtered to have a ripple of less than 1/5 of 1% or .024 volt of a.c. ripple. In addition to this d.c., the unit should also supply 8, 12 and 14 volts a.c. for ringing circuits.

Group number three is required to deliver 12 volts at 2 amperes d.c., filtered to have a ripple of 1/5 of 1%, or .024 volts a.c. ripple, also to have 12 volts d.c. at 1 or 2 amperes unfiltered, for the operation of relays, ringing circuits, etc.

Group number four requires 24 volts d.c. at either 4, 6 or 12 amperes, filtered to 1/10 of 1% ripple, or .024 volts a.c. ripple.

The following steps are suggested in the order to be followed in designing one of these units:

The output voltage required, and the percentage of ripple permissible being known, it is then necessary to determine the value of the chokes to be used for filtering. This calculation is made on the basis of using some standard size of lamination. The current requirements will determine the correct size wire to use; and the inductance of the choke is then calculated using the formula

$$L = \frac{.4\pi\ \mu N^2\ A K_1\ 10^{-8}}{Q}$$

Where

$4\pi = 1.257$ m.m.f. Steinmetz factor or conversion factor.

μ = a.c. permeability

N = turns of wire

A = area of core in centimeters

K_1 = stacking factor of the iron (manufacturer's rating)

Q = length of magnetic path in centimeters

Centimeter = 2.54 inches

The actual inductance of the two chokes may be measured by using the following formulae:

$$L = \frac{X_L}{2\pi F}\ 2, \text{ and } X_L = \sqrt{Z^2 - R^2} \text{ or}$$

substituting one in the other,

$$L = \frac{\sqrt{Z^2 - R^2}}{2\pi F}\ 2$$

Where

L = inductance in henrys

R = d.c. resistance in ohms

F = frequency of a.c. component

Z = impedance of choke to a.c.

X_L = inductive resistance

After the above calculations, it is necessary to know the d.c. resistance in ohms of these chokes. This may be obtained by finding the length of the mean turn of the coil, multiplying this by the number of turns, and consulting a wire chart for the resistance of that particular wire size for the number of feet used in the choke. [See RADIO NEWS, Feb. 1939, p. 29.] Knowing the output requirements and the voltage drop (current of the system multiplied by the resistance of the chokes) in the chokes, it is then necessary to add the voltage drop of the rectifier (found in the rectifier manufacturer's charts) at that current to calculate the amount of a.c. voltage needed to supply the rectifier. In the voltage range from 6 to 12 volts d.c., it is advisable to use magnesium cupric sulphide rectifiers because of their low cost and long life. However, for a 24 volt supply, the mercury vapor or argon filled tube rectifiers are recommended. These rectifiers are similar to the old type tungar bulbs.

From the above description the a.c. voltage and current and wattage to the rectifier is calculated. To the wattage found, the wattage required by the ringing circuit is added and the total wattage is that required from the transformer. The transformer will be connected to the line for 24 hours a day, it must be designed for this type of service.

The design of such a transformer was discussed fully in the October, 1938, issue of RADIO NEWS at page 35.

After finding the above information, it is then necessary to determine the values of the filter condensers required to obtain the desired ripple re-

(*More power on page* 63)

An Easy [illegible]

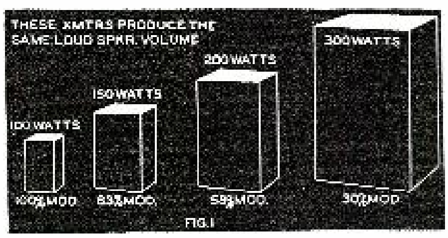
by JOHN P. TAYLOR, W5FQZ
Schenectady, New York

A modulation meter which reads the average value and the peaks as well.

OW many times have you heard a fellow op chortle "boy, I'm hitting 95% on peaks now"—and wonder how he knew it—if he did!! For the sad truth is that most amateur modulation "meters" leave much to be desired. An oscilloscope is a nice gadget—very useful around any rig—particularly for preliminary tuning up, neutralization, etc. But for continuous monitoring it is only an indicator—not a meter (in the precision sense). On voice modulation you can't tell 95% from 100%—or from 80%—or from 120%. The dry disc type modulation meters are not much better. The slow-speed types are too slow and inaccurate for voice. The high-speed types (if calibrated on voice modulation) are sufficiently accurate in themselves—but the needle travels so rapidly that peaks cannot be read with any consistency.

Now it is unfortunate that this situation with regard to modulation measurements should be the case. For modulation degree is important. It's an old story—but one that cannot be too greatly emphasized. Fig. 1, graphically illustrates the point—100 watts, 100% modulated is as good as 200 watts, 58% modulated, or 300 watts, 30% modulated; 50 watts, 100% modulated, is as good as 150 watts, 30% modulated; and so on. Modulation is more important than power—and, within limits, cheaper. Moreover, the "punch" of a fully modulated signal is unmistakable. Finally, a well-modulated signal (always assuming, of course, that it stops short of overmodulation) means highest ratio of service to interfering effect. But—and here's the important point—you can't take advantage of this unless you can read your modulation peaks accurately.

Suppose, for a moment, that your means of reading peaks is accurate only to ±25% (a fair estimate of most devices)—that means that you must keep your peaks to 80% on your indicator, or else run the danger of overmodulation. Now, since your signal varies as the square of the modulation, it is only 64% of what it might be. If your transmitter has a power of, say 100 watts, you are getting the same results as you would with 64 watts, 100% modulated. *Q.E.D.* an accurate modulation meter would be a nice

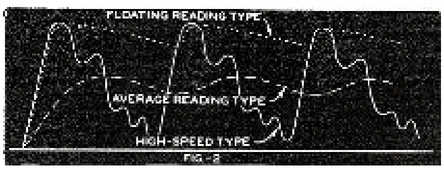


Comparison between xmtr powers.

thing to have. But there lies a problem!

Apparently the only answer—at least for the present—is the use of a device which will give a "floating reading"—similar to that of the modulation monitors and volume indicators recently adopted for broadcast station use. The essential advantage of these is demonstrated by Fig. 2. In this illustration the solid curve is a somewhat idealized modulation envelope (that is, the so-called "syllabic" frequency). Now a high-speed type of meter will follow this curve very closely—which means that it will travel much too rapidly for any kind of consistent observation. A slow-speed meter (or a damped meter), on the other hand, will follow only in the most general sense—tracing a path something like the broken curve shown. This is useless as far as peak measurement goes.

Consider, however, the dotted curve—which indicates the action of a floating-reading-type device. In this case the needle swings up quickly (The upswing time being determined by the



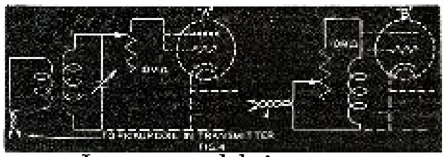
Modulation meters compared.

meter action alone) thus giving an accurate indication of peaks. But—because of provision of a return-delay circuit—it does not swing quickly down again. In fact it returns very slowly—taking approximately a second to reach zero. As a result, on ordinary modulation, it will have dropped only a little way before the next peak hits it. Thus it will need to travel upward only a small amount—and instead of having a needle gyrating wildly back and forth, we have one which simply bumps along on the peaks—very neat, quite accurate, and much less fatiguing to observe.

No doubt many amateurs have had the idea that such a monitor would be swell for ham use—the application to voice modulation being particularly noteworthy. And probably most of them, after taking a look at the rather complicated schematics of commercial types, have dropped the idea like a hot potato. However, on pursuing the subject a little further, it begins to look better. The circuits of the broadcast modulation monitors are rather fancy, for a reason—namely, that they had to meet specific FCC requirements on time constant, regulation, response, etc. Allowing a little more leeway (which seems amply justified) the idea simplifies considerably, and on actual trial has been found to be very much within the reach of most amateurs.

The Circuit

The circuit of the amateur-type modulation monitor to be described is shown in Fig. 3. Those familiar with broadcast monitor circuits will recog-



Inputs to modulation meter.

nize a similarity in the general idea—but not much else. While this instrument still requires five tubes, it has otherwise been greatly simplified. Moreover, the parts required are all of standard size and inexpensive—if in fact, not already available in the junk box. The tube complement—the only sizable item—can be changed within wide limits—to suit whatever you have on hand.

No pictures of the unit are shown for the reason that, at the time of writing, the thing had not progressed beyond the breadboard layout stage. Perhaps this is just as well, for it serves to emphasize the suggestion that the amateur builder first assemble the unit in this style—getting it working to suit before building it into its ultimate shape. There is much room for difference of opinion as to the best time characteristics of a device of this kind. There are numerous combinations of units (see below) which will give almost equivalent results. And, finally, components marked alike may differ enough to change the operating constants slightly. All of which commends the course of making an initial trial layout.

On the assumption, then, that most readers will make at least minor modifications as they go along (which after all is the true amateur spirit) the description will bear chiefly on the functioning of the circuit rather than on the details.

The complete circuit of the monitor—including power supply—is shown in Fig. 3. The first tube, a 56 is connected as a diode detector. Its function is to rectify the r.f. carrier. The

Modulation Meter

small condenser C_1, it should be noted, is not a tuning condenser, but is used, rather, as an r.f. input volume control. The rectified d.c. current flows through the circuit RFC, M, R_2—the r.f. component being filtered out by the low pass filter formed by C_2, C_3 and the r.f. choke. The meter M_1 has two important functions. In respect to the measurement of modulation it serves as a means of setting the input at a predetermined level—thereby avoiding necessity of recalibrating the modulation meter whenever the power of the transmitter is changed. In addition, it also serves as a convenient carrier shift indicator. This follows from the fact that the rectified d.c. is directly proportional to carrier power. Thus, if there is any tendency for the carrier to shift either upward or downward (on modulation, or for any other reason) this will be apparent immediately.

Such an indicator is a requisite to good operation. The modulated d.c. voltage appearing across R_2 is applied to the grid of the second tube. This tube, a 57, functions as an audio amplifier and phase inverter, the phase inversion circuit being of the very simplest type. The push-pull output of this stage is applied to the anodes of a 53 which is connected as a full wave rectifier. The function of this tube is to rectify the audio voltage. This rectified audio voltage (which, of course, is varying at syllabic frequency), appears in the cathode circuit. The audio component is bypassed to ground by C_7. The syllabic component (or envelope), however, being of lower frequency, is not easily bypassed by C_7. The action is best understood by considering what happens when this syllabic voltage is applied to the timing circuit, which consists of a relatively large resistor (as chosen by switch S_1) and the capacitor C_7. The operation of this is as follows: application of voltage causes current to flow and voltage to be built up across C_7. When the current stops, or decreases, this voltage can decrease only by discharging through S_1. The discharge rate is relatively slow, thereby providing the slow return desired. The voltage is read by means of a vacuum-tube voltmeter circuit, which consists of a 56 (to the grid of which the voltage is applied) with a suitable meter in the plate circuit. The circuit R_{13}, R_{14} provides a bucking voltage which allows the zero point of the meter to be set to correspond to zero modulation. R_{15}, of course, is simply a shunting resistor which allows the scale of M to be used most efficiently. The power supply is entirely conventional.

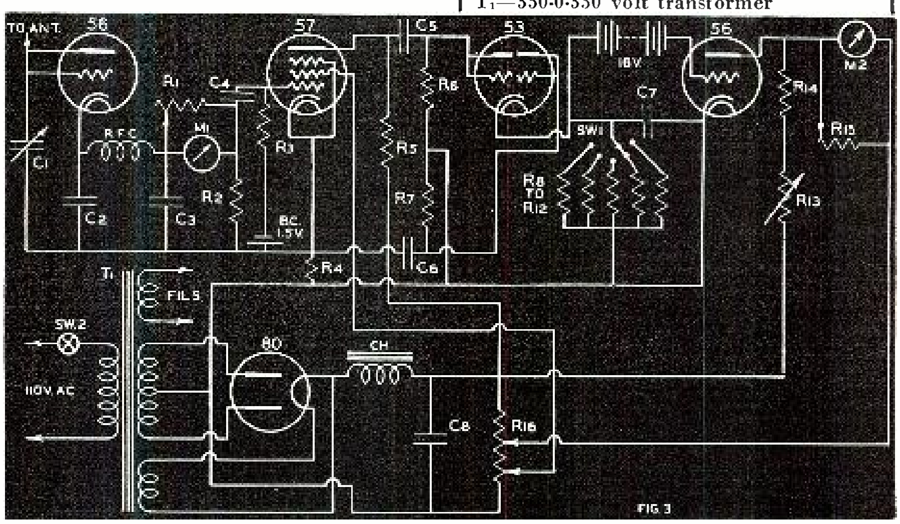
Adjustment

The operation of the unit will have been more or less obvious from the above description. The adjustment procedure is as follows: First, with *no input applied*, R_{13} is decreased until the meter M_2 reads zero. Next C_1 is turned to maximum, and the ground and antenna connected. The amount of pickup should then be adjusted (by shortening or changing the position of the antenna) until M_1 reads half-scale with R_1 all the way out. Modulation is now applied (a steady tone of any convenient frequency) and adjusted for 100% modulation as indicated by an oscilloscope, or, if such is not available, by noting the increase in antenna current (it should be approximately 22% for 100% sinewave modulation). Under this condition it is desired to have the meter M_2 read full scale. In case the pointer has gone off scale R_{15} should be reduced until the meter reads precisely full scale. This will necessitate slight readjustment of R_{13}. The two adjustments must be made by turning modulation off and on, and readjusting each time, until the correct zero and full scale deflections are obtained. In case M_2 does not read full scale for 100% modulation, more audio voltage obviously is required. This is obtained by decreasing C_1 until M_2 reads correctly. This done, the reading of M_1 can be returned to mid-scale (which is the most convenient reading —although there is no reason why some other point cannot be used if desired) by decreasing the resistor R_1.

When these adjustments have been made the unit is approximately calibrated, and ready to be given a trial. This should be done by voice modulating the transmitter and observing the action of the meter needle. For correct timing adjustment the needle should hold very nearly constant for rapid speaking in a level voice (that is, close spaced peaks of approximately equal height). If it does not, but instead tends to swing up and down, then the action is too rapid and should be slowed down by increasing the timing-circuit resistor (that one selected by switch S_1). To test the other extreme, speak even words rather slowly—or count at slow speed. On this the meter needle should show some slight drop between the peaks. If it does not, but instead continues to hold steady, then the action is too slow, and should be speeded up. This can be done by decreasing the size of the timing-circuit resistor. If one wants to make a nice experiment of it, the syllabic modulation can be simulated by an audio tone, and the adjustments made that way. Assuming syllabic frequency to be of the order of 5 to 10 cycles, the adjustments should be made so that for, say 15 cycles, the needle holds steady: just begins to follow the modulation at about 5 cycles, and follows practically the full swing up and down at 1 cycle. (Note: while most beat oscillators are not calibrated this low, they will usually reach down to this range, and the extra distortion is not of importance for this adjustment). And, as the best authorities are still in some disagreement as to the optimum time constants, you are justified in following your own ideas.

(*Modulate to page* 54)

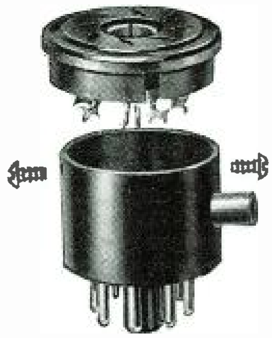
C_1—100 mmfd., midget
C_2, C_3—250 mmfd., mica
C_4, C_5, C_6—.25 mfd., paper
C_7—.01 mfd., mica
C_8—8 mfd., electrolytic
Ch—10 henry, 80 ma.
RFC—2.5 MH, choke
R_1, R_{15}—30 ohm, wire-wound
R_2—10,000 ohm, non-inductive
R_3—.25 megohm
R_4, R_5—.1 megohm
R_6, R_7—.5 megohm
R_8—.5 megohm
R_9—1 megohm
R_{10}—2 megohm
R_{11}—5 megohm
R_{12}—10 megohm
R_{13}—20,000 ohms, wire-wound, 5 watts
R_{14}—10,000 ohms, 2 watts
R_{16}—10,000 ohms, 20 watts
SW_1—Tap-switch
SW_2—s.p.s.t. switch
T_1—350-0-350 volt transformer



Circuit diagram of the modulation meter.

What's NEW in Radio

The American Phenolic Corporation, 1250 Van Buren St., Chicago, Ill., announce a new series of adapters for the existing loktal tubes. Five adapters are required to test all of the existing types in any tube tester, whether home - built or one factory wired. These units may be obtained either wired or unwired in kit form, and complete in-

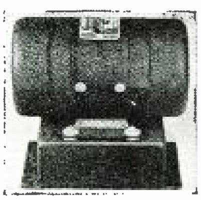


structions are furnished with each adapter to cover the several applications for which they are intended. They are available in black bakelite or a new tan color ultra-lo-loss mica-filled bakelite. Complete data on these units may be had by writing to the manufacturer.

The Arcturus Radio Tube Co. of Newark, N. J., have added a series of new midget type tubes to their line that are designed for series-filament service. They permit a reduction of 50% in the operating temperature of the receiver and eliminate the need for the line cord resistor. These tubes only require half the current of those of previous design. The total heater current on all nine of these tubes is only 150 milliamperes.

The Martin Research & Manufacturing Corporation, 98 Park Place, New York City, are now offering for sale a complete line of sending machines known as "Martin Flash Keys." Mr. Horace G. Martin, who long enjoyed an enviable reputation as one of the finest telegraphers in the profession and as an inventor and manufacturer of telegraph and wireless apparatus, has announced his retirement from the business which will be carried on by Robt. W. and John W. Martin.

Eicor, Inc., 515 So. Laflin St., Chicago, Ill., have introduced a new model C20 dynamotor with filter. This unit incorporates several features which include a holder that accommodates a brush of longer length and with a greater cross-section area. The manufacturers claim a substantial reduction in ripple voltage due



to the use of a stronger magnetic field. This makes possible the use of a smaller armature and a reduction in weight with lower resistance and thereby permits better regulation.

The Simpson Electric Co., 5216 W. Kinzie St., Chicago, announce their new "Hammeter" for the amateur or serviceman. This handy unit tests d.c. voltages up to 3000 volts with an accuracy of 2% on d.c. and 5% on a.c. Current readings may be made up to 750 ma. and a.c. voltages to 3000 may be read. The unit is small and may be placed on the average transmitter chassis when being used. Test cables are provided with insulation to with-

stand 5,000 volts. Alligator clips are furnished with heavy rubber guards to protect the user from possible contact. The tester measures 5¼" x 2-7/82" x 1¾" and weighs only 20 ounces. Complete details are contained in a circular which is available.

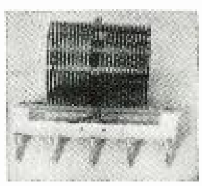
R. C. A. Mfg. Co., Camden, N. J., announce a new record player that may be used with any radio and which operates without any connecting wires to the set. It is of compact construction and may be placed on top of the re-

ceiver or on a table. Other features are: a feather-touch crystal pickup, modulation type volume control, constant speed motor and a pilot light. The tone arm can be raised to the vertical position for easy insertion of the needle. The cabinet is constructed of brown bakelite of modern design.

American Television & Radio Co., 300 East Fourth St., St. Paul, Minn., make a complete line of high grade vibrators of new construction. A tolerance of .005 of an inch is said to be maintained in the parts used in their construction. Features are: Oversize $\frac{3}{16}$" diameter Tungsten contacts, perforated reed of high quality, high-efficiency magnetic circuit with formed base, mica and metal stack spacers and, extra flexible leads with tinned clamp supports to insure freedom from breakage.

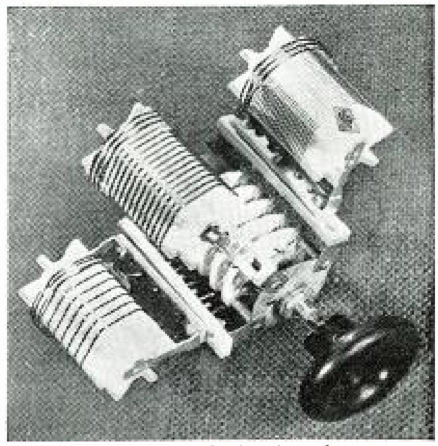
A vibrator guide is available from the above company and will be sent to those requesting it.

Bud Radio Inc., 5205 Cedar Ave., Cleveland, Ohio, have recently added a complete line of air-wound coils for amateur transmitters. They are suited for operation in stages up to 500 watts rating and for frequencies up to 60 megacycles. The coils are constructed of enameled copper wire which is firmly cemented on three fire-resisting plastic locking strips. The winding is mounted on Alsimag 196 bar strip with plugs for rapid insertion into the coil



mounting in the transmitter. Each coil is furnished with a link winding at the center. All hardware is brass. The new folder listing these inductors may be had by sending a card.

Coto Radio Products, Providence, Rhode Island, have added several small "PeeWee" inductors to their line. Any three amateur bands may be covered by inserting the proper coils into the switching assembly. These assemblies are designed to be used where space is at a premium. They are

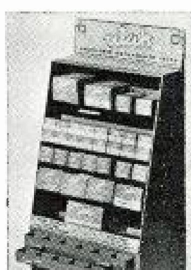


adapted for use in r.f. circuits where power does not exceed 50 watts. The coils are wound on threaded Alsimag ribbed forms and are available for all bands with end link, center link, and with center tapped without link.

Wholesale Radio Service Co., 100 Sixth Ave., New York, have released a new line of amplifiers. These are marketed under the trade name of *Lafayette* and offer a wide selection in units of various power

ratings. A new styling has been designed for these units and the one illustrated has a sloping panel to permit easy reading of the decibel meter by the operator. Inputs are provided for four microphones, together with a master gain and the tone control.

Utah Radio Products Co., 820 Orleans St., Chicago, Ill., have introduced a new "ServicePak" for the serviceman's shop. Included are 79 basic deplacement parts essential to the operation of any normal radio service. These parts are included in an all-steel cabinet. Ample room has been provided for the addition of parts of other makes. Drawer space is also furnished for resistors, condensers and other small parts.



The Operadio Mfg. Co., St. Charles, Ill.,

(*More new products on page* 58)

DANGER! High Voltage

By EDWIN WEAVER
New York City, N. Y.

When is there high voltage across that tank condenser? And when may it be touched without danger? It will pay to read!

BY eliminating the d.c. plate voltage across the tuning condensers in amplifier plate circuits, the voltage rating of the condenser can usually be reduced greatly. This reduction in the voltage rating may reduce the cost of the tuning condensers as much as 50% in some circuits.

While few hams seem to know what circuits to use to remove the d.c. voltage from across the tuning condenser, the circuits are extremely simple and used in many transmitters, although seldom for this very reason. And just to the opposite, many hams use plate blocking condensers to "remove" the d.c. from the tuning condensers, while in reality, they are actually putting d.c. across the tuning condenser by using the "d.c. blocking" condenser.

Generally speaking we can say that if the tuning condenser is connected directly across the tuning coil, no d.c. voltage can appear across the condenser because the coil is a d.c. short circuit across the condenser. (If the rotor of a split stator condenser is grounded, this may not be true.) If the condenser is not connected directly across the coil, usually a d.c. voltage will appear at, and hence across it.

In Fig. 1 is the simplest type of circuit employed in amateur transmitters. The plate voltage is applied at the cold end of the coil and is series fed to the plate. The tuning condenser is connected across the tank coil. The accompanying d.c. equivalent circuit shows that no d.c. voltage can appear across the condenser because both ends of the coil are at the same d.c. potential, V_p. As a result the only voltage across the condenser is the r.f. voltage V_{rf} appearing across the tank circuit. Naturally, the condenser has d.c. on it and it must be insulated from the chassis to prevent grounding the plate voltage. Also for safety's sake, the shaft extension to the dial should be insulated to avoid possible shocks from dial set-screws, etc.

In Fig. 2 the rotor of the condenser is grounded and a by-pass condenser from the cold end of the coil to ground is employed. This type of circuit removes the d.c. from the rotor side of the condenser, but in doing so, applies the full d.c. plate voltage to the tuning condenser. While this circuit is employed very much in radio receivers, it is not suitable for high-power transmitter stages because the voltage rating of the condenser must be increased to allow for the plate voltage. The d.c. equivalent circuit in Fig. 2 shows that the plate voltage is connected across the condenser. Therefore, the condenser must be rated to withstand the r.f. voltage across the tank coil plus the d.c. plate voltage. Since in most circuits the r.f. voltage is equal to or slightly less than the d.c. plate voltage, it follows that the voltage rating of the condenser must actually be doubled.

In some hook-ups, the use of a circuit having a d.c. blocking condenser may actually keep the d.c. off the tuning condenser. Fig. 3 is an example of this fact, yet by way of contrast in Figs. 9 and 11, the blocking condenser itself does not keep the d.c. off the tuning condenser.

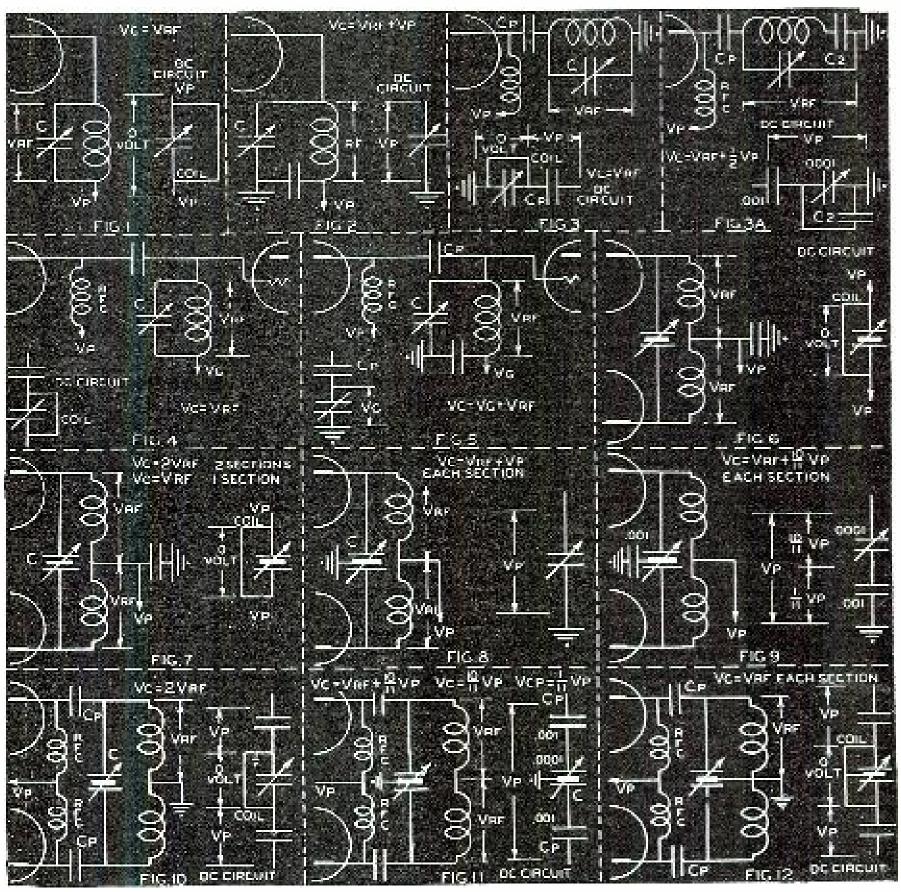
The d.c. is kept off the tuning condenser in Fig. 3 because the coil can be connected across the tuning condenser, not because of a d.c. blocking condenser.

How the indiscriminate use of a blocking condenser may sometimes lead just to the opposite of what is desired is shown in Fig. 3-A. Instead of connecting the coil directly to ground, the unthinking ham may decide to use a blocking condenser in series with the coil, while still grounding the condenser in order to decrease the voltage across the latter. The d.c. equivalent of the circuit shows that by removing the grounded end of the coil and substituting a condenser, the high end of the coil immediately assumes approximately the same d.c. voltage as the plate of the tube.

In order to explain this phenomenon, we must go back to the elementary electricity dealing with voltages and charges on condensers. When two condensers are in series and connected across a battery, the same number of electrons must flow into each condenser until each one is fully charged. Only identical quantities of electrons can flow through the circuit because it is a series circuit.

Elementary electrical principles state that the product of the voltage (V) times the capacity (C) equals the charge (Q), or in terms of a formula: Q equals C × V. Turning the formula around we have: V equals $\frac{Q}{C}$. According to this, the voltage is inversely pro-

(*Read further on page* 55)



TECHNICAL BOOK & BULLETIN REVIEW

RADIO TROUBLE-SHOOTERS HANDBOOK, by Alfred A. Ghirardi, first edition, is now off the press. This book is published by *Radio & Technical Publishing Co.*, 45 Astor Place, New York City. Containing 518 pages, this large handbook covers a multitude of service data on all receivers and associated equipment. Complete information is given on servicing home receivers, auto radios, public-address, recording, rectifier systems and many other chapters are included, and many charts and compiled data of value to the radio man are given.

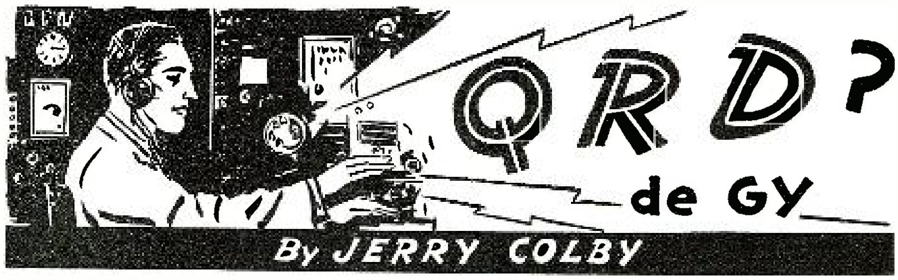
Directories are listed covering the various tube manufacturers, as well as those concerns making receivers, radio parts, tuners, accessories, sound equipment, test equipment, and other parts. General instructions for receiver analysis are completely covered so that the new serviceman may benefit from the reading of the book as well as the more advanced layman. There are 52 sections in the handbook, and each one covers its topic very thoroughly.

HANDBOOK OF TECHNICAL INSTRUCTION FOR WIRELESS TELEGRAPHISTS, by H. M. Dowsett, and published in England by *The Wireless World*, Dorset House, Stamford St. London, S. E.1., is a text book designed for the teaching of wireless communication to the beginner as well as the advanced student. Thirty-two chapters, containing full information on all phases of radio are included. A few of the chapters from this book are: Ohms law, etc., Scalar and Vector quantities, Accumulators, Measuring instruments, Switchboards and Switchgear, Aerials and Radiation, Thermionics and Valves, Depth Sounding, Wavemeters, Receivers, Marine Direction Finders, Distress Call Apparatus and Maintenance of Marine Equipment.

THEORY AND APPLICATIONS OF ELECTRON TUBES, written by Herbert J. Reich, Ph.D., associate professor of electrical engineering, University of Illinois. This new book is published by *McGraw-Hill Book Co.*, New York and London. The book is intended to give the student a sufficiently thorough grounding in the fundamental principles of electron tubes and associated circuits to enable him to apply electron tubes to the solution of new problems. The book is based upon mimeographed notes that have been used in the author's course on electron tubes during the past five years. These notes have been kept up to date and have been revised, as use in the classroom has indicated where improvement could be made. The text book contains 670 pages.

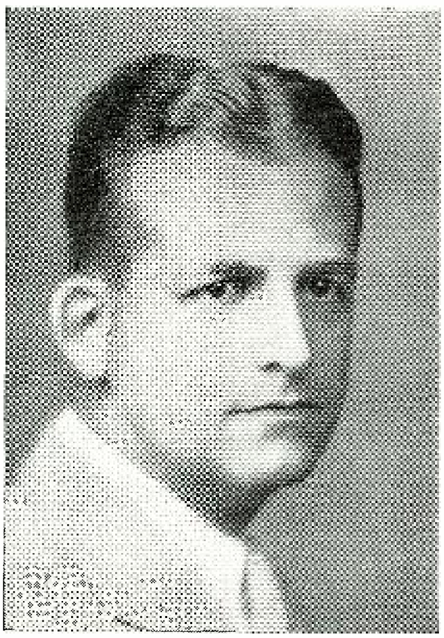
MODERN PLASTICS, published by *Breskin & Charlton Publishing Corporation*, 425 Fourth Ave., New York City, contains a wealth of information on various applications of plastics used in the radio and associated industries. Of particular value to the manufacturer is a very complete Plastic Properties Chart, which has been compiled by leading engineers and chemists. Many chapters are included which cover the materials and methods used in the making and forming of plastics. This annual handbook, catalog and directory is the third issue of this monthly publication and contains 304 pages, with careful consideration given to all of the branches of this fast growing field. Other chapters are: Machinery and Equipment, Laminates, Bibliography and Nomenclature and a complete Directory.

RADIO BUILDERS HANDBOOK, a publication of the *Allied Radio Corporation*, 833 W. Jackson Blvd., Chicago, is now available. This booklet includes the fundamental knowledge that the beginner in radio needs for a start. Although not a complete textbook, this information is given in easy-to-understand terms so that the student will not become confused or find the technical descriptions too deep in scope. This book is right up-to-date and includes information for the construction of apparatus. —30—



WE bring you the first in a series of thumbnail sketches of men who rose to prominence since the infancy of radio science. As an example of perseverance and ingenuity, J. R. Poppele, Chief Engineer of WOR. can be looked to with pride. Since 1911, when radio was mainly a matter of copper pipe, scrap metal and luck, he operated amateur station 2AEY in Newark, New Jersey. During the war, he pounded brass on a few coastal boats. And the apparatus on board then was a lot different than the modern equipment used today.

A galena crystal with its roving cat's whisker, a rotary spark was the xmtr that would blow up if its note stretched itself out for more than 50 miles. In 1917 he built the first direction finder and the skipper was skeptical when it was placed aboard ship for demonstration. But he was convinced shortly thereafter, when they located Scotland



"It's a miracle I wasn't killed. . . ."

Light in a dense fog. Mr. Poppele remembers well the old days when a quench-gap spark was installed and he carelessly tried to reduce power while still keying. He says, "The next thing I knew was when I recovered consciousness in the Captain's cabin. It's a miracle I wasn't killed." The shock had tossed him from his chair right through the door of the radio-room!

At the close of the war he became attracted to the then new field of radio broadcasting. Early in 1922 he became affiliated with the then low-powered station WOR. He has been with this station ever since, beginning as its first technician, watching its growth to the present 50,000 watt strength. His memories include a $1,000 offer made by bootleggers to put on a special weather announcement which would warn their boats at sea . . . the night that the *Shenandoah* tore loose from her mooring mast and was brought to safety . . . and the time he stood a straight 72 hour watch in the radio shack when his relief operator was stricken with appendicitis. But he emphatically states, "I have never regretted that day back in 1911 when I worried over my first xmtr and got bitten so hard by the radio bug that I've never recovered."

* * *

LES BOWMAN sends a call to all "hams" to listen to his new experimental xmtr W6XDA which will operate on 35.6 megacycles. This new transmitter is constructed so that the transmission line which carries the signal 225 feet from the equipment to the signal radiator is tuned. That is, the conduit dimensions are exactly right so that there is a minimum of line loss. The concentric radiator on the roof is tuned to 35,600 kcs. Bowman is an amateur enthusiast as well as a professional radio engineer and has constructed this experimental job for research in the field of seasonal variations, distance, absorption of signals by buildings, and to discover the most efficient xmtr design. Best of luck to him!

* * *

HERE'S some information in answer to requests from a few ops for the addresses of the two radiop unions. The national office of the CTU-Mardiv is located at 265 West 14th Street, New York, N. Y. And the national office of the ARTA is located at 10 Bridge Street, New York City.

* * *

THAT Yacht *Metha Nelson* which was the cause of scare headlines in national newspapers because of the cargo of celebrities it carried, also carried radiop M. E. Hulderman, an ARTA member. But Brother Hulderman refuses to talk for publication after his harrowing experiences with pirates, mutiny and the search for hidden treasures down in the South Seas. The only thing he said was that he kept his radio shack door locked whenever the noise became unbearable. Then, too, he didn't want to become involved in the mess. Which is good reasoning, in any country.

* * *

WE were very proud of ourselves when we noted that brothers Jordan and Pyle who are jointly editing a column for the ARTA publications *ACA NEWS*, mastheaded their column *QRD? Imitation is the sincerest form of flattery.*

But all we hope for is that, as QRD? by GY is unbiased and is the symbol true statements by and about radiops, so should they also keep their QRD column fair to all, regardless of party affiliations or difference of viewpoints.

* * *

CHARLEY LEIDEN would like to hear from his old shipmate Tim Furlong. He says Tim was the first radiop on the west coast to send out an *SOS* when he was on the old SS *Humboldt* which had gone aground in Puget Sound. Leiden says Tim is such an oldtime operator that when he first went to sea on an oil tanker, he worked the radio xmtr from a barge which was towed by the tanker. They did not install the apparatus on the tanker for fear the radio waves would blow it up. Well, it's a

(*Further QRD? on page* 58)

Simple Loop Construction

by JOHN X. UTLEY
Talkeetna, Alaska

An easy solution to the difficulties of building your own direction loop.

AFTER I had built the set described last month (RADIO NEWS, March, 1939, page 9), I wanted to turn it into a good direction finding instrument. I wrote to several manufacturers asking prices on loops, and was surprised that there were so few on the market that were anywheres within reach of my limited pocketbook. The loops were not only expensive, but they were scarcer than the proverbial hen's teeth. In addition to this I was supposed to furnish the manufacturer with data as to the input impedance of the receiver and the wave-lengths on which I wished to have my loop operate. Some of this I did not have.

I determined that there must be some short cut method, either "cut-and-try," or "hit-and-miss" which would give me the desired results. So I applied myself to the books. These, too, were much lacking in details of construction. I had read an article in RADIO NEWS from some time back [*Sept., 1938, issue, page 28. Ed.*], but that seemed to me to make a lot of to-do about very little, and I discarded the idea without even putting a hand to a hammer.

Sitting down I visualized the situation. I had to have a loop of wires completely enclosed in some sort of screening (except for a small "window") and it had to be rugged and cover frequencies from 200 kc. to 6000 kc. I wanted to do this without switches or tuning condensers.

At once the idea came to me that I could use some copper piping and bend it into a circle. After trying a few pieces and getting something that looked like anything *but* a circle, I gave that up. It was while I was coiling up some rubber hose that the thing hit me. If, I reasoned, I could coil hose so simply, why not put wire on the inside and that would give me the nucleus of the loop. No sooner said than done.

I purchased a 5 ft. length of ⅝-inch rubber bathtub hose and found that that gave me about the diameter that I wanted, namely 20 inches. It coiled very well. Next problem was how to get the wire inside. That was not so easy.

I started first with No. 18 bell wire, and before I had twenty turns, I saw that I would never get the amount that I had determined from my reading that I must have. This was 100 turns. I tried No. 22 enameled wire and found that it would work very well. In pushing the wire through the rubber I got it all twisted up and gave up that process in disgust. But I still thought that I had the right track.

I did some more "skull-duggery." I was going to put screening around the outside of my rubber hose, so I reasoned that I could cut the hose and then bind it together again. That was it; I would cut the hose.

Using one of my old razor blades (there is no charge for this information on what to do with your old razor blades) I slit the rubber lengthwise. It opened like an auto tire. Now to get the wire inside.

I placed my coiled rubber hose on a piece of wood and drew two lines with a pencil held against the inside and the outside. Removing the hose, I drove 3 inch nails into the wood dead center between the lines. This gave me a circle of nails whose circumference was the mean between the inside and outside measurements. I placed the nails about 3 inches apart. It was a cinch to wind the wire around these nails! After I had made 100 turns (about ¾ pound of wire is needed for this) I bound the bunch in several places with tape. It was the work of a minute to get the wire into the slit tube. So far, so good.

Next, figuring that I needed a *screened* loop, I purchased some No. 40 mesh brass screening. I can only say that I thought of the screening because the words "screened loop" suggested it to me. I bought a piece 6″ x 36″, and it cost me 98c. Cutting this piece into sections of 2″ x 36″ was but the task of a minute.

Next I started about 1½″ from the one inside end of the hose where the two pieces came together, and I wrapped my screening around the loop, stopping to "tack" it at each turn with some solder. In this manner I progressed all around the loop, and found that I had just enough to reach to within 1½″ of the other end. After the wrapping was on, I further strengthened the screening by tacking it at every turn in four places spaced 90° apart. Incidentally, use gloves in putting on the screen; it cuts like the mischief.

My loop was complete. Now for the first test; and I approached it with fear and trepidation. If my calculations were incorrect I would have to unsolder everything!

Grounding the screening to the proper post on the set, and hooking up the other two connections, I listened over the broadcast band. It worked! I got a very sharp "null" point in the direction of the broadcast transmitter. Next I tried it on all the other bands in which I was interested, and found that it worked there too. I had found a way to make a loop for approximately $2.02. This was divided as follows: Hose, 50c; screening 98c, Wire 44c, and tape 10c.

The manner of mounting came next. The hose was not rigid enough to stand by itself and so I cut an exact circle of heavy cardboard to fit the center. This I taped to the outside which I had previously covered with tape to prevent corrosion. Now the loop was rigid enough. Then there was the mounting of the jack. That presented no particular difficulty.

I cut three strips of bakelite, two pieces 3″ x 5″ and one 1″ x 5″ using ¼″ stock. I bolted my longer pieces each to one side of the "widow" and placed the other piece between them with angle irons. Into this final piece I mounted an *Amphenol* Male Plug and the job was complete. True it was that I could not use the loop in a high wind, but inside my room it worked to perfection. For outdoor use I am building another which will be cross-braced with bakelite strips which will have less wind resistance.

I do not know when I have had more excitement than in plotting the directions of the various stations around me. I cannot tell the exact direction because the loop is *bi-directional,* but knowing the general direction of the station—whether it is north or south of me, or east or west,—I have had no trouble in finding in what part of the foreign countries the transmitters were. Of course, on local broadcasters or those of Canada or the U. S. A. I have no trouble at all.

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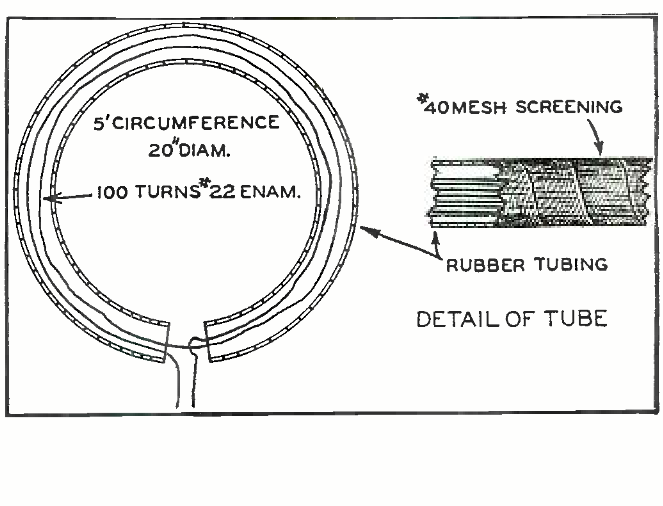
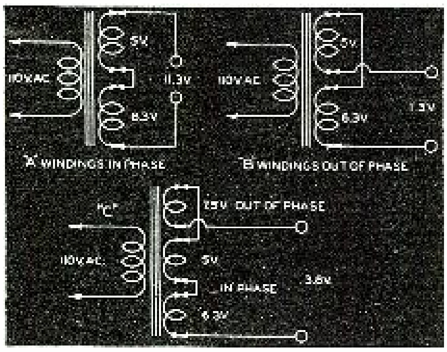


"RADIO Gadgets"

Obtaining Odd Voltages

IN working with various types of apparatus in the laboratory or service shop, one frequently requires A.C. voltages of an order not readily obtained from the standard filament transformer. Fig. 1 shows how the author obtains odd voltages from a regular transformer by connecting the windings in or out of phase with each other. At "A" the windings are shown in phase and the voltage is in-

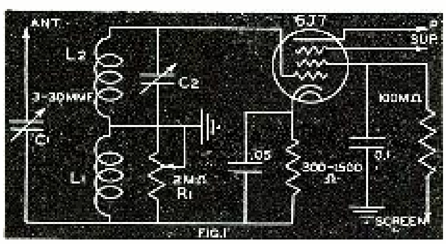


creased; at "B" the two windings are out of phase and the voltage obtained is the difference between the two values or 1.3 volts. A three-winding transformer is shown at "C" with two windings in phase and one winding out of phase, giving a voltage output of 3.8 volts.

Many amateurs can use these methods of voltage source in their rigs, as new tubes of different filament rating may be tried before purchasing a new transformer.

Antenna Coupling to Regenerative Mixers

Two secrets of success with regenerative mixer circuits are; smooth control of regeneration and efficient antenna coupling. Fig. 1 shows an improved method of coupling an antenna to this type of input. In this arrange-



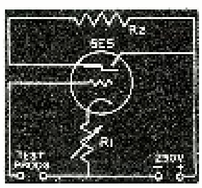
ment, the antenna coupling and the regeneration are varied simultaneously, resulting in better sensitivity and a higher signal-to-noise-ratio, especially on ten meters.

The circuit is adjusted as follows: Turn the 3-30 mmfd. trimmer completely out and advance the regeneration control, R1, full on. Now screw up C1 until the mixer circuit is barely oscillating. The potentiometer can now be reduced to one-half scale without affecting the tuning condenser, C2, appreciably. In short, the antenna coupling is increased or decreases as the regeneration control is advanced or retarded, holding the circuit just below the point of oscillation for any setting of R1.

"Magic Eye" Continuity Tester

The 6E5 "magic eye" tuning indicator tube makes an excellent continuity and insulation tester when arranged as shown in the illustration. The device is especially useful for checking very high resistances, such as grid resistors, etc., and for testing the insulation and dielectric of transformers and fixed condensers.

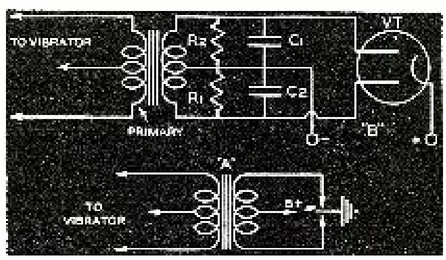
In the arrangement shown, R1 is a 10,000 ohm wire-wound potentiometer and is used to control the bias applied to the grid and therefore the size of the pattern. R2 is a one megohm fixed resistor. In actual use, R1 is adjusted, with the test prods "shorted," until the "eye" just closes. When testing, the pattern closes on a closed circuit and remains open on an open circuit.



Many other uses of this versatile tester will suggest themselves to the amateur and serviceman.

Revamping Vibrator Packs

Recently, we purchased one of the commercial 6 volt vibrator power units which supply 300 volts D.C. at 100 milliamperes. This particular unit



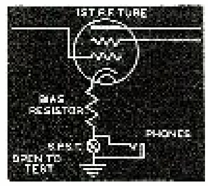
was of the self-rectifying or synchronous type and, like most hams, at times we frequently subjected it to heavy overloads. The result was that the vibrator points pitted badly, making the output voltage quite erratic. It was decided to change over the circuit to the tube-rectifying type.

The necessary changes are shown. It will be noticed that in the synchronous type, the transformer secondary center tap is the "B" plus, while in the tube-rectifying type, the center tap is the "B" minus. The resistors, R1 and R2, are 100,000 ohms each; the condensers are of the regular oil-filled type of .05 mfd., 1600 D.C. working volts rating.

Simple Monitoring with the Receiver

When the transmitting amateur finds himself shy of a monitor but uses a receiver with one or more stages of RF, a simple monitoring device can be quickly rigged up.

Open the grid return of the first RF tube, below the bias resistor and insert an open circuit phone jack. Then across these jack connections connect a SPST switch in series with the grid return.

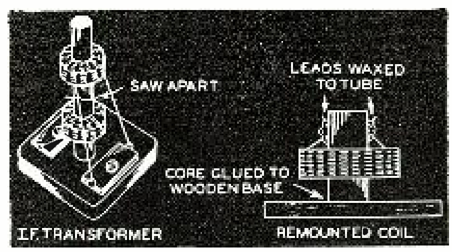


By inserting the phones, opening the switch and disconnecting the speaker, the transmitter can be nicely monitored. When receiving, close the switch and connect in the speaker, allowing the phones to remain in the jack for future use.

R.F. Chokes from I.F. Coils

The "Ham" who is constructing radio apparatus has use for many RF chokes, particularly in receivers. When these are scarce, and if IF transformers are plentiful, the coils in the transformers may be used to advantage.

Remove the coils from their cans and disconnect the coil leads from the padding condensers. Then cut the



wood or cardboard core between the coils and presto: two RF chokes are the result.

Make a little wood base for each coil, with a hole in the center into which the core can be glued in an upright position. Wax the coil leads to the core as shown or fasten to suitable binding-posts for circuit connection.

The smaller high frequency IF coils will of course make better chokes for the high frequency circuits. The padding condensers will also find a use in balancing circuits, neutralizing, etc.

Home Made Crystal Holder Looks Commercial

Crystal holders can be easily made, for those spare crystals, that are efficient and have a commercial appearance.

Saw off a tube base (five prong) to within ¾ inch of the bottom. Open the two necessary prongs. Cement a round disc of dry wood or heavy fibre

(*Gadget further on page* 61)

Seal of Acceptance RADIO NEWS

ANNOUNCEMENT is made of the following RADIO NEWS Seal of Acceptance awards:

To: American Phenolic Corporation, 1250 Van Buren St., Chicago, Ill.
Awarded Seal of Acceptance No. 104.1
Product: Amphenol Co-Axial Cable.
Descriptions: A co-axial cable made of Amphenol "912" beads, and other parts. Electrical characteristics: Impedance—82.5 ohms; loss per ft.—.0009 db; inductance per ft.—.1 microhenry; capacity per ft.—11.5 mmfd; resistance per ft.—.024 ohms. All measurements made at 1MC.

To: American Phenolic Corporation, 1250 Van Buren St., Chicago, Ill.
Awarded Seal of Acceptance No. 104.2
Product: Liquid Amphenol "912."
Description: 100% non-hygroscopic form of solid Amphenol "912." Increases break-down voltage to 20%. Used for doping coils, paper tubing, fibre, ceramics, etc.

To: American Lava Corporation, Chattanooga, Tenn.
Awarded Seal of Acceptance No. 106
Product: Alsimag.
Description: A ceramic insulating material. Material covered by Seal is: AlSiMag 35, 196, 197, 211, 72, 202, 203, 190, 192, Lava Grade "L," "M," "A." Report on properties on file with RADIO NEWS, as determined by Hans Thurnauer, M.S.C. under A.S.T.M. specifications.

To: Triplett Electrical Instrument Company, Bluffton, Ohio.
Awarded Seal of Acceptance No. 103
Product: Model 233, 0-1 Milliammeter.
Description: A rugged, accurate, durable, easy reading and simple 0-1 milliammeter.

To: Triplett Electrical Instrument Company, Bluffton, Ohio.
Awarded Seal of Acceptance No. 103.1
Product: 0-1.5 AC Voltmeter.
Description: An accurate, rugged and durable 0-1.5 AC voltmeter.

SEALS are awarded to those manufacturers whose products exactly measure up to the claims they make for them. The Seals are given out free as a service alike to the buyers and manufacturers. The former can purchase knowing that an impartial source has checked the product against claims made for it, while the latter has the opportunity of getting an unbiased opinion on the article.

For further information, write to the RADIO NEWS Seal of Acceptance Div., 608 S. Dearborn St., Chicago, Ill.

Hereafter each month this Division of the publication will carry a list of products on which Seals have been awarded.

—30—

ON THE COVER WE HAVE . . .

WALLACE BEERY, well known screen actor, pilot and radiooperator. Mr. Beery has been using radio in connection with his flying for as many years as he has had his plane. Of course he has his operator's license to do this. A great believer in safety in the air, Wallace Beery has said on more than one occasion that he would not be without the radio navigation aids.

While the set shown on cover is installed in Mr. Beery's old plane, he has since acquired a new *Howard Special* and had that completely equipped with two-way radio communications.

The transmitter is an *RCA-AVT 7B.* The frequency range of this set is from 2.6 to 6.5 megs. Employing a V-cut, low temperature coefficient crystal, the power output of the rig is 20 w. on phone or c. w. For this it consumes 14.5 amps @ 12 v. d.c.

The tube lineup is: 42 extal oscillator, 807 power amp., 42 speech input, and 6A6 modulator.

The transmitter is built up into three units. They are the xmtr itself, the control panel containing "on-off" switch, mike jack and pilot light; and the vibrator power unit. This latter is of the synchronous vibrator-rectifying type.

Push-to-talk is accomplished from the microphone itself by pushing a control button located there. All switching of frequency is done with a manually operated switch, and reception is by means of an automatic relay.

Two antennae are used, one fixed from the head of the plane to the tail, and another trailing one that may be let out for greater dx xmission.

For reception, Wallace Beery uses the radio compass, *RCA Model AVR 8D* receiver. This unit is complete with a small fixed receiving loop in a streamlined housing, control boxes, interconnecting cables, etc.

* * *

Since last month there have been many inquiries concerning the cover and what it represented. We had not thought that there could be so many different versions of what seemed to us a simple picture. Among the ideas that were presented were, "It's a picture of a Spanish refugee." "It's a shot of an African aborigine," "It's a picture of a portable phonograph."

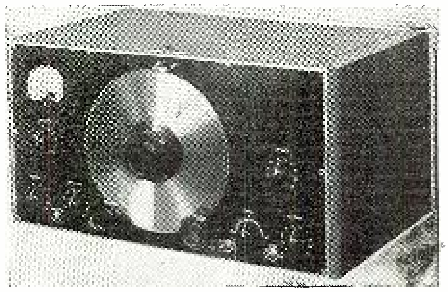
Unfortunately we do not have much information on the subject from the author. The picture was taken in India by Stanley Jepson of Bombay, and he gave us no dope on the set. Drawing on our memory (and we wish to be corrected by our readers if they know otherwise) we think that the set is an old *Remler* or *Pathé,* perhaps even a portable *Philco* or the forerunner thereto. It seems to us that it was built about the year 1921-1925. Does anyone know differently?

—30—

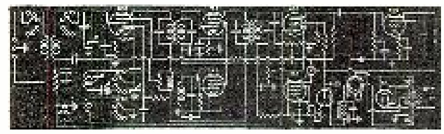
THE NEW SILVER-SUPER

A new type of communications receiver for those who build them.

THE new communication receiver to be described goes considerably beyond the earlier designs in that it includes a new noise limiter which is as effective as it is simple. It covers the



You'd never believe that the set was home-built. Circuit shown below.



full range of 5 through 550 meters with sensitivity of about 1 microvolt absolute throughout, has the extremely high signal-to-noise ratio; is completely free of "warm-up" drift, is both "portable" battery operated or "permanent" a.c. operated in the same unit, and can be expanded to anti-fading dual-diversity reception at no increase in size. Yet it can be built to "battleship" ruggedness by even a novice.

It can be aligned and tested without any service gear whatsoever, although a test oscillator makes the task most easy.

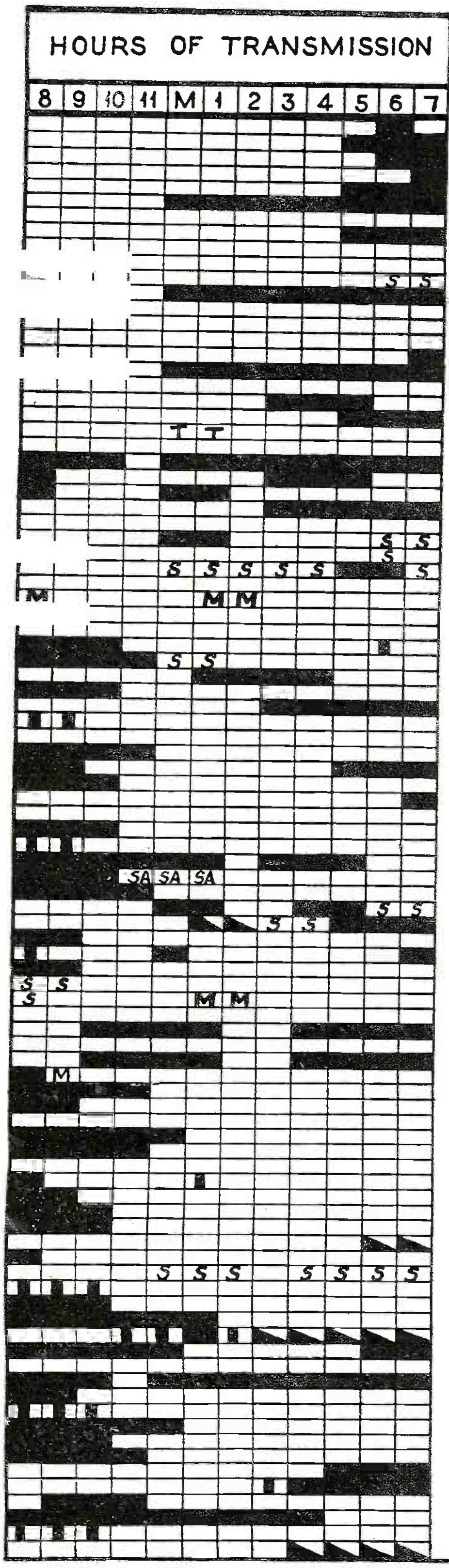
This receiver also has a.v.c., six low-C tuning bands, uses the newest all-glass "Loctal" tubes, has nearly twenty-two inches of effective dial length per band readable to one part in 5000—which can be stretched to over eleven feet per band, selectivity continuously variable from 12 kc. "high-fidelity" right up to sharper than the 1 kc. necessary to single-signal c. w. reception, 4.25 watts undistorted power output, and appearance and controlability.

This new set uses one 6K8 regenerative first detector-oscillator, one 7A7 "Loktal" regenerative i.f. amplifier, 7A7 audio beat oscillator, 6B8 second detector, a.v.c., first audio amplifier and new noise limiter, 6V6 beam power output tube, 80 rectifier, and if desired, one each VR150 and VR90 automatic voltage regulator tubes. Including a.c. power supply, it mounts on a chassis 1/16" thick for absolute mechanical rigidity which is only 15¾" long, 7" deep and 3½" high, with silver decorated black control panel 17" by 9½". A grey enamel steel cabinet is available.

—30—

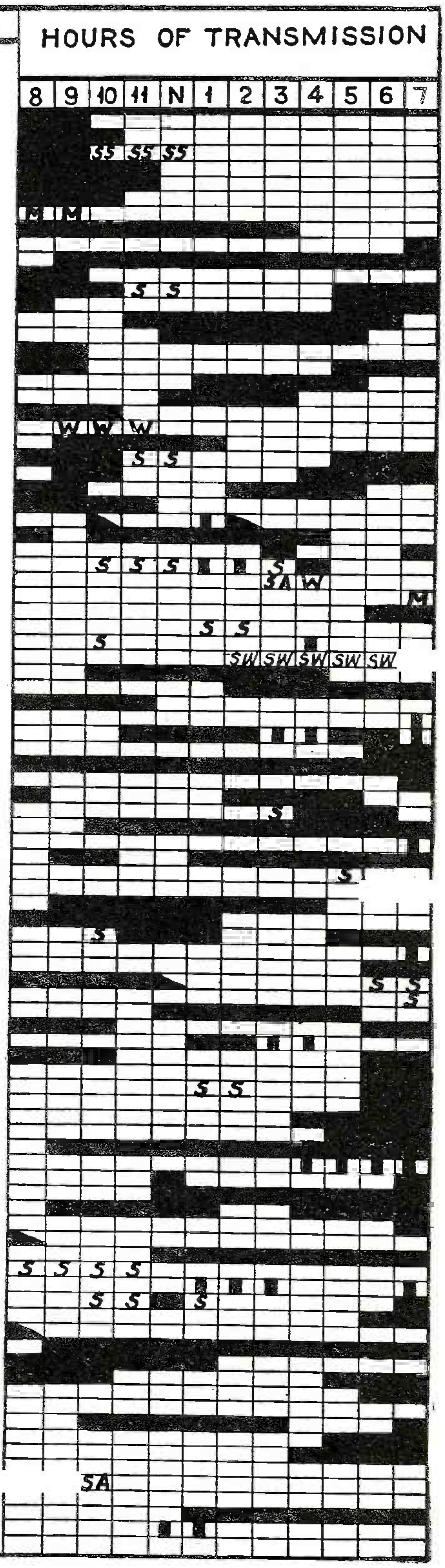
WORLD SHORT WAVE TIME-TABLE

Compiled by the Editors of RADIO NEWS
Hours of transmission for the World's Short Wave Broadcast Stations



EASTERN STANDARD TIME

Wave-length Meters	Call Letters	Frequency Kc.	City Country
13.93	W8XK	21540	Pittsburgh, Pa.
13.93	GSJ	21530	Daventry, England
13.91	W2XE	21520	New York, N. Y.
13.96	W2XAD	21500	Schenectady, N. Y.
13.97	GSH	21470	Daventry, England
13.99	DJS	21450	Zeesen, Germany
15.77	HS8PJ	19020	Bangkok, Siam
16.86	GSG	17790	Daventry, England
16.87	JZL	17785	Nazaki, Japan
16.87	W3XL	17780	Bound Brook, N. J.
16.88	PHI2	17770	Huizen, Holland
16.89	DJE	17760	Zeesen, Germany
19.56	DJR	15340	Zeesen, Germany
19.57	W2XAD	15330	Schenectady, N. Y.
19.60	GSP	15310	Daventry, England
19.62	LRU	15290	Buenos Aires, Arg.
19.63	DJQ	15280	Zeesen, Germany
19.65	W2XE	15270	New York, N. Y.
19.66	GSI	15260	Daventry, England
19.68	TPA2	15243	Pontoise, France
19.71	PCJ2	15220	Huizen, Holland
19.72	W8XK	15210	Pittsburgh, Pa.
19.74	DJB	15200	Zeesen, Germany
19.76	GSO	15180	Daventry, England
19.79	JZK	15160	Nazaki, Japan
19.82	GSF	15140	Daventry, England
19.84	HVJ	15121	Vatican City
19.85	DJL	15110	Zeesen, Germany
19.89	RKI	15090	Moscow, U.S.S.R.
20.04	LZA	14970	Sofia, Bulgaria
20.08	PSE	14935	Rio de Janeiro, Brazil
20.64	HBJ	14535	Geneva, Switzerland
22.00	SPW	13635	Warsaw, Poland
24.52	TFJ	12235	Reykjavik, Iceland
25.00	RNE	12000	Moscow, U.S.S.R.
25.21	XEWI	11900	Mexico, D. F.
25.24	TPA3	11885	Pontoise, France
25.27	W8XK	11870	Pittsburgh, Pa.
25.29	GSE	11860	Daventry, England
25.34	OLR4A	11840	Podebrady, Czech.
25.36	W9XAA	11830	Chicago, Ill.
25.36	W2XE	11830	New York, N. Y.
25.40	2RO4	11810	Rome, Italy
25.42	DJZ	11801	Zeesen, Germany
25.42	JZJ	11800	Nazaki, Japan
25.45	W1XAL	11790	Boston, Mass.
25.49	DJD	11770	Zeesen, Germany
25.51	OLR4B	11760	Podebrady, Czech.
25.53	GSD	11750	Daventry, England
25.58	CJRX	11720	Winnipeg, Canada
25.60	TPA4	11718	Pontoise, France
25.60	CR7BH	11718	Lourenzo, Marques
25.63	SBP	11705	Motala, Sweden
25.64	HP5A	11700	Panama, Pana.
25.66	XTJ	11690	Hankow, China
26.01	SPD	11535	Warsaw, Poland
26.24	COCX	11435	Havana, Cuba
26.31	HBO	11402	Geneva, Switzerland
27.17	CSW	11040	Lisbon, Portugal
27.27	PLP	11000	Bandoeng, Java
29.04	ORK	10330	Ruysselede, Belgium
29.24	PMN	10260	Bandoeng, Java
29.35	PSH	10220	Rio de Janeiro, Brazil
30.43	EAQ	9860	Madrid, Spain
30.52	IRF	9830	Rome, Italy
30.81	CSW	9737	Lisbon, Portugal
31.02	W3XAL	9670	Bound Brook, N. J.
31.06	LRX	9660	Buenos Aires, Argentina
31.09	CS2WA	9650	Lisbon, Portugal
31.10	HH3W	9645	Port-au-Prince, Haiti
31.14	12RO3	9635	Rome, Italy
31.20	HJ1ABP	9616	Cartagena, Colombia
31.25	RAN	9600	Moscow, U.S.S.R.
31.28	VK6ME	9590	Perth, Australia
31.28	W3XAU	9590	Philadelphia, Pa.
31.28	VK2ME	9590	Sydney, Australia
31.28	PCJ	9590	Huizen, Holland
31.28	HP5J	9590	Panama City, Pana.
31.32	GSC	9580	Daventry, England
31.32	VKVLR	9580	Lyndhurst, Australia
31.35	W1XK	9570	Millis, Mass.
31.37	OAX4T	9562	Lima, Peru
31.38	DJA	9560	Zeesen, Germany
31.41	W2XAD	9550	Schenectady, N. Y.
31.42	OLR3A	9550	Podebrady, Czech.
31.42	XEFT	9550	Veracruz, Mexico
31.45	DJN	9540	Zeesen, Germany
31.48	W2XAF	9530	Schenectady, N. Y.
31.48	LKC	9530	Jeloy, Norway
31.49	ZBW3	9525	Hong Kong, China
31.51	OZF	9520	Skamlebak, Denmark
31.55	GSB	9510	Daventry, England
31.55	HJU	9510	Buenaventura, Colom.
31.55	VK3ME	9510	Melbourne, Australia

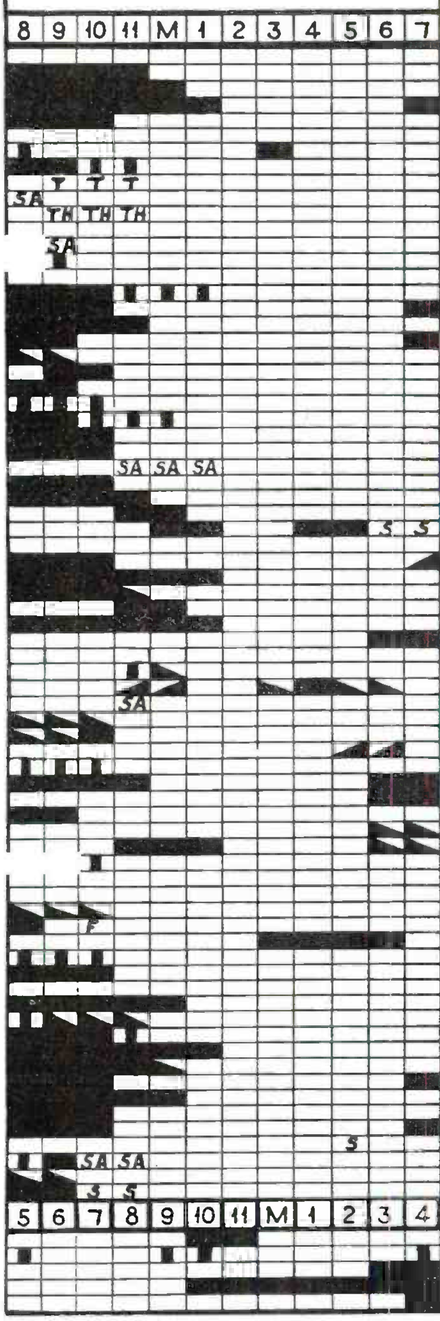


WORLD SHORT WAVE TIME-TABLE

Compiled by the Editors of RADIO NEWS

Hours of transmission for the World's Short Wave Broadcast Stations

HOURS OF TRANSMISSION



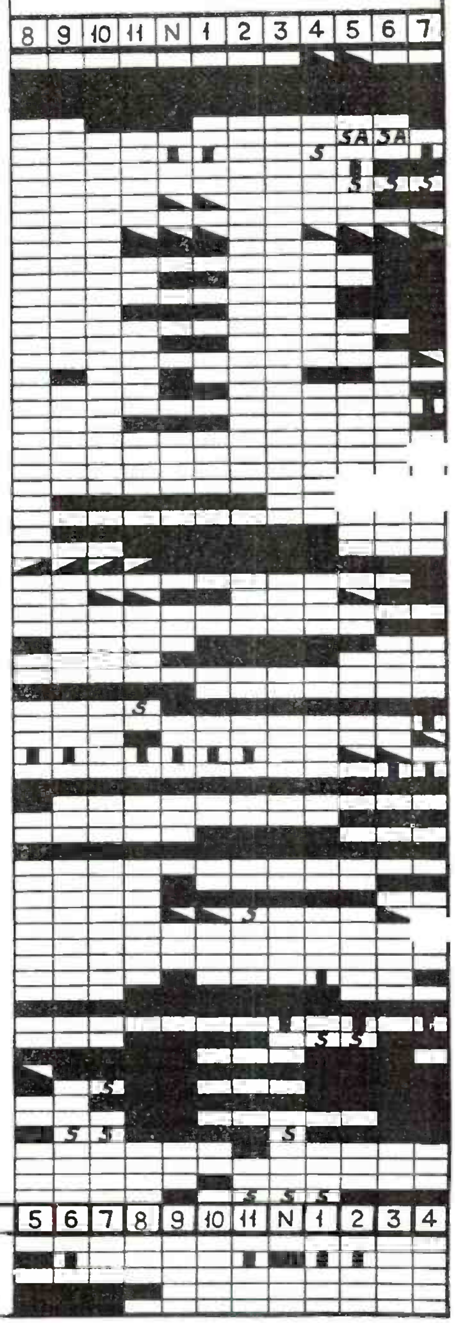
EASTERN STANDARD TIME

Wave-length Meters	Call Letters	Frequency Kc.	City Country
31.79	COCH	9428	Havana, Cuba
32.12	OAX4J	9330	Lima, Peru
33.32	COBX	9025	Havana, Cuba
34.62	COJK	8665	Camaguey, Cuba
38.48	HBP	7797	Geneva, Switzerland
44.14	HIH	6796	San Pedro, D. R.
44.71	TIEP	6710	San Jose, Costa Rica
45.22	HC2RL	6635	Guayaquil, Ecuador
45.25	HIT	6630	Trujillo, D. R.
45.34	PRADO	6618	Riobamba, Ecuador
45.80	HI4D	6550	Trujillo, D. R.
46.01	YV4RB	6520	Valencia, Venezuela
46.08	HIL	6510	Trujillo, D. R.
46.66	HI1S	6430	Puerto Plata, D. R.
46.85	YV5RH	6400	Caracas, Venezuela
47.02	YV5RF	6375	Caracas, Venezuela
47.12	YV1RH	6360	Maracaibo, Venezuela
47.24	HRPI	6350	San Pedro Sula, Hond.
47.69	HIG	6280	Trujillo, D. R.
47.77	COHB	6280	Cancti Spiritus, Cuba
48.05	HIN	6243	Trujillo, D. R.
48.15	OAX4G	6230	Lima, Peru
48.50	HI1A	6185	Santiago, D. R.
48.62	OAX1A	6170	Chiclayo, Peru
48.62	XEXA	6160	Mexico, D. F. Mexico
48.72	YV5RD	6158	Caracas, Venezuela
48.78	CJRO	6150	Winnipeg, Canada
48.82	HJ4ABE	6145	Medellin, Colombia
48.86	W8XK	6140	Pittsburgh, Pa.
48.88	CR7AA	6137	Lourenzo Marques, A.
48.94	LKJ	6130	Jeloy, Norway
48.94	VE9HX	6130	Halifax, N. S.
48.94	COCD	6130	Havana, Cuba
48.96	HJ3ABX	6122	Bogota, Colombia
49.00	W2XE	6120	New York, N. Y.
49.10	GSL	6110	Daventry, England
49.18	YUA	6100	Belgrade, Yugoslavia
49.18	W3XAL	6100	Bound Brook, N. J.
49.18	ZRK	6100	Klipheuvel, So. Africa
49.20	ZRJ	6098	Johannesburg, Africa
49.26	CRCX	6090	Toronto, Canada
49.30	HJ5ABD	6085	Cali, Colombia
49.31	HJ3ABF	6084	Bogota, Colombia
49.32	VQ7LO	6083	Nairobi, Kenya, Afr.
49.34	HP5F	6080	Colon, Panama
49.34	XETA	6080	Monterrey, Mex.
49.34	ZHJ	6080	Penang, S. S.
49.42	YV1RD	6070	Maracaibo, Venez.
49.46	SBO	6065	Motala, Sweden
49.50	W8XAL	6060	Cincinnati, Ohio
49.50	W3XAU	6060	Philadelphia, Pa.
49.59	HJ3ABD	6050	Bogota, Colombia
49.59	GSA	6050	Daventry, England
49.65	HJ1ABG	6042	Barranquilla, Colom.
49.67	W1XAL	6040	Boston, Mass.
49.67	YDA	6040	Tanjong Priok, Java
49.75	OLR2B	6030	Podebrady, Czech.
49.75	HP5B	6030	Panama City, Panama
49.83	DJC	6020	Zeesen, Germany
49.83	XEUW	6020	Veracruz, Mexico
49.88	XEWI	6015	Mexico, D. F., Mexico
49.90	HJ3ABH	6012	Bogota, Colombia
49.92	COCO	6010	Havana, Cuba
49.96	CFCX	6005	Montreal, Canada
49.96	HP5K	6005	Colon, Panama
50.00	XEBT	6000	Mexico, D. F., Mexico
50.25	HJN	5970	Bogota, Colombia
50.25	YV5RC	5970	Caracas, Venezuela
50.26	HVJ	5969	Vatican City
50.50	TG2X	5940	Guatemala City, Gua.
50.72	HH2S	5915	Port-au-Prince, Haiti
50.76	HRN	5910	Tegucigalpa, Honduras
50.85	YV3RA	5900	Barquisimeto, Venez.

PACIFIC COAST TIME

Wave-length Meters	Call Letters	Frequency Kc.	City Country
25.25	VLRS	11880	Melbourne, Australia
25.42	JZJ	11800	Tokyo, Japan
43.00	XGXA	6975	Chungking, China
70.26	RV15	4270	Khabarousk, U. S. S. R.
61.48	VUC2	4880	Calcutta, India

HOURS OF TRANSMISSION



LIST OF SYMBOLS

S—Sunday

M—Monday

T—Tuesday

W—Wednesday

Th—Thursday

F—Friday

SA—Saturday

SS—Saturday, Sunday

—Daily

—Irregular

—Daily Except Sunday

—Daily Except Saturday, Sunday

SHORT WAVE FLASHES

BY CHARLES A. MORRISON

and JOHN D. CLARK

By Charles A. Morrison

Frequency in megacycles Time is Eastern Standard

Short-Wave International Friendship Program

Monday, March 20, from 1 to 2 a.m., over YSD (7.894) of San Salvador, El Salvador.

Pan American Airway's Pacific Radio Stations

Radio stations to provide weather reports on *Pan-American Airways* new flying route between Hawaii, and Auckland, New Zealand, have been established on Canton, Jarvis, and Enderbury islands. Inter-island communications are carried-on, on a frequency of 8.1, with the exception of occasional contacts on the 20 meter amateur band. KF6DHW on Canton, works KNBF at Honolulu, near 2:40 a.m. and K6PPR at Schofield Barracks, Hawaii, from approximately 3:30 to 4:30 a.m. KG6HCO on Jarvis, contacts KF6DHW, irregularly near 3 and 4 a.m., and KF6ODC on Enderbury, communicates with other stations in the network, as necessity demands. According to Ashley Walcott of San Francisco, California, a quartet has been organized which sometimes puts on an interesting home talent program over KNBF, and the operator requests reports on same.

Radio Transmitters on Dead Whales

Radio-Press-Service relates the whaling vessel *"Unitas,"* which has just left for a whale hunt in the North Atlantic, has taken with it dozens of little radio stations which work automatically. These are destined to be installed on the whales, once they have been harpooned. Since most of the boats from which the whales are harpooned are far too small to take aboard the enormous body, up to now it was the custom to put a fairly long stick with a small flag on the body of the whale, and the body was then left floating, so that the main boat could find it after the hunt. It sometimes took days, or even weeks, to locate these floating whale bodies again. Now the work is facilitated by the installation of a small automatic short-wave transmitter on the body of each whale. Each little station transmits a signal on a certain frequency so that it is easily possible to locate it by means of direction bearings taken on the main vessel.

New Short-Wave Stations
(*On the Air*)

CHINA—Japanese operated station XOJD (6.88), replacing the old Chinese owned station at Hankow, broadcasts daily from 6 to 8 a.m. in Chinese. Eight chimes are sounded just before the station signs-off.

ENGLAND—A new frequency, GSV (17.81), ("V for Valor"), is now in use daily from 5:45 to 8:50 a.m. and from 12:20 to 4 p.m.

FINLAND—The new 10,000 watt Finnish transmitter OIE (15.19), is being heard daily from 1:05 to 4 and from 9 a.m. to 5 p.m.

INDIA—The new 10,000 watt Delhi transmitter VUD4 (15.29), is now operating experimentally from 9:30 to 11:30 p.m. in parallel with VUD2 (9.59).

JAPAN—JLG (7.285), Tokio, operates daily from 2:30 to 4 p.m., beamed on Europe.

PERU—OAX2A (11.85), power 250 watts, owned by Rafael Larco H. Hoyle, Hacienca Chiclin, Trujillo, has been heard testing near noon.

SWITZERLAND—A 100 watt experimental transmitter, located near Schwarzenburg, is broadcasting programs on 9.535, daily as follows: from 1 to 2 p.m., for Africa; from 6:45 to 7:45 p.m., for South America, and from 8 to 9 p.m. for North America.

UNITED STATES—General Electric's new 20,000 watt short-wave station W6XBE, located at Treasure Island, site of the Golden Gate International Exposition in San Francisco, should be on the air long before you read this item. The station operates daily from 3 to 9 a.m. on 9.53 and 15.33; the former frequency being used when the path between the transmitter and the listening points is entirely dark, and the latter frequency being used when the path is part light and part dark.

VENEZUELA—YV1CB (7.66), was heard calling someone that sounded like "Celealo" at 6:27 p.m. by Earl Roberts of Indianapolis, Indiana. . . . An official list gives the following new stations: YV2RN (4.87), "La Voz de Tachira," San Cristobal; YV3RN (4.82), "Radio Barquisimeto," Barquisimeto, and YV6RU (4.88), "Ecos del Orinoco," "Ciudad Bolivar," Bolivar.

(*Under Construction*)

CUBA—COCE, a short-wave relay for broadcast station CMC (1530), is now under construction.

ROUMANIA—A new 50,000 watt transmitter is under construction at Bucharest.

STRAITS SETTLEMENT—A new station under construction by the Malayan Government on the East coast, at Kuantan, in Pahang, will be completed soon.

SWITZERLAND—Construction on the new 25,000 watt Government short-wave station at Schwarzenburg, is progressing nicely.

Notes of Interest

ARGENTINA—LSX (10.35) of Buenos Aires, has been operating a lot lately near 4:45 to 5:15 and 11:15 to 11:30 p.m.

AUSTRALIA—Ashley Walcott of San Francisco, Calif., is hearing unidentified airways stations on 6.54, between 3 and 5 a.m.

BRAZIL—PSH (10.22), still operates daily from 6 to 7, and on Mondays from 8 to 8:30 p.m.

CANADA—C. J. Fern of Lihue, Hawaii, writes the new call for VE9CA (6.03) of Calgary, Canada, is CFVP. . . . *Trans-Canada Air Lines* operates on a day frequency of 5.6425; a night frequency of 3.2125, and a traffic channel of 7.46.

CANARY ISLANDS—EAJ43 (7.49) of Tenerife, is being heard with good signals nightly from 8 to 9 p.m.

CHILE—J. Hodges of Regina, Canada, reports that commercial station CEC of Santiago, does verify on church programs. . . . Ray Shaffar of Waterloo, Iowa, would like help in identifying a CEO1, heard calling a CEO2, both on 7.63, near 9 p.m.

CHINA—Alan Breen of Dunedin, N. Z., reports hearing XGOY (9.5) of Kunming, Yunan Province, near noon. The call XGOY is announced frequently. . . . The Shanghai commercial station on 9.295 has discontinued its morning programs. It phones Tokio intermittently to 10 a.m. . . . According to David Hutchinson of Manchester, Conn., XGRV (11.4) of Chungking, is also being heard from 7 to 7:30 p.m. now.

COLOMBIA—HJ5EAD, Cali, has a distinct harmonic on 9.59.

C. R.—TIEP (now 6.69), announces its call frequently in English.

CUBA—NBC programs are not being broadcast over COCQ for the present.

CURACAO—PJC1 (9.091) has not been heard recently.

CZECHOSLOVAKIA—The new name for Czecho-Slovak radio, which up to now has been "Radio-journal," is "Ceskelslovensky rozhlas spol" (Czechoslovak radio).

D. R.—New calls for HIG, are HI1G (6.29), and HI2G (9.295); for HIN, is HI1N (6.243). . . . HI6H is still on the air, on a frequency of 6.6.

EGYPT—SUZ (13.83) is heard occasionally at 11 a.m., working Europe.

EL-SALVADOR—YSP (10.4), often operates in parallel with YSD evenings.

F. M. S.—Stanley Koenig of New York City, reports that ZGE (6.24) of Kuala Lumpur, has closed down due to financial difficulties.

FRANCE—French colonial transmitters in Dakar, Madagascar, and French Indo-China, are shortly to receive substantial increases in power.

FRENCH SOMALILAND—FZE8 (17.28) at Djibouti, is still operating only once a month, but soon the station will be on at more frequent intervals.

HAWAII—KHE (17.795) of Kahuku, is sometimes used for the relay of programs to the United States.

INDIA—Earl Roberts of Indianapolis, Ind., writes he heard VUC2 (9.528) of Calcutta, at 5:30 a.m. with an R9 signal, although some QRM from ZBW3 on 9.525.

ITALY—IQY (11.67) is no longer used to relay the American Hour from Rome, heard nightly 7:30 to 9 p.m. . . . ICC (6.35), is heard daily from 3 to 3:30 p.m., with a broadcast in Russian.

MADAGASCAR—"Radio Tananarive" (6.063) is being heard on the west coast daily from 10 to 11 a.m., sometimes with remarkably good volume.

MANCHUKUO—TDD (5.83) of Hsinking, phones Tokio, intermittently from 6 to 9 a.m.

MEXICO—August Balbi of Los Angeles, writes XEWI (11.9) of Mexico City, is being heard from 9 to 11 p.m. with much stronger and clear signals; perhaps a new transmitter.

MOZAMBIQUE—CR7AA (6.137) of Lourenco Marques, is audible from 10:30 to 11 a.m. at present, in California.

NORWAY—LKC (9.525), Jeloy, can easily be heard Sundays on a clear channel near 2:30 a.m.

POLAND—SP31 (9.525), Warsaw, can often be heard with announcements in Polish, just after it comes on the air at 3 p.m. W2XAF drowns it out when it puts its carrier on the air at 3:45 p.m. Reports should be sent to Listeners' Research Dept., Polskie Radjo, Mazowiecka 5, Poland.

PORTUGAL—The power of "Emissora Nacional," short-wave station CSW of Lisbon, Portugal, is soon to be increased to 20,000 watts.

SPAIN—Nationalist news in English, originating over "Radio National," Salamanca, Spain, may be heard on 10.37, at 9:05 p.m.

SWEDEN—SBP (11.705), Motala, is being heard best from approximately 4 to 4:15 p.m.; SBO (6.065), is being heard daily from 4:30 to 5:05 p.m. Both stations announce in English just before signing-off.

URUGUAY—CXA4 (6.125), temporarily off the air, will move to 9.62 and broadcast under the new call CXA6, as soon as its new transmitter now under construction is completed. . . . CXA8 (9.64) verifies with a form letter.

UNITED STATES—W2XGB, *Press Wireless*, at Hicksville, N. Y., has increased power to 10,000 watts. . . . W1XAL, the University Club station at Boston, Mass., relays MBS, CBS, and BBC programs irregularly.

U. S. S. R.—RIM (15.25), Tashkent, can be heard near 8:30 a.m., phoning Moscow. A woman, and a man announce alternately.

VATICAN CITY—Carl Weber of Philadelphia, Penna., reports hearing HVJ sending a program to South America, at 1 p.m., on its rarely used frequency of 17.84.

Special Transmissions of Interest

Daily—at 5:15, 6:30, and 9 p.m., Spanish Nationalist news in English, over EA9AH (13.997) of Tetuan, Spanish, Morocco.

Weekdays—at 2 p.m., news bulletin in French; at 2:15 p.m., news bulletin in German, and at 2:30 p.m., news bulletin in Italian, over GSA (6.05), Daventry, England.

Sundays—at 1 p.m., news bulletin in French; at 1:15 p.m., news bulletin in German, and at 1:30 p.m., news bulletin in Italian, over GSA (6.05), Daventry, England; at 4 and 9 p.m., Short-Wave Listeners Mail Bag Program, over CHNX (6.13) of Halifax, Canada.

Mondays and Wednesdays—6 to 6:30 p.m., transmissions in English, over "Radio Martinique" (9.705) of Fort-de-France, Martinique.

Saturdays—1 to 1:30 a.m., "Voice of Hawaii" program, over KQH (14.92) and KKH (7.52) of Hawaii; 3:45 to 4 p.m., Mail Bag program, over TAP (9.465) of Ankara, Turkey; 4 to 4:30 p.m., NNRC program, over W2XJI (26.3) of New York City; 11 to 11:30 p.m., "Hawaii Calls" program, over KQH (14.92), and KKH (7.52) of Hawaii.

Revised Schedules

AUSTRALIA—VK2ME (9.59) of Sydney, operates Sundays 1 to 3, and 5 to 11 a.m.

SOUTH AFRICA—The official schedule for all South African stations is now as follows: ZRH of Pretoria, on 9.523, weekdays 5 to 7:30 a.m. and on Sundays 5:30 to 7 a.m.; on 6.007, Daily except Saturdays, 11:45 p.m. to 12:50 a.m., weekdays 10 a.m. to 3:30 p.m. and Sundays 9 a.m. to noon, and 12:15 to 3:15 p.m. . . . ZRK of Capetown, on 9.606, Daily except Sundays, 11:45 p.m. to 12:50 a.m., weekdays, 3:20 to 7:20 and 9 a.m. to 11:45 a.m., and Sundays 3:30 to 5, 5:30 to 7, and 9 to 11:45 a.m.; on 6.0975, weekdays noon to 4 p.m. and on Sundays, noon to 3:20 p.m. . . . ZRJ of Johannesburg, on 6.0975, Daily except Saturdays 11:45 p.m. to 12:50 a.m., weekdays, 3:15 to 7:30 and 9 to 11:30 a.m. and Sundays, 3:30 to 5, 5:30 to 7, and 9 to 11:30 a.m.; on 6.007, weekdays 3:30 to 4 p.m. . . . ZRD of Durban, on 9.72, Daily except Saturdays, 11:45 p.m. to 12:45 a.m., weekdays 3:30

(*More DX Notes on page 46*)

Television

(Continued from page 9)

In the preceding paragraph you will note I explicitly spoke of inductance "in coils." Inductance in other parts of the circuits is most undesirable—that means leads to coils, to capacities, to resistors, to tube pins. Although it will probably not be so stated in "how to build" articles you read, every set designer is trying to obtain reduced and stabilized values of input conductance. Even relatively minute lengths of inductance in cathode circuit leads are sufficient to cause appreciable increase in the input conductance; so also, do inductance values in the grid leads. The importance of short, heavy, low-inductance leads cannot be too strongly emphasized.

The schematic of Figure 14 shows only the input and 2nd r.f. stages; the third stage is a duplicate of the second. It is presumed that gang switching will be employed, and that condensers C_1 and C_3 will be set for the 44-50 mc. channel, and C_2 and C_4 adjusted for the 50-56 mc. channel. When a third channel comes into use in your locality, a few 10 to 15 mmfd. capacity air trimmers and use of another contact point in each switch will make it available.

The 2000-ohm resistor across the tuned circuits is something new to radio practice, and it does just what you think it will—broadens the tuning. Remember, we are tuning to a 4-megacycles wide sideband and trying to handle the whole width uniformly. The better we do this, the better the picture detail. Aside from these resistors, this diagram of three r.f. stages is not unusual.

While this circuit, in an efficiently-planned layout, will bring in television signals over a distance of a few miles, it must be understood that the two goals we are seeking cannot both be obtained 100% with it. Impedance or conductive coupling, such as this, has a strong tendency to "peak" and, while the resistors flatten this considerably, the resulting gain per stage, even at the top of the broadened "hump" is none too great. Were a narrow channel being tuned-in, we could adjust all humps to the same frequency and have fair over-all gain; if, however, we do this on a 2.8 mc. to 4 mc. sideband, there will be adequate gain on but a small percentage of the band width and a sad falling-off on the rest.

In actual practice, the tuned circuits are brought to slightly different resonance peaks which tends to level the over-all response curve for more uniform performance from 0 to 2.8 megacycles, and the total over-all gain will be much less than it would have been for the narrow channel reception. For a limited distance and a good "line of sight" location, these tuned r.f. sets will give good reception and fair detail, but do not ask too much of them.

At this point, I would like to insert a discussion of vertical and horizontal detail and its relation to width of sideband. Vertically, there can be 410 picture elements (we lose 31 in vertical blanking). Since the aspect ratio is 4 to 3 there may be 547 elements horizontally. Since a maximum-detail cycle consists of a dark element and a light element side by side, this means 273 cycles. Now, a horizontal line must be transmitted in 0.85 of 1/13,230 second. The computation 273 × 13,230 × 1/0.85 indicates the necessity, theoretically, of 4.25 mc. per second for maximum detail.

In actual practice, vertical detail may be figured as something less than 410, and it is found that equal horizontal and vertical resolution, using a 441-line system, is secured if we multiply 4.25 by the factor 0.80, and utilize a band width of 3.4 mc. Thus it will be seen that the wider the passband, the greater the detail horizontally; the wider the passband, however, the more difficult is receiver design and construction. Satisfactory entertainment value seems to result if we compromise on trying to do a good job of getting equal response on all frequencies up to 2.8 megacycles.

Getting into super-het input circuits, one should first get, in his mind, a very clear picture of what we are going to do with our 44-50 or 50-56 channel signals. Taking, as an example, the lower one, it should be recalled that the video carrier is at 45.25 mc. and we are using the sideband extending *upward*. This will be approximately flat to 48 mc. and then attenuates rather sharply, to disappear at 48½ to 49. The sound carrier is at 49.75 mc.

Now, if we mix into this a 58 mc. frequency, the resulting video i.f. carrier is 12.75, with a sideband extending *downward* which will be approximately flat to 10 mc. and attenuating to, perhaps, 8¾ or 9. At 8.25 mc. is the i.f. sound carrier.

If one is but six to ten miles from a station, and the situation is not complicated by another transmitter on the next channel, the circuit of Figure 15 can be recommended. Here, an 1851 is used as the converter and a 6J5 as the oscillator. The inductance unit would be developed on a ½-inch tube or rod with a single-turn antenna coil coupled tightly to L_2 (6 turns, tuned by 20 mmfd.), which is in turn rather loosely coupled to a similar coil (L_3) and capacity. Rather loosely coupled to L_3 is L_4, tuned by a 20 mmfd. trimmer. Presuming the 6J5 is oscillating at 58 mc., we will have two frequencies appearing at "i.f.", one for video and one for sound. The 8.25 mc. signal can be disregarded if a separate 5-10 meter receiver is being used for sound; or, this carrier can be fed into an all-wave set handling this frequency. Television receiver manufacturers are including at least a one-stage i.f., a second detector and an output stage for sound.

To secure greater gain and selectivity, an r.f. stage must be inserted between the antenna and the converter. Shifting the inductance unit of Figure 15 (minus L_1), so that it is in front of an 1853 tube, as shown in Figure 16, we will develop our first tuned circuit by inserting a resistor across L_2 and adding one switch of a gang, to throw in any one of three condensers for a choice of three channels. The second tuned circuit is broadened with a resistor and, likewise, provided with a switch and condensers for channel choice.

Between the r.f. tube and the converter, the coupling is produced by a switch, three condensers and inductance L_4. Coupled to L_4 is the plate inductance of the 6J5 oscillator, L_5, and coupled to this, in turn, is the grid inductance L_6. The oscillator is transferred from channel to channel with a fourth switch and a trio of condensers tuning L_5. This is an excellent circuit but its L/C ratio in each channel, and the flatness of response between r.f. and converter, are not as good as the design which follows.

For the development of a highly-sensitive, more even response "super," our discussion can start with Figure 17A, the schematic of an r.f. stage. It is shown simply for comparison with 17B. It provides an untuned primary, and a tube input circuit which utilizes the approximately 25 mmfd. capacity to be found in the wiring. The resistor across the secondary is 1800 to 2000 ohms, and switching from channel to channel is done by varying the turns of inductance. It is attractive because of simplicity, but when a check-up of gain is made between 17A and 17B, it is found that 17B provides *double the gain* of 17A. It is advantageous then to provide some means of tuning the primary, preferably by varying turns of inductance as shown.

The type 1853 tube is selected for the r.f. stage because of (1) its extended cut-off characteristic, and (2) its 57-to-1 signal-to-noise ratio as calculated in the plate circuit. An even better ratio would be good but, among the various tubes considered, the 1853 presents the best combination of features for this usage.

To couple this stage to an 1852 converter, one thinks first of the usual single-tuned, shunt, plate-grid circuit such as was used in Figure 14. If, however, we develop a band-pass filter which will utilize the output capacity of the 1853 and the input capacity of the 1852 as shunt elements, *double the gain* will be secured at this point, and gain prior to the converter is very important.

Such a band-pass filter is shown in Figure 18; if but one station is to be received, one such unit can be designed, shielded and adjusted, then let alone. Combining our r.f. stage, the filter, a converter and an oscillator into what should be a top-notch input arrangement, we have Figure 19. Here, r.f. unit A_1 is placed in its can, so that its air trimmers may be adjusted for the 44-50 mc. channel, and leads brought out to gang switches. For the 50-56 mc. channel, *another* such unit is


THE MAN FROM MARS SEE BACK COVER
Fantastic
ADVENTURES
FIRST ISSUE
MAY 20c
The INVISIBLE ROBINHOOD
by EANDO BINDER
THE BEST IN SCIENCE FICTION
A. HYATT VERRILL
F. A. KUMMER, Jr.
ROSS ROCKLYNNE
MAURICE DUCLOS
HARL VINCENT
ARTHUR TOFTE'S GREATEST STORY
REVOLT of the ROBOTS

to be similarly constructed which would be unit A_2 (not shown).

Between the 1853 and the 1852, a band pass filter is to be constructed for the lowest frequency channel (B_1, shown) and another for the next channel, B_2. Here again, the gang of switches permits quick transfer from channel to channel. At the oscillator, we need only one switch in the gang to transfer from C_1 (pre-set for channel I) to C_2 (pre-set for channel II) which tune the tuned-plate oscillator. This oscillator circuit is chosen for stability against voltage fluctuation, while its method of coupling (single-turn in converter grid lead, tightly-coupled) will not adversely affect the band pass filter termination.

The circuit of Figure 18 will give just about maximum possible gain to the point marked "To i.f.," will have as much selectivity as is necessary for television, and will produce exceptionally uniform response, up to 2.8 mc., of the side band.

Correlated Reading

AN EFFICIENT DIPOLE AERIAL
Television & Short Wave World (London)—November, 1938.

THE PROBLEM OF SYNCHRONIZATION IN CATHODE-RAY TRANSMISSION
F. J. Bingley
Proc. I.R.E., Volume 26, No. 11—November, 1938.

THE FINE STRUCTURE OF TELEVISION IMAGES
H. A. Wheeler & A. V. Loughran
Proc. I.R.E., Volume 26, No. 5—May, 1938.

THE TELEVISION PICTURE AND INTERFERENCE
Television & Short Wave World (London)—November, 1938.

A FOUR-VALVE SUPER-HET FOR TELEVISION SOUND
Television & Short Wave World (London)—December, 1938.

Short Wave Flashes

(*Continued from page* 43)

to 5:30 and 9 to 11:45 a.m. and on Sundays 5:30 to 7 and 9 to 11:30 a.m.; on 4.8764, weekdays noon to 3:45 p.m. and on Sundays noon to 3:20 p.m.

UNITED STATES—W2XE of New York City, now operates as follows: Mondays through Fridays, on 21.57, 7:30 to 10 a.m. and on Saturdays and Sundays, 8 a.m. to 1 p.m.; on 15.27, Mondays through Fridays 1 to 3 p.m. and on Saturdays and Sundays 1:30 to 2:30 p.m.; on 11.83, Mondays through Fridays, 3:30 to 6 and 6:30 to 10 p.m. and on Saturdays and Sundays, 3 to 6 and 6:30 to 11 p.m.; on 9.68, Mondays through Fridays, 10:30 to 11:30 p.m. and on 6.17, Mondays through Fridays, 12 mid. to 1 a.m. and on Saturdays and Sundays, 11:30 p.m. to 1 a.m. . . . W8XAL of Cincinnati, Ohio, operates as follows: Sundays, 8 a.m. to noon, Tuesdays, Wednesdays and Fridays, 5:45 a.m. to noon and 11 p.m. to 2 a.m., Mondays, Thursdays and Saturdays, 5:45 a.m. to 2 a.m. and on Wednesdays, 9 p.m. to 2 a.m.

Frequency Changes

CHILE—CD1190, Valdivia, to 11.91; CB970, Valparaiso, to 9.725.

COLOMBIA—HJ3CAX, Bogota, to 6.02: HJ6ABB (not using new call of HJ6FAB yet), Manizales, to 6.054.

COSTA RICA—TILS, San Jose, to 6.165; TIEP is jumping between 6.69 and 6.696.

CUBA—COCM, highly variable, near 9.805.

DENMARK—OZH, Skamlebak, operates Sundays, 8 a.m. to 1:30 p.m. on a new frequency of 15.32.

DOMINICAN REPUBLIC—HI2G, Trujillo City, to 9.295; HI1S, Santiago, to 6.625.

ECUADOR—HC2CW, Guayaquil, to 9.35.

EL SALVADOR—YSP, now in vicinity of 10.4.

GUADELOUPE—FG8AH, Pointe-a-Pitre, to 7.435.

GUATEMALA—TG2, Guatemala City, to 6.195.

HAITI—HH2S to 5.955.

INDIA—VUD2, Delhi, to 4.96 to 4.975; VUM2 to 4.92; VUB2 to 4.885; VUC2, Calcutta, to 4.83.

PARAGUAY—ZP14, Villarica, to 11.72.

PERU—OAX5C, Ica, now in the clear, on 9.39.

PHILIPPINES—KZIB, Manila, now 9.49 to 9.495, to get out from under VK3ME.

SPAIN—"Radio Nacional de Espana" to 7.66.

U. S. A.—W3XAU, Philadelphia, to 15.27, daily 3 to 7 p.m.

VENEZUELA—YV1RL, Maracaibo, to 4.86; YV3RA, Barquisimeto, to 4.99; YV5RM (ex-YV5-RD), after an experimental sally down to 5.01, is now back on 6.163.

Data

ALASKA—K7XFS (8.09), Fairbanks, broadcasts weather reports, and contacts other Alaskan stations, some of them on the same frequency, intermittently between 12:30 and 9 p.m.

ALBANIA—ZAA (7.487), "Radio Tirana," operated by the Directorate General of Posta and Telegraphs, with studios in the Tirana City Hall. is on the air from 2 to 3 p.m. and closes with the announcement "Radio Experimental Tirana," followed with the national anthem.

ARGENTINA—LRX (9.66) verifies with a pale blue on white card; interval signal is 4 vibraphone notes.

AUSTRALIA—VK6ME (9.59), Perth, verifies with a red, black and grey QSL card with a map of Australia in the center. . . . VK9MI (6.01), the S.S. Kanimbla. signs-on with "Sweet Dreams" and God Save the King.

BRITISH GUIANA—VP3BG (6.13), Georgetown, operates weekdays from 10:15 to 11:15 a.m. and daily from 3:45 to 7:45 p.m.; gives world news, tides, shipping, mails, market quotations etc., at 4 p.m.; signs-off with the "Good Night Song."

CANADA—CJRX (11.72) and CJRO (6.147), Winnipeg, operate Saturdays from 6 p.m. to Sundays at 4 a.m. . . . CFCX (6.005), Montreal, operates weekdays from 7:45 to 1 a.m. and on Sundays from 9 a.m. to 11:15 p.m.

CHILE—CB970 (9.725), "La Voz de Chile para toda la America." relays CB76, from 11 a.m. to 11 p.m. and occasionally to 1 a.m. Reports should be sent to La Cooperativa Vitalicia, Lira No. 543, Valparaiso. . . . CD1190 (11.91), Valdivia, operates from 6 or 7 to 10 p.m.

CHINA—XGAP, not XUD (9.56), verifies promptly, also sending 8 beautiful scenic postal cards. This station controls all broadcasting in North China. Send reports to S. Yoshimura, Director, Peking Central Station, Hsi-chan-an Chieh, Peking. . . . XGRV (11.4), "The Voice of China," Chungking (replacing XTJ, Hankow), broadcasts daily from 1 to 1:30 a.m. in Chinese and Japanese, and from 8 to 8:30 a.m. in English and French. Send reports to H. K. Tong, China Information Committee, Box 90, Hankow. . . . XPSA, or XGSA (7.01), Kweichow, is now broadcasting daily from 5:30 or 6, to 11 a.m.; English news at 9 a.m.

COLOMBIA—HJ4DAP (4.885), Medellin, operates from 8 a.m. to 2, and from 6 to 11 p.m.; HJ4-DAE (6.15), Medellin, "La Voz de Antioquia," operates from 5 to 11:30 p.m.

COSTA RICA—TIEP (6.69), often announces as "The Voice of the Tropics," in English.

D. R.—HI4V (6.455), 100 watts, "La Voz de los Almacenes Hnos Chabebe," San Francisco de Macoris, is owned by Louis Raul Betances Recare. . . . HI8Q, Trujillo City, is reported to be on the air again, and operating on 6.2.

ECUADOR—HC2RL (6.635), P. O. Box 759, Guayaquil, 150 watts, operates Sundays from 5:45 to 7:45 p.m., and on Tuesdays from 9:15 to 11:15 p.m. The program begins with, and ends with the national anthem; verifies promptly with a blue and white card picturing the station.

FRENCH INDO-CHINA—Murray Buitekant of New York City, advises "Radio Hanoi" has two separate transmitters; one operates on 9.51, with a power of 15 watts, and is owned by the Radio Club D'Indochine, 82 Rue Jules Ferry, Hanoi, the other operates on 11.91, with a power of 100 watts, and is also owned by the Radio Club D'Indochine of 32 Rue de la Pepiniere, Hanoi.

FRENCH SOMALILAND—FZE8, (17.28), Djibouti, has a power on phone of 3,500 watts. Reports should be sent to the Ministere des Postes, Telegraphes, et Telephones, Station Intercoloniala de T.S.F., Djibouti.

GUADELOUPE—FG8AH (now on 7.435), "Radio Guadeloupe," operated by Andre Haan, broadcasts nightly from 6 to 7, or 7:30 p.m. English announcements, which are given two or three times during the program and just before sign-off give the mailing address as P. O. Box 125, Pointe-a-Pitre.

HONDURAS—HRN (5.875), Tegucigalpa, operates from 6 to 10:55 p.m.; gives station identification in English, weekdays at 10:30 p.m. and on Sundays at 9:45 p.m.; signs-off with Ted Lewis' "Goodnight" song.

INDIA—News in English is broadcast over VUD2 (4.96), Delhi, daily at 7:30 a.m.

ITALY—IQA (14.73), verifies with a rather plain blue and red card.

MACAO—Alan Breen of Dunedin, N. Z., writes that he has received a communication from J. Estrela, Chief of the Radio Station, Post Office Building, Macao, to the effect that CQN was off the air for several months during alterations to the transmitter, but is now operating again as CRY9 (6.08), Mondays from 8:30 to 10 a.m.

MANCHOUKOU—JDY (9.925), 3, Shotokugai, Dairen, Kwantung, Manchoukou, operates daily 7 to 8 a.m.; the QSL card is black, yellow, red, grey and orange, picturing a native girl, and the call in black.

NICARAGUA—YN3DG (7.12), 200 watts, Estacion Radiodifusora "Gilfillan," Leon, under the management of D. E. Gallo, is operating evenings; verifies promptly. . . . YNRF (6.76) and YNPR (8.58), operating in parallel, announce simply as "Radio Pilot y Radio Nicaraguente simultaniamente." . . . YNOP (5.46), Managua, gives station announcement every quarter hour and uses five tinkling notes—all of the same pitch, as an interval signal; verifies with a plain black and white card.

NORWAY—LKC (9.527) and LKQ (11.72), operate weekdays from 4:30 to 9 a.m., Sundays from 2:30 to 9 a.m. and after 10:30 a.m. over LKC (9.527) and (15.166).

PANAMA—HOA (2.34), "Ron Dalley," P. O. Box 1121, Panama City, operates in parallel with HP5G nightly from 6 to 10 p.m. The theme song is "Prelude from La Traviata."

PHILIPPINES—The correct mailing address for KZIB (9.5), is I. Beck Inc., Crystal Arcade Building, P. O. Box 440, Manila. An international reply coupon is not required with your report.

PORTUGAL—Late operating schedule for CSW, "Emissora Nacional" is as follows: CSW5 (11.04), Lisbon, operates from noon to 5:30 p.m. and CSW7 (9.735), operates from 5:45 to 9 p.m.; signs-off with clock striking two, followed by the national anthem.

TAIWAN—The interval signal for JIB (10.53), Taihoku, is a series of chimes.

UNITED STATES—W3XAU, Philadelphia, is operating on a new frequency of 15.27, daily from 3 to 7 p.m. . . . WAFX, Pan American Airways Co., Port Washington Seaplane Base, Port Washington, N. Y., will operate on 2.87. A new 16 watt transmitter, owned by the same company, will transmit from Treasure Island, San Francisco, Calif.

U. S. S. R.—RV96 (9.52), is now broadcasting an additional program daily from 4 to 5 a.m.

URUGUAY—CXA8 (9.64), Colonia, is now operating from 5 a.m. to midnight (Saturdays to 1 a.m.), according to an announcement heard over that station.

VENEZUELA—YV1RB (5.845), YV1RL (5.935), YV5RC (5.973) and YV1RD (6.081), all come on the air at 5:30 a.m. . . . YV3RX, former YV3RA, "La Voz de Lara," Barquisimeto, has moved to 4.99, where it relays the programs of broadcast station YV3RA. nightly to 9:30 p.m. . . . YV4RB (6.52), operates daily from noon to 1 p.m. and from 6 to 10 p.m.; verifies promptly with a white card having red call letters.

Amateur Reception Notes

BRITISH NEW GUINEA—M. W. Soplop, reports a verification from VK9XX of Rabaul, in which the operator, Basil Dale, states he run VK2XX in Australia for three years, but moved to New Guinea and put VK9XX on the air on August 28, 1938. The crystal frequency for the transmitter is 14.28, and the input power approximately 30 watts. The only other active ham phone in Rabaul is VK9GW.

BRITISH SOMALILAND—Eugene Reinhard of Locust, N. J., reports hearing VQ6XT (14.1) in British Somaliland at 2 p.m. The call was announced as VQ6, X-ray, Tokyo.

CANARY ISLANDS—EA8AE (7.2), Las Palmas, is being heard nightly with loud signals working South American hams from 11 to 11:30 p.m.

EGYPT—SU1AX QSL's with a fine card but says in the future he will not verify SWL reports.

ETHIOPIA—Ron G. Baker of London, England, notifies me he recently logged 17AA in Addis Ababa. This is probably the same transmitter that is used for short-wave broadcast station IABA.

KANYA COLONY—VQ4KTB (14.060), of Nairobi, announces he will verify but the listeners should have patience for a few months.

MAURITIUS—J. May of Wilkinsburg, Penna., reports a QSL card from VQ8AE of Phoenix, Mauritius.

ORKNEY ISLANDS—GM3TR (7.05), owned by J. Critchley Graham, Air Ministry Control Station, Wideford Aerodrome, Kirkwall, Orkney, may often be heard near 3:30 a.m. Reports are welcome.

PALESTINE—Seldom has a new amateur station caused the excitement that greeted the appearance on the air of ZC6EC. This station is being heard on the low frequency side of the 20 meter band, near 14.04 and also on an announced frequency of 14.316.

ST. VINCENT—G. W. Rockwell of Halifax, Nova Scotia, Canada, writes that VP2SA (7.1), operated by Weston Lewis, P. O. Box 73, Edinboro, St. Vincent, B. W. I., is being heard near 4 to 6 p.m. The station verifies promptly.

SO. AFRICA—Ray Messer of South Portland, Maine, reports hearing ZS4H (14.1) of Kimberley, as early as 2:40 p.m. with very loud signals. Reports should be sent direct to ZS4H and not to the QSL Bureau.

By JOHN D. CLARK
All times are Pacific Standard

From the Orient

During the past few months many Pacific Coast listeners have requested that RADIO NEWS publish a general guide to reception of Japanese, Chinese, and other Oriental short wave transmitters. Below is a brief outline of the strongest and most reliable Oriental broadcasters which are now audible on America's West Coast.

Nippon

Japanese programs are divided in two distinct classes—those intended for transmission to foreign countries, and those relayed from regular local stations.

The first class includes six daily broadcasts, only three of which are received regularly in this region at the present time. The 5 to 6:30 a.m. transmission for China and the South Seas is heard with excellent volume through JVP (7.51); the 5 to 5:30 p.m. broadcast is easily audible through JZK (15.16), although JZJ is still listed as the official carrying station; and the 9:30 to 10:30 p.m. program (which is directed to the Pacific Coast) is always received via JZJ (11.8). It might be noted that news in English is scheduled for 5:25 a.m., 5:05 p.m., and 9:35 p.m.

Regular local programs of the Broadcasting Corporation of Japan are relayed on short wave from 10:40 to 11:20 p.m., and from 2 to 4:40 a.m. through JVN (10.66). In addition, JVH (14.6) has a somewhat irregular relay schedule throughout the afternoon and early evening. Reports indicate that the station is heard at 3:20, 4:30, 6:30, 7:00, 7:30, and sometimes 8:30 p.m. A curious time signal, consisting of a series of gongs and chimes is broadcast at 7 o'clock daily, and is followed by program announcements in Japanese.

In addition to the above, two stations in Taiwan (Formosa) transmit a daily program from 5 to 6:30 or 7 a.m., with news in English at 6:05.

China

As we go to press, only two Chinese broadcasters are being received reliably on the Pacific Coast. One of these is the old reliable ZBW (9.53), which is now on the air from 1 to 7 a.m. (to 8 a.m. Saturday); and the other is the new XPSA of Kwei Yang, on the air from 2 p.m. to 7:10 a.m., but heard only during the last three or four hours of its transmission.

A communication just received from the Chinese Consul General indicates that XRVG is on 11.42 from 9 p.m. to 5:45 a.m., but for some reason its signals do not seem to reach the Pacific Coast.

Other Chinese stations which have been heard irregularly in this region include XGAP of Peking on 9.56 near 6 a.m.; XOY of Chengtu on 9.37 from 6:45 to 7:30 a.m.; XTJ of Hankow on 11.69 from 4 to 4:30 a.m.; and station XGOX on 15.19 from 6 to 9 p.m.

India

The recent construction of many powerful new Indian short wave transmitters has resulted in some truly remarkable reception from this distant land during the past few months.

Three stations—VUD2 of Delhi (4.99 and 9.59), VUC2 of Calcutta on 4.88, and VUM2 of Madras on 4.95—are responsible for good signals during the hours just before 7 a.m. VUD2 commences operation at 4:30 a.m., VUC2 at 4:06 a.m., and VUM2 at 4 a.m., all three attaining maximum volume near 6 a.m.

Although a number of Indian stations are on the air at other times of the day, only one is being heard regularly on America's west coast. This is VUD3 of Delhi which, at the present time, seems to have shifted its frequency from 15.16 to 15.29. Although time schedules still show 5:30 as the transmission commencement time, the station does not begin broadcasts until 6:30. The first hour's program is usually received quite well, but the station begins to fade out after 7:30, and often becomes inaudible before 8 o'clock.

Siberia

Station RV15 of Khabarovsk, U. S. S. R., is still on the air from 11 p.m. to 8 a.m. daily, but is jumping around the dial so frequently that it is almost impossible to predict its wavelength from one day to the next. As we go to press our records show that the station has changed no less than seven times during the past two weeks. The amazing thing about RV15 is that volume is always excellent, regardless of what the frequency may be.

Reception has been reported and verified on 4.27, 6.03, 6.49, and 9.53. Usually only one of the above wavelengths are used at a time, but occasionally two have been employed simultaneously. Hongkong's ZBW, which also uses 9.53 is almost completely blocked out by RV15 when it operates on that particular frequency.

Siam

The most reliable Siamese broadcast, a transmission which has regularly reached the Pacific Coast with excellent volume, is released every Thursday on 9.51 from 5 to 7 a.m., with announcements in both English and Siamese. The same station, working on 15.23 and 19.02 is on the air Monday from 5 to 7 a.m.

A mysterious Oriental, believed to be located in Siam, is again being heard on approximately 6.11 Monday and irregularly on other days from 5 to 7 a.m. Although modulation is none too good, the station's signals are surprisingly strong. Programs consist of popular and classical recordings, and announcements are made in an unknown language.

Burma

Since its increase in power, the government station in Rangoon, Burma, has become a regular visitor to the western United States. Programs of recorded music are released on 6.01 between 4:15 and 7 a.m. daily, and announcements are made in English. The station closes down with *God Save the King*.

Straits Settlements

After several months of inaudibility, station ZGE of Kuala Lumpur, Federated Malay States, is again being reported by Pacific Coast listeners. The transmitter is still operating on the same schedule—Sunday, Tuesday, Friday, from 3:40 to 5:40 a.m.

ZHO of Singapore is now working on an announced frequency of 6.175 until 6:40 a.m. daily, usually relaying programs of dance music from some hotel in Singapore. Like the station in Rangoon, ZHO also closes down with *God Save the King*, and announcements are made in English.

It is expected that ZHP (9.69), which was used for several months last summer, will replace ZHO within the next month or so.

Dutch East Indies

A station YDE2 of Solo, Java, is now broadcasting on 4.81 (just under India's VUC2), and has been reported by many west coast listeners with excellent volume between 4 and 6:30 a.m. All programs consist of native eastern music.

PMY of Bandoeng, Java (5.14), YBG of Medan, Sumatra (5.17), and PMH of Bandoeng, Java (6.72), YDB of Sourabaya, Java (9.55), and PLP of Bandoeng (11.00) are all coming through well at the present time, but the first three will probably fade out and become inaudible within the next few months. PMY and YBG reach maximum volume at 6 a.m., while PMH, YDB and PLP are heard fairly well until sign-off time at 7 o'clock (until 8 on Friday and Saturday). A station YDA, located in Tandjongprick, carries the same program as YDB and PLP, but usually fades out after daybreak.

Miscellaneous Tuning Tips

Our listeners tell us . . . that a new Japanese station JLG (7.285) is now working simultaneously with JZJ from 11:30 a.m. to 1 p.m. . . . that RW96 of Moscow, which is heard during the early evening hours on 15.18, is probably the world's most powerful short wave station, now using 100,000 watts power . . . that VK6ME of Perth, West Australia, a prize catch for the DX fan is again being heard several times a week between 3 and 5 a.m. on 9.59 (just above the Australian VLR) . . . that KKH of Kahuku, Hawaii, is now carrying the "Hawaii Calls" program on 7.51 at 10:15 p.m. Friday . . . that SBP of Stockholm, Sweden, after being unreported on the Pacific Coast for many months, is again being heard on 11.70 between 10:20 and 11 p.m. irregularly. One report indicates that it may also be on the air near midnight Sunday . . . that a Manila phone station KBL is working on about 11.54 irregularly near 6:45 a.m.

European Tips for Western Listeners

It is interesting to note that GSD (11.75) is being heard on the Pacific Coast with fair volume after midnight. This is the first time in many years that a London station has been logged in this region with good volume during the hours after midnight. This sudden activity on 25 meters has also resulted in surprisingly good reception from TPA3 of Paris (11.88) between 11 p.m. and 12:30 a.m.

On the other hand, the 25 meter band has been exceedingly erratic during the afternoon and early evening hours. Even from hour to hour violent fluctuations in signal strength have been noted in this particular part of the short wave spectrum. On several occasions, the powerful Japanese JZJ has dropped from "strong" to "inaudible" within a period of 30 minutes.

The 31 meter band, however, has remained fairly stable. English stations GSC and GSB, have not only been consistent, but have shown considerable improvement during the last 30 days. All stations are usually quite good near 6 p.m., GSC in particular maintaining an excellent signal between 6:20 and 8:20 p.m. Incidentally, GSC during London's sixth transmission is the only English station now being heard on the Pacific Coast with strong volume.

Czechoslovakia is again using OLR4A (11.84), and the Prague programs are therefore again being heard west of the Rockies. W3XAL completely blocked the attempt to use OLR3B on 9.67, and it is hoped that OLR4A will continue in use.

As I See It!

(*Continued from page* 10)

your head—or whatever you wish to say. Every form of comment is welcomed by the sales managers of companies who sponsor such meetings and your letters function as guides for future activity.

Sometimes the secretary of the local association, if there is one, writes a letter of thanks. Naturally, such letters are welcome, but I don't think it's thanks that the sales managers look for or want. They would like to know your reactions. The sales manager of a company is only a human being with normal emotions. I don't imagine that he believes himself to be a super-human individual who is positive that every step he takes is correct.

As far as service meetings go, sales managers are groping in the dark. They, like yourself, would like to know if they are on the right track—if they are doing the right thing. Why not tell them!

Are You in the Right Spot?

I KNOW a man who was groomed for the legal profession when he entered high school. He graduated, entered college and spent the full time there; then he went through his law apprenticeship and all of the formalities associated with it. Finally, he went out on his own. During this period he dabbled in drawing—strangely, drawing designs of furniture. After several years of painstaking effort at law and pleasure in the moments he could devote to drawing, he came to the conclusion that maybe law was not his forte—that maybe he should go in for furniture designing and consider his college studies for the legal profession as just so much education. Today the man is happy and doing well.

We have met servicemen of the same type. Not necessarily interested in furniture designing, but men who are doing service work, but it is not their love. Naturally, the train of stick-to-it-iveness is to be admired. According to the *Alger* books, the hero worked day and night, froze in the winter and perspired in the summer, but finally achieved success, etc., etc.

The same thing can happen today; but seldom does that happen unless the person is wholeheartedly enthused about what he is doing, and has an aptitude for his work. Very many men are practicing radio service work who find it extremely difficult to grasp the electrical fundamentals associated with the work, yet they seem to possess a natural inclination for some other form of activity, which they may now employ as a hobby. They have a natural leaning for the avocation rather than vocation. Their interest in the subject never dulls, they find it a simple matter to gather facts, to correlate them properly and to the best advantage, to forget all troubles and worry when working with it, to conceive ideas, to visualize applications, in fact, to do everything which would lead to success; if that were their means of earning a livelihood, but they do not realize the fact.

They are so engrossed fighting something they do not like that they cannot envision themselves doing something else for a living.

Many men are engaged in the servicing business who just detest that portion of their business associated with record-keeping—there are others who just cannot seem to be able to sell themselves to a customer. Not that they are shy—just the contrary in their social life—but they just don't like to sell. They have a natural dislike for bargaining, they just can't seem to conceive sales ideas to buck competition. They want to work with their hands and to use their thinking capacity in connection with the technical side of radio. Men of this type must of necessity realize their likes and dislikes and tie up with others who can sell, so as to form the ideal combination. They are not in the right spot to run a servicing business all by themselves.

There are others who find it extremely difficult to absorb technical details, who are not handy with their fists—who can't seem to hold a soldering iron without burning their fingers—their clothes and the insulation of all the wires near the joint they wish to solder. Yet, they find it easy to sell themselves to a customer; they seem to have the proper answer to questions relating to business; they are adept at figures; they have sales ideas; but they are slow in grasping technical ideas, understanding radio theory. They are not in the right spot in a servicing business. Such men require a partner—a man to do the technical work, while they do the selling.

We are not trying to dishearten men in the servicing industry, but judging by correspondence received, we know that many men are confused. They thought that radio was their chosen field, only to discover that something associated with it rankles the soul, continually irritates the mind—in general, has a very disquieting influence. In other words, there are men now associated with radio servicing who do not belong in the business. Their temperament, mental or physical agility, their natural ability is not suited to the radio servicing business.

They're not in the right spot.

Spare Moments

EVERY so often we note an article in a radio periodical, wherein the statement is made that the following piece of test equipment can be made during the few spare moments that a service man has during his normal working day. Now, maybe it is not within our province to speak about suggestions made in radio periodicals—perhaps we'll be stepping on somebody's toes, but here goes anyway.

As I see it, there are not enough spare moments in the average service shop, considering the value of these spare moments. The very last thing I can think of is to use these spare moments for the construction of some physical something or other. I don't mean to imply that there should be too many spare moments during a working day, or that some use should not be made of spare moments, but there are lots of things which can be done with spare moments other than work similar in character to that being done during the active moments.

For example, one thing we can do is to sit down in a comfortable chair and think a little. About what? There are hosts of things. Maybe we can think of a way of rearranging the bench so that the various units used during the day can be handled more efficiently—more rapidly, with less effort, so that we can create more spare moments for more thinking. Or maybe we recall an attempt to sell a customer and we missed the boat because we did not have the answer to the question asked—or maybe we can think of a new direct selling piece to be dropped into letter-boxes or perhaps mailed to a list of prospects.

Perhaps during a service job, we experienced a phenomenon which is not comprehended and we try to locate some information about the theory associated with the device in question. Maybe the spare moment is a good time to do a little studying—an operation very important in the life of every serviceman who is doing radio work. This business of burning midnight oil is all right for a while, but cannot be carried on forever, and night time is also recreation time.

You know that spare time is a good time to rest and to recuperate a little energy or mayhap you would like to read the instruction bulletin covering a new piece of testing equipment and really find out what the thing will do, so that you can really get your money's worth from your purchase.

And don't for one moment think that you are wasting your spare moments if you devote a few to doing absolutely nothing, just sitting in the chair with a completely blank mind. If you wish to allow your mind to wander to something entirely foreign to radio, do so—no harm done. As a matter of fact, you will find that you can think more clearly later, when you go back to tackle that pesky job.

Service work taxes the brain as well as the body and continual work without any rest will fog the brain. A few moment's rest and you're ready to go back to work. Really, I can think of doing lots with spare moments, other than building individual test equipment. As a matter of fact, I don't believe in building individual test equipment which can be bought. —30—

Within Earshot

(Continued from page 4)

you incline) and we heartily recommend that you try this unit . . . for your ear's sake.

* * *

WHO knows when the tube numbers will give out? Every day new and different tubes make their appearance on the market. First it was "tipless," then "pin-less," then "octal" and now "loktal" tubes. We have figured out that using not more than two numbers ahead the letters, and not more than two letters, and then not more than two numbers after the two letters, plus the usual numbered tubes there can only be seven million seventy-four thousand seven hundred (7,074,700) different tubes before they run out of numbers! It is silly facts like this that make big paragraphs like these.

* * *

WE have left out the usual two pages of *Spatari*. To those who have been following it we urge that you let us know, and those who would have us reinstate it, please drop us a line and if there is sufficient demand we will be happy to include *Spatari* again with the next issue.

* * *

AGAIN our mail is filled up with one question. "Do I need a license to have a radio telephone transmitter. I only want to talk to Aunt Tillie's son, Herman, who lives a block away!" The answer is "YES" . . . with great big capital letters.

Once again we reiterate—A LICENSE IS ABSOLUTELY NECESSARY TO DO ANY TRANSMITTING BY RADIO OR TO OWN A RADIO TRANSMITTER. Make no mistake about this. It is not a question of how far the transmitter will send; that is immaterial. The U. S. Government has been more than usually active in running down unlicensed stations in the last few moths, and dire penalties—perhaps imprisonment—await the offender against this law.

There is not any charge for a license. It is only required that you be a citizen of this country and that you pass a code test and a written examination showing that you know something about the hobby that you wish to espouse. Kids of 10 have passed the test. There is not any reason *not* to pass the exam if you but apply yourself to the books. To those who scoff at the long arm of Uncle Sam, remember that even a hardened crook is mighty afraid of Old Man Whiskers, *and there are over 50,000 licensed hams sworn to report you if they hear you!* Obey the Law; get a license!

* * *

WATCH for the next issue. We hope it will have the most television ever to be brought out on the subject in a radio magazine. We plan a complete coverage on receivers and transmitters and we hope to have information on what you may expect from the new programs and a review of those of the past. Don't miss this big issue. You will want it for the future as a reference book on the start of television in NYC, for it should make a fine memento of the beginning of what will some day surpass the broadcast industry.

* * *

THIS month we break our new *Hamchatter* column. We hope that it will grow and become the fount of news about your friends on the ham bands. We welcome all contributions from hams, DX hounds, and experimenters. *What you say, you clubs,* here is a chance for you to swell your treasury. Have your sec'y write us your club news and collect (if we use it).

JUST a word to the thousands of hams and experimenters who daily "play" with high voltage! It is very, very deadly. Do not take a chance of any sort. Remember that condensers hold their charge for a time, and that with the rig entirely dead, the condenser still holds lethal electrical power. Put in bleeders across these potential killers. But nothing . . . nothing can take the place of good skull-work. Use your head and *BE CAREFUL! DEATH IS SO FINAL!*

* * *

WELL, that's that with our stint. 73 till next month.—KAK.

RADIO PHYSICS COURSE

(Continued from last month)

The broadcasting station: The electromagnetic radiations used in radio work are commonly produced by high-frequency alternating electric currents (called the "carrier current") flowing in suitably arranged circuits in the transmitting stations. These circuits will be studied later. The high-frequency currents (500,000 to 1,500,000 cycles per second used in ordinary broadcasting) are generated by large vacuum tubes known as "oscillators," since it is not practical to generate them with the rotating type of electrical generators employed for generating ordinary 60 cycle a.c. for electric light and power work. Each broadcasting station is assigned to *broadcast* or radiate energy at a definite frequency, by the government department in charge of licensing. Practically all stations, in the same vicinity at least, are assigned to broadcast on different frequencies or wavelengths, so that in any receiving station the principle of electrical resonance may be used to allow the reception and amplification of the signal energy of the particular station it is desired to receive and present such a high impedance to the flow of currents of all other frequencies (from other stations) that they are excluded from the circuits; and therefore the other stations are not heard at the same time. This is accomplished by "tuning" the receiver.

Thus, station WEAF in New York City transmits with a carrier current having a frequency of 660,000 cycles per second. The transmitting aerial of this station produces electromagnetic radiations of this frequency, which travel outward in all directions to the antennas of thousands of receiving stations located over a wide area. The wavelength of these radiations (and that of the station), is 300,000,000 divided by 660,000 or approximately 454 meters. Also station WABC located near it, transmits with a carrier current of 860,000 cycles, or a wavelength of 349 meters etc. Radio station schedules and programs printed in newspapers usually give the frequency or wavelength of the station, or sometimes both. For convenience in tuning for stations, the tuning dials on some radio receivers are calibrated in kc. and others are calibrated in wavelength. Many are simply calibrated with a scale divided into 100 equal parts, there being no direct relation between the scale divisions and either the wavelength or frequency.

If our eyes were capable of responding to the radiations sent out from the aerials of radio transmitters, these aerials would appear to us like so many huge lighthouses flashing on and off, each one a different number of times per second corresponding to the sound vibrations in the program being transmitted.

—30—

Serviceman's Experiences
(Continued from page 22)

the set is correct as far as specification is concerned, the customer remembers him as a furtive felon."

"Now, my lad, tell me this: why does that serviceman work hours that would only be justified if he joined two unions; at a salary his customer would laugh at, if it was offered to *him;* spend half the night tossing and worrying about the sad state of the business; and get nothing more at the end of the week than uncalculated loss by depreciation and a needless reputation for being underhanded?"

"How can *I* help it if the customer thinks I'm a gyp?" I asked. "All of them remember the clippings they got in the early twenties!"

"Let them think so," Al replied. *"Then show them by your deportment that you are not. Be cheerful, confident; smile pleasantly if the customer makes any cracks,* like: 'My sister had her set fixed last week, and honestly, it sounds worse now than it did before.' Laugh, even though it isn't funny—just to show it doesn't hit home."

"When you find the faulty part, remove it, if possible, or point to it, and say: 'I want you to see this. There's nothing mysterious about it—simply a coil of wire that broke, and you need a new one. I'll have to make the replacement and give it a breakdown test in the shop, where it will have the best surroundings. It will cost exactly $8.69, including labor, tax, and installation, and you'll get it back two days from now. Will anyone be home Thursday morning?' Act like that, and your customers will appreciate your work."

"But Fletcher's *Bosch,* Al." I insisted. "Did you, or didn't you, put in new tubes?"

"Lee," Al said, out of breath, "take a walk. I'm not going to answer your question; but while you are walking remember how long you've known me; remember how many jobs we have gone to extremes with to keep our contract at the given price, even at loss to ourselves. Ask yourself if the term 'gyp serviceman' isn't a cynical expression used by idle gossipers rather than a true description of the workers in today's field. How many of our permanent competitors have based their operations upon the principle of the golden fleece?"

I *knew* it; Al was guilty, and trying to cover up. I went to the door with a heavy heart—which jumped when I saw Fletcher kick the door open and stop, pointing at me.

"Are you busy?" he asked, threateningly.

"Not very," I replied, nervously.

"Well, you're *going* to be—explaining why you didn't replace tubes after you charged me six dollars for them!"

He weighed about twice as much as I, and my knees felt like they would bend both ways if I tried to walk away.

"Oh, Al," I called, in a weak, poorly modulated voice, "here's the man who owns the *Bosch* we delivered yesterday."

My partner came briskly from the rear of the shop, but walked past us instead of stopping, and went to the door, to examine the place Fletcher kicked. "That glass cost us ten dollars, mister," Al said, very abruptly. "Next time, be careful!"

"There isn't going to be any next time," the customer replied, calming down, but becoming more sarcastic. "Know who I am?"

"Yes, I do," Al replied. "You are Mr. Fletcher, an irritated customer, but you act like a locomotive behind schedule. You came here because you think you didn't get something you paid us for."

"You're a smart fella, all right," Fletcher said, "so perhaps you can tell me why the same notches were on my tubes when they left the house, and on the new ones when you brought the set back. Lucky thing the new tubes have letters instead of only numbers—you'd probably add the type number to the bill if they didn't!"

"Come back to the workbench," Al ordered. "I saved these tubes for you—the ones that came out of your *Bosch*. Notice that they are notched. Notice also that this 'clock' shows they were manufactured before you bought your set. The ones you have in your hand are *new* tubes—which I notched very carefully before I installed them."

Fletcher looked, and wilted. Big fellows look funny when they act sheepish. "Gosh," he said. "Maybe I'm a chump, eh? But why did you notch your tubes?"

"You wouldn't have notched *yours* if you didn't suspect us," Al replied, "and I wouldn't have notched *mine* if there was any other way to bring you into the shop so I could talk to you. That's the only way I could keep you as a customer!"

Fletcher laughed so loudly the small parts jingled. "Boy," he said, "ya got me! Say—send that helper of yours over to fix my brother's set—same address, second floor. I'll tell him you're okay!" He closed the door—*very* slowly—and waved to us when he reached the sidewalk.

"Fellow had a lot of nerve—thinking we'd gyp him," I said, indignantly. "As if we didn't know honesty was the best—"

"Get going on that call," Al interrupted. "We can't run an honest business unless we have business. Start moving, honest engine—but don't forget: life is what we make!"

—30—

Modulation Meter

(Continued from page 33)

With the time constant suitably adjusted, it is well to make a final check on the modulation reading. The previously-mentioned procedure included only the zero and full scale adjustments. If the constants shown in Fig. 3 are followed the scale will be linear, and hence will be direct reading (on a 10 ma. meter—other-size meters can be equipped with a hand-marked scale). If other constants or tubes are used, which is entirely feasible, the scale will have to be checked for linearity. The most important determining factor is the characteristic of the tube in the last stage. If necessary, the bias and bucking voltages can be varied (thus moving the operating range along the tube characteristic) until linearity is obtained. This adjustment can be made by direct comparison with an oscilloscope (using steady tone modulation)—one of the important aspects of this type of modulation meter being that it reads the same for tone as for voice.

Application

After the unit has been once adjusted and calibrated (which is not as hard a process as it sounds), it requires no further adjustment unless tubes or other components are changed. If desired, power supply fluctuations (although not usually of large importance) can be compensated for by slight adjustment of R_{13}. When the power or frequency of the transmitter is changed—or the meter used to monitor a different transmitter—all that is necessary is to adjust C_1 (and in some cases the external pickup) until the carrier meter M_1 reads just half scale. Incidentally this meter M_1 is in itself a valuable adjunct to correct operation. It should remain constant during operation. If it does not, it is certain indication that something is happening to change the output power of the transmitter. If it swings upward on modulation peaks it indicates that negative peaks are being cut off—probable causes of which are too much modulating voltage, over-excitation, or too light loading. If it swings downward on modulation peaks it indicates that positive peaks are foreshortened—causes of which may be under-excitation, too-heavy loading, incorrect bias, etc.

As to the actual application in monitoring use, very little need be said. The unit can be built up in any desired mechanical style—as, for instance, in a box to match the receiver, on a standard rack panel, or in any form which will place the meters in a conveniently observed spot. The only caution to be observed, in using the instrument, is to remember that it actually indicates peaks—hence there should be no "allowing" for these as is often done with other style meters. Of course, if you hesitate between words the needle will eventually drop to zero. But even in this case (that is, for a swing starting from zero) the response is such that the indicated peak on the meter will be within 10% of the true value.

If it is intended to use the unit for testing—as, for instance, in making frequency response measurements on the transmitter and speech equipment—then it is desirable to make sure that readings are the same, or nearly the same, at all audio frequencies. The circuit shown should make this possible—but it would be best to make a check run before assuming it to be so.

Suggestions

As mentioned before, it is the writers thought that it will be best for any builder to make a trial assembly of the unit before building it up in a can. In doing so there are any number of possible modifications, and no doubt some real improvements, that can be made. There is almost nothing in the circuit which can not be altered in one way or another. The tubes used were simply those available—and almost any others, the six-volt series, the metal tubes, or the glass equivalents, can be used. Multiple purpose tubes might be utilized—for instance, a 2B7 in place of the first 56 and 57 (this would require a smaller meter for M and possibly other changes). The input circuit is certainly subject to some experimentation. That given in Fig. 1 uses an antenna and ground connection. If insufficient pickup is obtained in this way the circuit of Fig. 4(a) can be used—although it has the disadvantage that the use of a tuned circuit will probably require plug-in coils (although a tap arrangement might do). The circuit of Fig. 4(b) can be used if desired, but requires more power. (In each of these the resistor, of course, functions as an input control in the same manner as did C_1 of Fig. 3.).

It is even possible—and might be worth considering—to place the first rectifier right in the transmitter, thereby obviating need of the r.f. leads. The output circuit may also be modified to suit convenience—or more likely to suit whatever meter is available. This may require a change in the output tube complement. The 56 will give a very uniform characteristic for a 5 mil meter, and a satisfactory one with a 10 mil meter. However, putting a pair of 56's in parallel will give a straighter characteristic when the 10 mil meter is used.

Then there is the design and adjustment of the timing circuit. As previously noted the upward swing of the needle is determined chiefly by the constants of the meter, while the downward swing is determined by the constants of the parallel circuit. There is wide divergence of opinion as to the best characteristic. Obviously it should not be too slow—but at the same time it should be slow enough for easy reading. The best answer to this is to try different combinations of capacity and resistance until you find one to suit yourself. The values indicated in the circuit are meant as illustrative rather than as necessarily the best choices for a permanent setup. Inspection of manufacturer's literature shows values that vary from .005 mfd. to .25 mfd., and from .025 megohms to 50 megohms—which allows plenty of room for experiment. If desired the switch S can be made a part of the permanent setup. —30—

Danger, High Voltage!

(Continued from page 35)

portional to the capacitance of the condensers when they are in series. This relationship is true for a.c. and d.c.

If in Fig. 3-A we assume that the plate blocking condenser is .001 mfd.; the tuning condenser .0001 mfd.; and C_2 equal to .001 mfd.; we have the following voltage relationships insofar as d.c. is concerned. (Note that the values are typical for high-frequency circuits.) The voltage across C_p will be approximately ½ V_p, and the voltage across the C and C_2 parallel combination will be approximately ½ V_p. If C_2 were omitted (coil not grounded), the voltage across C would be 10/11 V_p. While circuit 3-A may seem a bit odd for transmitter circuits, it is used in push-pull circuits minus condenser C_2 as shown in Fig. 11.

When the tank circuit is transferred to the grid circuit of the following tube as illustrated in Fig. 4, the relationship is the same as for in the plate circuit. Compare circuits of Figs. 1, 3, and 4. In all cases the only voltage across the tuning condenser is the r.f. voltage because the coil is connected directly across the condenser and thus forms as d.c. short.

If the circuit of Fig. 2 is transferred to the grid as shown in Fig. 5. the d.c. voltage again appears across the tuning condenser. However, in this case it is the d.c. grid voltage or bias of the following tube. Ordinarily this grid voltage is quite low, although in certain circuits using high grid driving power it may be nearly equal to the plate voltage of the driver tube. If a condenser is used in this circuit it must be rated to withstand the maximum d.c. grid bias (under load conditions) plus the r.f. voltage.

The double-ended or push-pull amplifiers are similar to the single-ended, except that the r.f. voltage from plate to plate is twice that found in the other type. In Fig. 6 we have a push-pull amplifier using a single-section condenser. From a d.c. viewpoint, there is no voltage across this condenser. When the amplifier is operating, the total r.f. voltage across both halves of the plate coil is across this condenser, and it must be designed to withstand this voltage.

The use of a double section condenser has no effect upon the voltage across the both sections as shown in Fig. 7. However, each section of the condenser has but one-half of the total r.f. voltage across the coil. In this respect, each section of the condenser need have only half the voltage rating needed in Fig. 6.

Fig. 8 shows the push-pull circuit most commonly used in ham transmitters when a split condenser is available. In this circuit the full d.c. plate voltage is applied to the tuning condenser. As a result each side or section of the condenser must be able to carry the d.c. plate voltage plus the r.f. voltage. *(Turn the page, please)*

The use of a d.c. blocking condenser in the ground circuit as shown in Fig. 9 does not change the condition of Fig. 8. Contrary to what most hams believe, the blocking condenser does not appreciably change the d.c. voltage across the tuning condenser. If a .001 blocking is used and the tuning condenser has a capacity of .0001 for each side the voltage across the tuning condenser is 10/11 of the plate voltage. There has been a reduction of but 1/11 or 9%. For all practical purposes, we can state that the condenser must be designed to withstand the d.c. plate voltage plus the r.f. voltage.

When parallel plate feed is employed as shown in Fig. 10, the d.c. voltage is effectively removed from the tuning condenser. As shown in the equivalent d.c. circuit, the plate blocking condensers are subjected to the d.c. plate voltage. Since the coil is grounded at the midpoint, no d.c. voltage can exist across it and the tuning condenser. Consequently the tuning condenser need withstand only the r.f. voltage.

By grounding the rotor of the condenser only, the d.c. voltage is placed on the tuning condenser as shown in Fig. 11. The d.c. circuit shows that for .001 mfd. blocking condenser and .0001 mfd. tuning condensers, 10/11 or 91% of the d.c. plate voltage is placed across each section of the tuning condenser. When this arrangement is employed, plan on a condenser that will handle the d.c. as well as the r.f. voltage.

Combining Figs. 10 and 11, we get a circuit as shown in Fig. 12. This circuit is the same as Fig. 10 except that a double section condenser is used with a grounded rotor. Since the coil is also grounded, no d.c. voltage appears across the tuning condenser, so it must have only sufficient voltage rating to withstand the r.f. voltage across the tank circuit.

When designing transmitter tank circuits it is well to take the beforementioned factors into account, for by eliminating the d.c. voltage from the tuning condenser, condensers with smaller plate spacing may be used with equal effectiveness. However, it is not the purpose of this article to recommend the use of a circuit only because the condenser may have a lower voltage rating. There are many other factors in the design of transmitter tank circuits, and sometimes to obtain other benefits it may be impossible to keep the d.c. voltage off the tuning condenser. If these benefits are of sufficient value to offset the increased expense of the condenser required, then it is advisable to forget about keeping the d.c. voltage off the tuning condenser.

In many transmitters built by the writer and many of those described in radio publications, it is possible to save considerable money by keeping the d.c. voltage off the tuning condensers—and this can be done without sacrificing transmitter performance.

—30—

Model KW Rig

(*Continued from page 30*)

to the various units. The one big bug in amateur class B phone transmitters, that operate on high power from the house mains, is the blinking of the lights caused by the rise and fall of the plate current to the modulators. The type 250th tubes make excellent audio modulators in either class AB or B, and the former was selected to reduce the range of plate current swing normally encountered in the latter application. The total plate current *variation* is reduced to less than 100 ma. and there is no blinking of lights. Of course there are other factors that enter into the design of good regulation and these will be covered in later paragraphs.

The modulators are shown in the lower window where observation may be made in the same manner as was described for the final. The two modulators operate at an orange color and circuit balance may be observed as before stated. It is imperative to use separate power supplies to the final and to the modulators if maximum performance is to be realized. The plate current to the modulated amplifier does not vary more than 1 ma. in this transmitter when operating on phone at maximum input and this is made possible by using choke-input filters to all stages and by the use of class AB modulators.

There are several ways that we can attack the problem of wiring; point to point, cabled, and haywire. The latter does not insure efficiency and should be disregarded. Point-to-point wiring is best adapted to r.f. circuits, and cables are well suited in carrying the power leads and those that terminate at the meter panels. The writer uses automotive ignition cable for these latter connections and they are designed to withstand a 10,000 volt breakdown. Filament cables are made to the larger tubes with number 10 soft drawn copper wire which is enclosed in a heavy spaghetti tubing.

Ground returns to chassis are made at one point only per stage so that no difference in potential will occur. A complete analysis of correct wiring may be had by referring to the March 1939 issue of RADIO NEWS, page 33. All chassis in the three transmitters are made of auto-body steel and these are first copper plated and then cadmiumed for a neat finish. Lockwashers are used under all screws and nuts so that vibration will not cause any connection to become loose.

Current readings for the various stages are: Osc. plate 30 ma., Doubler plate 40 ma., Driver plate 100 ma., Final plates 490 ma. The overload relay trips on any current in excess of this amount and cuts the primary to the high-voltage transformer. The class AB Modulators have a static plate current of 300 ma. and rise to 400 ma. for full output. Line voltage is set to 115 by means of a 5 kw. autoformer. The modulation transformer is protected by an underload relay so that plate voltage cannot be applied to the modulator tubes until they are drawing proper current and in turn offer the proper impedance load to the secondary of the transformer.

Many a class B transformer can be saved from breakdown if this precaution is taken in any amateur transmitter operating on phone and is cheap insurance when the cost of a replacement is considered.

Power Supplies

It is always good practice to design the power supplies for *continuous* operation and never for *intermittent* service. Plenty of capacity should be used in the filter networks to insure a hum-free carrier and this applies particularly to the modulator power supply at the output. The large transformer shown in the bottom of the cabinet on the right hand side is the high voltage plate transformer. The rectifiers are underslung between this and the modulation transformer. The filament transformer for the two rectifiers and the two filter chokes for the high voltage are mounted on two channel irons above the rectifiers.

The bulk of the weight is thus kept at the bottom of the assembly and eliminates the need for a chassis to hold this weight. The control relays may be seen mounted on the side of the cabinet above the plate transformer. Pilot lamps that operate on the line voltage are used for filaments, bias and plates. The line and control wires are all contained in BX conduit for safety as well as the additional shielding provided by its use.

The exciter unit contains its own plate and filament supply on the same chassis and consists of a two-section filter with choke input.

All units with the exception of the bottom portion are removable and connections are made by means of amphenol cables and plugs to each chassis. In this way a section may easily be removed for making any changes without disrupting the remainder of the transmitter.

Control Console

All of the circuits at the station are controlled from this console, and the connecting cables are all long enough so that the desk may be moved to different parts of the room for a change of scenery. The use of key switches makes for rapid changeover. All of the associated equipment for the transmitters is controlled from these switches and the selector switch. A complete picture of the sequence may be had by referring to the schematic diagram of the control panel.

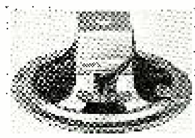
It is not within the scope of this article to cover all of the details in the construction of all of these units and I have merely tried to bring out the more commercial appeal as far as construction is concerned. Perhaps the illustrations can tell the story to best advantage, as, after all, the basic circuits are all tried-and-proven and have appeared many times in print.

Later articles will describe the other transmitters used at this station.

What's New in Radio

(*Continued from page* 34)

make a line of replacement speakers and Uni-match transformers for the trade. These units are designed so that the speaker and its transformer may be used as a replacement in practically any radio. A proper impedance match is a universal feature of the transformer. A rotary switch is supplied on the terminal strip and it is only necessary to turn this switch to the proper point for correct match to the output of the set being used. Further details may be had from the manufacturer.



National Radio Institute, of Washington, D. C., are celebrating their twenty-fifth anniversary. Twenty-five years ago, Mr. James E. Smith began teaching a group of four men in a wireless class. In those days the public thought of radio as a plaything or a passing fad, and saw no possible future for it. Today radio is a $912,000,000 industry and employs 345,000 people in its various branches.

QRD?

(*Continued from page* 36)

good story, true or. . . . With stories like these under his hat, we'd also like to hear from Tim Furlong.

* * *

NOW that wintry weather is fully upon us (ah, for the life of a yacht operator who is now basking in the warm sunshine of southern climes) the east coast vessels are keeping the ops on their toes with their gyrations. One never knows what his next move will be. But whether it rocks beamways or from stem to stern, or whether or not it is okay in every seam perfect spar, there's always the ever-present possibility that some other vessel or plane might be in need of help. So the cans are kept on continuously . . . in spite of Automatic Alarm equipment. That was a very nice piece of work on the part of the *Esso Baytown* which rescued the passengers of the British flying boat *Cavalier*. If not for the coolness and operating ability of the radiop of the *Cavalier*, every one would have gone to an icy-water grave. As it was, three were lost. . . . So stick to your cans, just in case.

* * *

IT was a pleasure to hear from "Ham" William Drebert, Moravian College for Men. To get into the Airways, one must pass a civil service examination. Details of the time and place of examinations can best be obtained by writing to the *Department of Commerce, Washington, D. C.* The aviation companies must be contacted separately. As for ship berths, the field is rather well filled and a second class ticket without any previous experience would have to first get "apprentice" experience before you could possibly take a boat out by yourself. Good luck to you.

* * *

LETTERS occasionally come over the desk that require a straightforward answer. In other words, "no beating around the bush." There are a lot of chaps who believe that some of the men holding down various jobs on ship stations and broadcasts don't know, as one fellow puts it, "the difference between a modulator and an egg-beater." He moans that they're holding the billet while he's still on the available list. Well, brother brass-pounders, all I can say is that if these "know-nothings" have the berths, then they must have their tickets to operate. And if they have their tickets, then they must know their stuff, because I've never heard of an *RI* who could be bribed. As a matter of fact, the nephew of an *RI* was flunked because he was given some extra questions, in addition to the regular examination, which he couldn't answer. So instead of thinking the other guys don't know what it's all about, it's a good idea, instead, to take that time to build up our own knowledge.

And now that '39 is well under way, let's hope for peace and good shipping from all ports . . . so with 73 . . . ge . . . GY.

—30—

Video Reporter

(*Continued from page* 14)

and recommendation. As the FCC remarked, the Journal Company's application is the first looking to establishment of an experimental program service for reception in the home as distinguished from fundamental research or technical experimentation in the art of developing television apparatus. The Commission has previously issued a number of licenses for technical experimentation only.

The proposed standards for television transmission were recommended to the Commission recently by the Radio Manufacturers Association. The Commission has taken no action upon the recommendation. Some manufacturers and experimenters have expressed opposition to the promulgation of standards.

World's Fair Television

RESPONDING to the rapidly mounting interest in the advent of public television, which is expected to coincide with the opening April 30 of the New York World's Fair 1939, the Radio Corporation of America announced a decision to almost completely revise its exhibition plans at the Fair in order to increase the scope and effectiveness of the television presentation.

Original plans for the RCA exhibit building drawn up more than a year ago, provided six ground-floor rooms where television was to be viewed under conditions simulating those of the home. Because these accommodations are now looked upon as inadequate, RCA is redesigning the ground-floor arrangement to greatly enhance the utility of the available space.

One phase of the revision which has been agreed upon, however, is the retention of two of the original viewing rooms for the purpose of presenting the Television Living Room of Today and the Radio Living Room of Tomorrow. The television living room will be decorated with period furniture, featuring one of the new model home television receivers. The Radio Living Room of Tomorrow, decorated in the most advanced style of modern furniture, will present in some form yet to be designed a combination of sound broadcasting, television, facsimile broadcasting, phonograph recording, and phonograph record playing. The RCA exhibit building, erection of which was completed about a month ago, is shaped like a huge radio tube affixed to a base and the whole lying on its side.

Add These to Your List

THE FCC has just assigned the following experimental television broadcast call to the General Electric Company: W2XB, Albany, N. Y.; W1XA, Bridgeport, Conn.; W2XD and W2XH, Schenectady, N. Y. The frequency band for the Albany and Bridgeport stations shall be 60,000 to 86,000 kc. and the Schenectady stations' frequency band shall be 42,000 to 56,000 kilocycles, with 40 watts power.

Tele-Casts

RECENTLY a Broadway columnist reported that RCA was contemplating forming a new company to take care of television exclusively. The new company was to operate under the name of the *Television Corp. of America* with Lenox Lohr as its headman. —30—

Practical Oscillator

(*Continued from page* 16)

there is not any too much room in the can for an extended jack frame. The right cabinet wall makes a good spot for the male receptacle for power cable plug and the top of the can or the front panel seems the right location for the binding post output assembly.

No chassis need be employed. Sockets for the plug-in crystal and for V_1 and V_2 may be of the above-chassis type, mounted directly on the bottom plate which is provided with the can. The various condensers and resistors may go anywhere, but they should be positioned to permit short leads to the associated components, particularly if we are to get away with a layout which will not involve shielding between circuit groupings.

No wiring instructions need be given. If the layout is followed and the usual precautions are taken the business of making proper connections will take care of itself. Some leads *should* be run through low capacity shield tubing, if it is found advisable to isolate stages; and to prevent unwanted coupling; but we will refrain from giving any definite suggestions along this line, as it is entirely possible to wire up the job without the use of shielding anywhere at all.

Some items, say, C_3, R_1, and R_2, may be connected directly at the socket terminals.

Check the wiring and measure the available B voltage for operation. The voltage may be the conventional 250, providing R_8 is of sufficient resistance to drop the potential to about 180 as measured at the V_1-r.f. plate. Whatever this voltage, be definitely sure that its value is brought down to at least 180 v. Use a variable resistor at R_8—or try out various resistors until the r.f. B+ does get down where it belongs. So long as the crystal will oscillate, voltage less than 180 will be satisfactory; but one should never go higher, as filter crystals plugged into the circuit might be ruined.

Plug in any available crystal [Ed. Note: 10 and 20 meter crystals are not suited for use in this type of circuit, as they are normally ground to 60 meter fundamental] insert a milliameter of 0-10 range in the meter jack, with the two tubes inserted with the power cable connected. Adjust the switch so that either one or the other r.f. choke-grid condenser combinations is in circuit, depending upon which is in order for oscillation with the particular crystal employed. If the reading is high—somewhere in the neighborhood of 8 ma.—then the Pierce circuit is not oscillating, and C_1, if a variable, should be adjusted in value until oscillation, as evidenced by a sharp current drop, is obtained. If the reading is about 4 ma. and if this reading jumps to a higher value as the crystal is touched with the finger, then the circuit is oscillating properly.

It should be possible to obtain zero modulation; if any amount of modulated signal is present with R_7 in the off position, then this or the tone control should be provided with a switch cut into the lead between R_9 and B+.

The note, with modulation up, will be about 400 cycles in frequency, as we have previously explained. If a higher tone is called for, the pitch control may be advanced—or the alternative fixed-tone selector switch adjusted to bridge a desired condenser across the secondary.

Modulated or unmodulated, the signal should and will be controllable down to practically zero output through adjustment of R_6.

Application

We should like to point out, if we have not done so already, that this design becomes of particular interest not only to the amateur or professional radioman, but to the layman who desires to keep his superhet in peak operating condition at all times.

The layman should first find out the peak i.f. frequency for his particular receiver. Any serviceman should be able to give him this information. He should then obtain a low cost crystal cut to this frequency and inserted into

Watch for the BIG Television Issue next month

its socket in the oscillator. Make sure of proper oscillation, and proceed to align the intermediate channel—using a signal attenuated down to minimum usable level and modulated as required.

The proper procedure is outlined in understandable, non-technical language in many readily available textbooks and need not be detailed here.

For the amateur, the generator has two-fold value. It may be applied as a means of effecting an alignment of his single-signal receiver,

For the serviceman, the oscillator makes an ideal auxiliary signal generator for speedy, effective, and highly accurate i.f. line-up. True, a number of crystals in standard frequencies might be required, for maximum flexibility of application (say of 175, 262, 370, 456, and perhaps 465 kc. value); but manufacturers are leaning more and more toward a common i.f. frequency of 456 kc., and it is entirely reasonable to suppose that the apparatus would have excellent utility value when provided with but a single crystal cut to this value.

Harmonic Operation

Any oscillating circuit will produce harmonics, and this means that the unit will produce usable signals of the 2nd, 4th, and higher harmonics of the fundamental frequency. The harmonics, of course, are very accurate—but the available signal level goes down as the frequency multiplying increases, so that the harmonic serviceability of the instrument is more or less limited.

We might perhaps double in the output circuit, employing a switch to cut in a second plate coil tuned to twice the crystal frequency. Any such coil should, when brought into connection, either effectively replace R_5 or tie in between the output side of C_6 and ground; and it should be provided with a fairly low impedance secondary across which the output level potentiometer may be bridged. The switching should be such that the doubling is thrown out when operation on the fundamental is desired.

Emergency Operation Without Crystals

One of the peculiar features of the Pierce circuit is that it will work with only a coil plugged into the crystal socket—connected, in other words, between r.f. oscillator, grid and plate. The adjustment is a little bit tricky and it goes without saying that the exact frequency of a produced signal, not being crystal controlled, will be in some question; but be that as it may, the idea of building coils which will, when used in this instrument, provide for circuit oscillation at the approximate frequencies desired, is extremely practical.

Coils may be made quite small and may be trimmed by midget semi-variable capacitors or left untuned. Good practice, by the way, would be to build them into male cable plug assemblies (five prong), such as the familiar Amphenol jobs, which have metal shell jackets. The cable hole in the shell could be used to provide access to trimmers. —30—

"Crowd-Stopper"

(*Continued from page* 21)

of the building is easy. The unit is built on a chassis which measures 3"x7"x12". The larger relay and the insulated pick-up post are mounted above the chassis, the other parts underneath. All of the parts, including the variable condenser, must be insulated from the chassis. Be careful in wiring the unit as the circuit is quite unusual. Notice that the two-tube cathodes are connected to *opposite* sides of the 110-volt line.

The single flashlight cell furnishes current for operating the power relay. It is mounted by means of a bracket and a knurled head machine screw through one end of the chassis. One of the battery terminals is grounded to the chassis.

In testing the unit, connect it to the 110-volt line and plug a reading lamp into the receptacle in the end of the chassis. Remove one of the tubes. Then close the relay contacts on the first relay by pushing on the arm with a pencil. If the lamp turns on, the relay circuit is working properly. Plug in the tube and wait a minute for it to warm up.

Set the variable resistor at one-half scale and rotate the variable condenser. Over quite a portion of the dial the relays will close and the lamp stay lighted. Turn the condenser slowly until the lamp goes out. At the optimum adjustment, the condenser is opened until it has slightly less capacity than is necessary to operate the relays. Bringing the hand near the pick-up plate, which may be any piece of metal which is not grounded, or walking near it, has the same effect as increasing the capacity of the variable condenser. The variable resistor allows adjustment of the screen voltage for maximum sensitivity.

One merchant used a capacity relay of this type for an electric light bulb display. A large bulb was concealed underneath a pile of light bulbs. This bulb, of course, was connected to the capacity relay. When a customer walked down the aisle so as to pass the display the whole pile of bulbs mysteriously lighted!

—30—

Tuning Devices

(*Continued from page* 17)

most practical for the set will depend entirely upon the cost of one against the other, or the amount of space available The push-button assembly is adjusted in the same manner as that using the rotary switch.

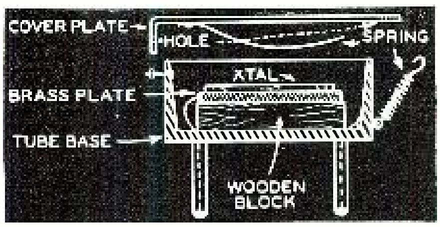
A profit of five or ten dollars, depending upon the type used, should provide an incentive to the progressive serviceman who can use this additional source of store income. —30—

Radio Gadgets

(*Continued from page* 38)

into the bottom of the base and then saw out a slightly smaller disc of *flat* brass or copper and cement or otherwise secure it to the top of the insulating disc. Polish the surface flat and clean.

A wire from one prong should be soldered to the edge of the metal disc. Drill a tiny hole near the bottom of the tube base into which fasten a small spiral spring with a hook on the



top end. Connect a wire from the second prong to this spring. A pin should then be inserted in the tube base near the top on the opposite side.

The cover-plate can be cut out of stiff metal to the shape indicated. One lug must be bent down and notched to fit under the pin in the tube base. A small hole in the other plate takes the spring hook. Then solder a strip of thin, flexible brass to the under side of the plate that will make light, but firm contact with the crystal. —30—

Bench Notes

(*Continued from page* 27)

The condenser is flat metal-cased unit, bolted beneath the left side of the tuning chassis. It's a bit unhandy to get to, but worth while if a dollar sign is stamped on it.

Californians May Skip

For some time, I have been passing a colleague's radio store during my trips to and from the shop. In his window is a neon sign: *Radio Repairs.* Strung beneath it is either a sign reading: *Service charge, $1,* or one saying *Service charge, $1.50.*

I stood it as long as I could; then dropped in to ask why the price was low one day, and hung high another. He laughed and gave me a pip of an answer—that, during fair weather, he answered calls with little discomfort en route, and charged the lower fee; but, when it was raining, it was very messy, and worth four bits extra!

Novel idea, trying to suit payment to weather—but it doesn't seem good business to make it tougher for customers on the stormy days when they want music most, and are most likely to call a repairman. *When the weather is with you, why stand in your own way?*

Dead End

When you are running a substitution test with an upside-down open chassis on the bench, disconnect the ungrounded ends of resistors first. There are two good reasons for this: the grounded end is usually the most difficult to unsolder, because it is wrapped around a heavy lug; leaving it intact is handier when you resolder. The loose ends are left at ground potential, and, as a result, you can work with less chance of getting "bitten" in the forearm.

When you disconnect sections of a filter condenser, it is good practice to make a habit of touching the lead to ground (chassis) before you let it loose in the wind. High voltage condensers know full well when they are charged —and if you forget, they are more than willing to remind you of it.

A safer way, of course, would be to turn the juice off and on when each change is made—but who bothers to do a thing like that? Watch the higher voltages on p.a. jobs, though—*unless you want the record of the repair job carved in stone!*

Especially watch those condensers on the new Television receivers—those with the 9″ tubes. They are supposed to be charged with better than 4,000 volts. *Quite enough to kill you suddenly, efficiently and very, very quietly!*

THE READER'S RIGHT

"I believe *Repairman's Holiday* re engineers in February BENCH NOTES is a very fine analysis. RADIO NEWS is doing a good service for repairmen, and they should make use of the opportunity it offers to bring their problems to its pages for discussion."—W. Rieger, Valley Stream, N. Y.

Many thanks, Friend Rieger, for ringing the bell for me. Because an exchange of information is always helpful, I welcome discussion from other professionals in the field.

★

"Perhaps," writes J. S., of Winchester, Indiana, "my problem is typical throughout the country. I am bothered by radio amateurs who clutter up my shop during the best evening hours. Their conversation, although inoffensive, is e n d l e s s—consisting mostly of 'Q' signals and net prices. While I realize they have a government license to talk, I have to earn my living. Can you suggest some soft shoe method of getting rid of them?"

Many a true jest is spoken in words, J. S. I have turned your problem over to Mr. Sheldon, who says it will probably get narrative treatment in a future Serviceman's Experiences. I'll bet "Al" finds a way out!

★

T. S. Wrightson, of Stormont, Virginia, says: "I sell and service radios and have many complaints about the reception in this locality. I cannot recommend a high-priced set to a prospect when the night reception is no better than that with a five-tube midget. Many times we cannot receive any station good and clear, although our closest one is about fifty miles away. My theory is that there are too many high-powered stations."

So many factors relate to a problem like this that it is impossible for an outsider to lay down rules which will apply to all cases. Good engineering will show up, however, in both receiving and transmitting equipment, despite adverse local conditions.

Let's approach the problem with the thought that it may be typical in various other sections of the country, and that its treatment may help other servicemen in similar sections: of the three main considerations involved in reception—transmitter, radio medium, and receiver—the last two are probably the most likely to cause trouble. Transmitters are, in this day and age, at a point far ahead of average design found in all receivers, old and new, in use today.

The radio medium (including terrain near transmitter, receiver, and the path between) is a possible cause of poor reception; more so than the receiver, because, in a section where conditions are adverse, the listeners and dealers have learned, over a great period of time, which circuit types are best for the conditions they must contend with. If they don't, it's an opportunity for some serviceman to conduct an investigation which will help all concerned; including himself—the results of such observations will gain him prestige, thanks, and more business is certain to ensue.

In your location, T.S.W., it is interesting to know, since we have decided the radio medium is most probably at fault, that marine operators report a dead spot just to the east of you, off the Atlantic coast.

I suggest you write to the engineering departments of several of the nearest broadcast stations, requesting field strength data in your direction. They probably compiled such information when they were choosing an antenna location, or applying for an FCC license. From the reports of two or more stations, you can learn what results you can reasonably expect in your location.

Broadcast stations are an excellent source of such information. Do not approach them with the thought they are doing you an altruistic favor in discussing your problem. No matter how you are hampered in business by adverse conditions, they are also hampered—and to a greater degree—because their investment is larger. Because of this, they are MORE INTERESTED IN TRANSMITTING TO YOU THAN YOU ARE IN RECEIVING FROM THEM. The better their coverage, the more their station time is worth.

It is not fair to assume it is their fault in not getting across because of bad conditions in the medium, or at the receiver. Broadcast engineers, although you seldom hear of their work, are an exceedingly capable group, and a wave front, starting from a central point, meets many different influences; not all are good. Radio equipment is made by men like you and me—but the intervening terrain is put there by someone else.

If no improvement can possibly result because of unfortunate surroundings, you will at least have authoritative information in your hands which will help explain the adverse geographical conditions to your customers. This information will be of obvious help to you in making sales; if both you and the customer understand what you have to contend with, the customer will never feel he should get ideal reception with the best set in your store. Simply explain that, while neither the cheapest nor the most expensive receiver can be operated to its best advantage, the better ones will give him more satisfactory reception. —30—

Power Packs

(*Continued from page 31*)

duction. This may be obtained by using the formula:

Alternating current voltage across load is

$$\frac{1}{\omega^4 L_1 L_2 C_1 C_2}$$

Alternating voltage applied to input where

$\omega^4 = 2\pi F^4$

L = inductance in henrys

C = capacity in farads

Values of .02 henry chokes to carry 2 amperes and electrolytic condensers of 1000 to 2000 mfd. at 12 working volts are obtainable from various manufacturers. —30—

Signal Generator

(*Continued from page 20*)

primary of this unit is non-inductively coupled to the secondary it is mounted about the wooden core at right angles to the two coils forming the split secondary as shown.

Now then, as to the type of oscillator circuit proper. The apparatus was designed to operate from an a.c. source with tubes having cathode heater construction. Wide filament temperature changes due to supply variations are minimized by operating the oscillator tube heaters at slightly over half their normal voltage by inserting a suitable resistance in series with each. The lowest voltage at which the tubes will start functioning after an approximate 40 second warmup will be found best.

Since the plate current is very small, these tubes will attain only a very perceptibly weak warmth when in operation. Pentode tubes are good in this service because of greater isolation of the output circuit and when electron coupling is used the result is favorably comparable to that with a crystal unit under similar conditions. The metal tubes are as satisfactory as the glass tubes when used with these precautions. Some special tubes with low internal change characteristics recently have been developed, but particularly for d.c. filament supply, such as the RCA type 840.

However well the shielding may be placed between radio frequency oscillators and between them and their associated apparatus there is always the possibility of a small amount of coupling between such units which manifests itself in most disagreeable effects in the conventional beat frequency machine. In such case the audio output at low frequencies has a pronounced saw-tooth waveform. This may be due to one oscillator having more output than the other and as one tuned circuit lags the other it bears an inductive relationship to the leader. Then the in-phase condition at the audio wave node of one circuit becomes decreasingly cyclic in advance of the other and thus exerts a capacitative effect upon the other.

As the discharge curves are dissimilar for condenser action and dying-out of inductive field it is seen that one side of the audio wave is steeply curved while the other tends to be a straight line. Unless we secure good sine waveshape output the measurements and calculations we make upon other apparatus are likely to be worthless because of the harmonic content which in nearly all cases will prove unfigurable.

It is well to mention one other form of distortion which may be serious in conventional generators since it will afford more understanding about what goes on in our new piece of apparatus. Figure 3 shows the combination of mixing frequencies occurring in the grid circuit of a plate-circuit detector or demodulator.

This is a graphical representation of the case of "100 percent" modulation in which case one carrier is of equal amplitude to the other. The high frequency curve represents what is seen on the oscilloscope or what may be plotted out on paper as the sum of two equal amplitude waves of slightly different frequency. As will be noted, there is a phase reversal at every internode, which is also accounted for in higher mathematics. The heavy line of the envelope represents the pulsating d.c. through the primary of the detector output transformer and thus is the audio output. The axis of this envelope should be at "O" in the figure, but because of the unbalanced waveshape it must appear displaced to some region as "X." The result is that one side of the audio waves is flat-topped while the other is rather pointed. This distortion effect is only minimized by reducing the percentage modulation as shown in Figure 4 which is about 50 percent. It is noted that the internodal phase reversals have vanished and the rectified envelope tends to become a sine wave. It is actually found that as the modulation is decreased the waveshape becomes better until it reaches a very satisfactory value at about 10 percent. This also necessitates an increase in audio amplification. Before we now take up the discussion of detection as employed in the balanced circuit let us consider the radio frequency amplifiers.

Why an amplifier for each individual oscillator unit? Well, first, such amplifiers are to advantage in any beat frequency signal generator for the purpose of isolating the two oscillators which is much more effective than bridge circuits. Secondly, in our instrument, they serve also as frequency multipliers since the least common multiple of the two oscillators must now be combined and rectified to yield the desired audio frequency. Thirdly, they perform the double function of amplifying the common harmonic frequencies to approximately equal levels while at the same time the variable frequency amplifier is grid-controlled from the audio output and a.v.c. stage to insure a flat amplitude response characteristic over the entire audio range.

As will be shown later the balanced sideband method of detection permits substantially 100 percent modulation between the mixing frequencies, which allows of high detector output provided there is sufficient excitation present. The a.v.c. device is a further refinement, although practically *flat* response may be had by peaking the variable radio frequency amplifier tank circuit near the corresponding end of the audio spectrum at which any droop may be experienced. And by *flat,* we mean plus or minus not more than one-fourth d.b.

Even if the variable frequency oscillator has uniform output we may expect some attenuation of higher audio frequencies due to the shunting effect of the detector plate circuit filters and also some discrimination due to the band width of the padded radio frequency tank circuit in the plate side of the variable amplifier.

Even though balanced detector action is utilized in the true sense, a radio frequency path must be provided in the plate circuit since the detector tubes are amplifying at radio frequency after the scheme of high power, high efficiency plate rectification. There exist erroneous ideas that have been published and statements to the effect that such radio frequency bypass condensers are not needed in balanced plate rectification circuits, so let us stress this point.

In conventional radio receivers having so-called push-pull detectors or diode devices, push-pull does not exist for the audio frequency at this stage and a second harmonic or "doubled" full wave rectified radio frequency persists across the plate to ground path which must be taken care of through a small condenser if any degree of efficiency and power is to be retained.

Because the tubes are thus operated after the fashion of class-B and since the instantaneous values of the sum of both rectified plate currents is not a constant but follows the double frequency pattern, it is similar to that of an ordinary a.c. full wave power pack having no filter. It is also worth pointing out that in cheap receivers this bypass path is often had through the resistance coupling device of the first audio stage with the result that this stage may be overloaded with low percentage modulation radio frequency while the audio handling power of the tube may be curtailed.

The particular detector circuit of this device has existing across the grid-to-grid coil an in-phase fixed radio frequency voltage biased alternately back and forth by the link coupled variable radio frequency voltage and represented by the graph in Figure 5. The condenser feed carrier tends to suppress itself in the balanced plate circuit and hence becomes a sideband manifestation only. Since the tubes are operated in the cutoff region they constitute a high impedance rectifier.

It is seen that there are two audio envelopes which may be rectified out, with axes at "O" and also "O'." Since these envelopes are 180 degrees out of phase they may both be utilized in true push-pull audio interstage devices. It is interesting to note that if additional d.c. bias of a value equal to "O-A" be supplied to the detector grid circuit, the plate circuit will then function as class-B with respect to the audio envelope, and only the portion of the graph between "O-B" and "O'-B'" will appear in the plate circuit.

Another picture of what takes place in the mixing circuit is shown in Figure 6, which illustrates the back-to-back relationship of the grid voltage and plate current characteristics of the two detector tubes. The value of fixed frequency excitation "X" should be adjusted from cutoff to the center of the linear portion of the plate current curve. This grid voltage is adjusted to a peak value "Y" approximately equal to one-half the linear portion of the grid voltage plate current curve, as appearing across each half of the grid coil and thus operates upon one grid circuit 180 degrees out of phase with the other as represented by (+) and (—).

As the vector value "Y" is constantly faster or slower than the instantaneous values of "X" (in this instrument it is slower to increase the audio frequency) "Y" is shown to rotate about the peak value of "X" which is supplied by condenser to the coil mid-tap. One envelope of revolution of the vector "Y," having produced an alternating additive and subtractive cycle to the vector "X" constitutes one cycle of audio frequency when projected from the graph in linear form and since the analysis is that of simple harmonic motion it is that of pure sine wave form. It must be remembered that the corresponding end of the vector (+) or (—) as applied to one of the tubes must be adhered to that tube throughout the entire cycle or revolution.

When a milliameter of suitable range is inserted in either of the detector tube cathode returns the pointer will be observed to oscillate very smoothly at such low audio frequencies as the meter movement may respond to, on down to zero frequency. This feature allows of positive single zero point calibration of the frequency scale when the instrument is periodically rechecked, and allows of no errors in any mechanical synchronizing devices.

Beam type power tubes are used in the output stage with no reverse feedback nor other complications. This is absolutely permissible because only one frequency is handled at any one time so the subject of frequency phase shift distortion does not apply. The problem of obtaining complex waveforms and frequencies in their corresponding output-to-input relationships ceases to exist. With the a.v.c. action there is no change in amplitude output with occasional changes in load impedance, which eliminates correction. The use of beam type tubes in a single stage balanced amplifier is very advantageous in that enough power output is realized to operate loudspeakers at high volume when pursuing rattles and resonances. Also, in making minute measurements the signal-to-noise ratio is increased which minimizes stray pickups.

The a.v.c. leveller action is automatically obtained by the most effective trigger action circuit as employed in some of the older conventional radio receivers. Additional controlling bias for the variable radio frequency amplifier is obtained across the plate resistor of the a.v.c. triode rectifier. This tube is normally biased to near cutoff by means of the output control potentiometer which is connected across the grid bias battery.

With a given amount of audio excitation supplied to the grid circuit from the secondary of the output transformer winding, the anode current is substantially zero, and the additional bias supplied to the variable radio frequency amplifier will be zero also through the grounded end of the control tube anode resistor. When the amplitude of excitation builds up to the degree which just upsets the control tube bias on positive peaks, however, a small anode current is allowed to flow through the resistor of such polarity as to increase the bias on the variable amplifier and thus bring it back to equilibrium.

If the device is designed to work at this threshold value of cutoff bias a trigger action and consequent flat response is had which is not obtainable with conventional diode devices as used in radio receivers. It is apparent that as the control tube bias is manually increased, the audio output will be increased to an amount to just upset this value, which affords a good means of quiet output control. Otherwise, a dual potentiometer may be placed in the grid circuit of the output tubes. A connection from the 250 ohm output winding is suitable for excitation of the control tube, and with a good output transformer having this and lower taps the coupling between taps is close enough that no padding circuits are necessary when the load is connected to the various taps in matched relationships.

The coupling condenser back to the grid of the control tube must be sufficiently large in proportion to the grid resistor so that no discrimination appears to cause an audio response rise at low frequencies due to impaired control tube excitation at these low frequencies. When operating at frequencies of only a few cycles per second this condenser circuit may be opened, for if the time constant of the filtered plate control circuit is made equal to about one-fifth of a second it is obvious that a serious distortion would level these frequencies completely in such a manner as to cut off the tops of one side of the output waveshape.

We may conclude with some precautions helpful in setting up and outlining the procedure for testing the completed instrument. From the rear view of the mechanical layout it will be noted that the oscillator and amplifier circuits parallel each other which is permissible in that no two circuits are operating at the same frequency. The variable tuning condenser is mounted upon the panel to secure drive rigidity and a type of dial provided which has no backlash. A vernier calibration is provided to add a calibrated scale. The coil shields are individual steel and firmly held in place by being screwed to heavy retaining rings. The power tubes and power pack is mounted overhead in order to facilitate heat dissipation away from the oscillator proper. If voltage supply is unsteady it will be found advantageous to employ a tube regulated source of plate supply or drive the oscillator tubes from battery.

When the apparatus has been assembled and the radio frequency ranges found suitable, the excitation to the detector circuit may be adjusted by means of the radio frequency amplifier bias values and also by means of the plate circuit voltage dividers of the oscillators.

The plate transformer of the variable radio frequency amplifier may be broadened over its operating range by inserting a resistor of the carbon variety in the inductive leg of the tuned circuit which may then be tuned towards the end of the audio frequency spectrum which may show signs of falling off. This circuit is slightly overcoupled to the detector grid circuit through the link of approximately twenty-five turns on each end. With the operating voltages as shown, a suitable plate current for each detector is about three milliamperes which may be set by stopping the variable oscillator temporarily. At this point the bias potentiometer is adjusted to balance both detector tubes and if the grid coil is not exactly electrically center-tapped a turn or so of wire around the high side lead as represented by C_{14} in the schematic diagram will bring things around all right. A transfer switch in the model served to place the milliameter in any one tube cathode circuit for checking; however, a plug and jack arrangement may be used if preferred.

It is now time to put both oscillators in operation and make any further checks that may be necessary. If handy, an oscilloscope will serve very conveniently at this point and also to calibrate the instrument against line current or any standard source of supply. Although this circuit is much more complex than many others, it is one of the easiest with which to obtain the very best results because of the design which eliminates so many sources of trouble experienced with conventional signal generators. The time, patience, and knowledge of the builder will secure fine results almost gratuitously of his efforts.

—30—

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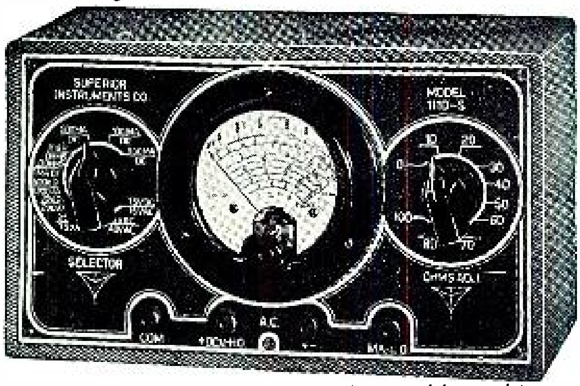

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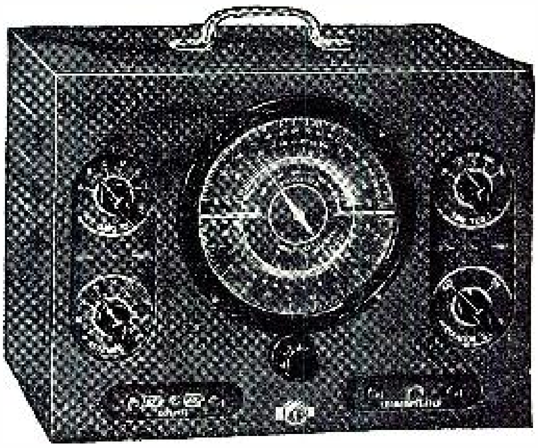

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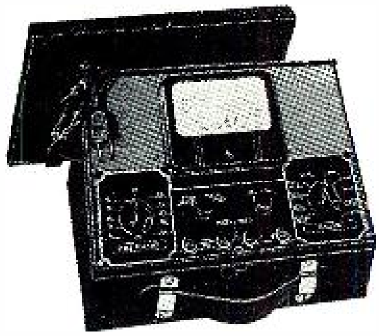

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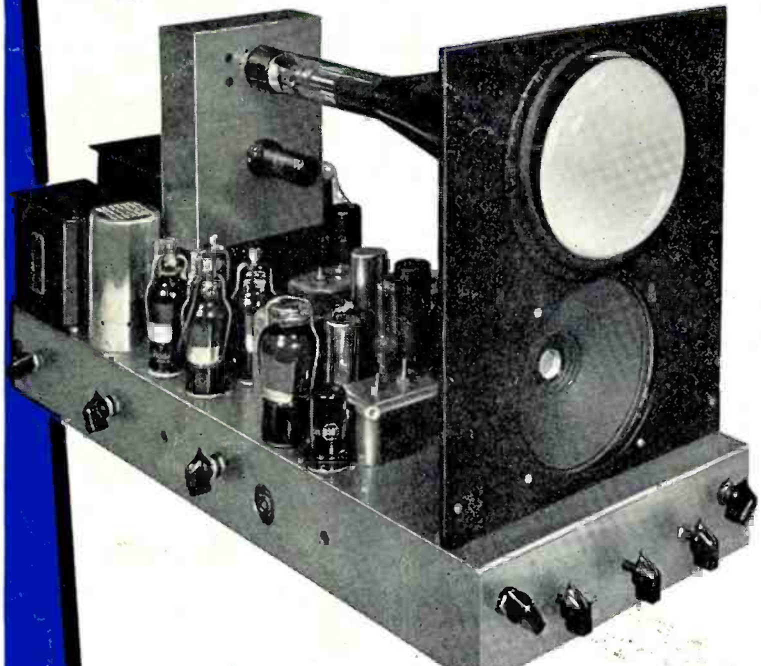

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