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Europe's Radio War - Making a Hi-Fi Tuner - Servicing A.C.-D.C. Sets

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July

New Radio Service "Car"
See Page 13

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J. E. SMITH, President National Radio Institute Dept. 86X Washington, D. C.

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Please Say That You Saw It in RADIO-CRAFT

www.americanradiohistory.com
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NEXT MONTH—
TELEVISION NUMBER

Television is now undergoing its final polishing stage prior to its presentation to the public in workable form. Regular transmission schedules have just been announced by NBC; August Radio-Craft will help you keep abreast of these new and important developments.

Service Men, public-address specialists, radio set builders and beginners also will find in August Radio-Craft many valuable articles to their individual liking.
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99 Hudson Street
New York, N. Y.
SERVICE IN RADIO SERVICING
An Editorial by HUGO GERNSBACK

In China, doctors, for untold ages, have been in the habit of collecting a fee for keeping patients free from sickness. In China you do not pay a doctor when you are ill. This is excellent psychology not only from the doctor's viewpoint, but from the patient's as well, as no one likes to be sick. It is much better to pay a small fee every month or quarterly to a doctor who makes it his business to keep you well.

In the United States, it is the custom, with dentists, particularly good dentists, to send their patients an appointment card every 3 to 6 months for a general cleaning of the teeth. In doing so, the dentist keeps your teeth not only in good condition but he can discover the start of decaying teeth and fill them before the damage becomes more serious. This, too, is good business for the dentist and the patient because it saves the patient much expense in the end. It is an easy matter to fill a tooth that has just begun to decay. It is quite another matter when the decaying process has gone so far that the tooth becomes worthless and must come out. This means expensive bridgework, and special treatments compared to the trifling cost of filling the tooth at the time attention was first necessary.

Now, Radio Service should not be any different in principle than the two examples given. Up to very recently, Service Men have been extremely shortsighted in regard to their relationship with the people whose sets they service, and they are now paying the penalty of this shortsightedness caused by having the public mistrust the Service Man and his work. The public has come to realize that many Service Men have taken ruthless advantage of them and now the average non-technical radio set owner does not place too much confidence in radio repairmen.

Often when a Service Man was called in, he would immediately run up a bill of $20 or more when there was really nothing wrong with the set except perhaps a loose connection or even such a trifling thing as a disconnected aerial binding post, yet the dishonest Service Man would tell the radio set owner that the transformer was burned out, new tubes were needed, etc. Of course after awhile the public became wise to such crude methods and the result was that in the end these radio Service Men were the chief sufferers themselves. What usually happened was that the Service Man who took advantage of radio set owners' ignorance, was never called back a second time and he eventually had to go out of business because he had no more customers left.

In Radio Servicing, as in any other business, it is always the Golden Rule that counts. No Service Man can expect to live and prosper if he does not use up-to-date methods and give his customer a square deal. It is much better for the Service Man to make no money at all on the first transaction because in the end he will get much further with the radio set owner, once the customer finds out that the Service Man merits his confidence.

Applying the Chinese doctors' and dentists' methods to Radio Servicing, it is soon discovered that such methods will in the long run work out most advantageously to the Service Man. Suppose for instance that a Service Man has 100 customers or prospective customers on his list. It should not be too difficult for him to convince them that for a fee of from 50c to $1 per month (depending upon the value of the set) the Service Man or his organization will keep the radio set in perfect working order for the duration of the service. In 9 out of 10 cases, with such a method the Service Man must be "in the money" because in the very nature of things, most repairs that come along are small and inconsequential. Even if a customer has a set that was entirely demolished by lightning, the Service Man could still repair or replace it because he would have had enough income to do so without any quibbling or fuss.

In a running business, it is the volume that counts as well as the law of averages. Out of 100 sets, few will need very extensive or expensive repairs during the course of a year. Of course with this method it is perfectly natural to find that once in a while a customer will take advantage of a Service Man, but again the law of averages works in favor of the radioman because people as a whole are honest in their dealings and the Service Man should experience little difficulty in this respect. Then also, and this is a big point, remember always that a Service Man has a tremendous advantage over the average salesman.

The average salesman has considerable difficulty in getting into people's homes whereas the Service Man is ACTUALLY INVITED into the home. Just imagine how a hard-working vacuum cleaner salesman would jump at such a chance to be invited by his customer, yet the Service Man never takes advantage of this great opportunity. It means that in a large proportion of calls the Service Man can sell the radio set owner many other things besides Radio Service. There are a host of electrical appliances which can be sold to such customers, but of course you must be prepared to show them manufacturers' literature or samples and this should not be a very difficult thing.

"In this manner the Service Man can double or triple his income, so why not try it? The Radio Servicing business is only what you make it. It is only "bad" if you make it so yourself."
THE RADIO MONTH

YOU CAN'T SAY THAT!

The censors and their proponents continued to struggle along, last month, losing out in these United States but booming blithely in Britain.

In the tight little isle, Pearson's Weekly patted itself gently upon the back, last month, because a radio announcer prefaced a program by saying that it was unsuitable for young children. A mother wrote in to comment upon this and to recall that the weekly had suggested some such sort of procedure. The B.B.C. also announced that its radio dramatization of "Dr. Caligari" would be similarly introduced. It's a nice little play—about a madhouse!

Here the estimable Christian Science Monitor, last month, praised Britain's defense of "helpless creatures—children for one class," and quotes a letter from President Byrd of the U. of Maryland, in which he threatens to throw away his 3 receivers if his two sons won't stop listening to blood-curdling programs. Other educators write similarly, one believing the fact that his young neglect their home-work for "the radio." No one mentions (and, possibly, rightly so) that persons who cannot control the actions of their own children might find it a bit difficult to control one of the country's major industries—and no one else seems to want to control it. Anyway, why not let the kids enjoy life? They're much safer getting their thrills in their own homes than they would be sneaking up a back alley with the "Ten Beautiful Art Studies Weekly" or a copy of "Sexy Stories."

But censorship has its opponents, too. One of these is the redoubtable Hugh Johnson, who last month went on to say that even the F.C. Commission's authority to decide whether stations are operating "in the public interest, convenience and necessity" gives it too much power over what may and what must not be said. William S. Paley, President of the C.B.S., widely famed as a public-spirited citizen, suggests that listeners cock a suspicious eye at all attempts to censor the medium which affords them so much entertainment.

The amount of entertainment is, according to Dr. Jay B. Nash, 150,000,000 listener-hours per day. The good Doctor, who is chairman of the Physical Education Department of New York University, last month declared, "It is the moronishness, the stupidity, the inactivity of it (radio), rather than the badness, that gives us the greatest concern." The Doctor is to be complimented upon having made a contribution to the nation's language, if not to its thought, for "moronity," not "moronishness," is the word given in our Unabridged.

TELEVISION COMES ALONG

Television progress is apparently similar to the movement of a glacier—irresistible, but awfully slow.

Best sign of last month was N.B.C.'s announcement of broadcasts to be run 5 hours weekly during the period of a month. These were planned to include thrice-weekly hours of stills and charts for engineers' check-ups, and twice-weekly evening hours of live talent and movie film. Pictures were to be 441 lines on 46.5 mc., with associated sound on 49.75 mc.

The next most important step of last month was the provision of a number of aliases for the cathode-ray and other tubes. Thus, a C-R tube used in an oscilloscope becomes an Oscilatron, while, if used in television, it changes its name to Teletron. An image emitter,
or tube which provides a standard video signal source as reported in April Radio-Craft, is a Phasenjector and an "electric eye" or PE. mosaic pick-up tube for use in television cameras is an Electromalux, and has nothing to do with refrigeration. The Du Mont Laboratories announced their adoption of these names.

In Australia, the editor of a Sydney radio weekly became quite enthusiastic over an announcement last month that John Logie Baird, television inventor, plans to erect a $65,000 station there. His enthusiasm was not shared by Stuart F. Doyle, chairman of the Commonwealth Broadcasting Corporation, who stated that television programs in England are "anything but entertaining," and that the sales of televizers there are less than 10,000 per year. "Unquestionably," says Mr. Doyle, "television will be a most interesting development in the next few years, and it is up to some brilliant organizer to find a way of making it commercial."

Eric C. E. Rogers, director of engineering for C.B.S., returned last month from a trip to England and remarked that British television was good, but that the public was only curious, rather than interested.

The reason for such insular apathy may be revealed in a discussion of television which took place in the House of Commons last month. Member White said that receivers cost too much; Member Simmons added that telly had not been developed "either geographically or technically," and that first-rate artists were not being televised, which meant that programs seemed amateurish. Member Morrison said that the service was being monopolized by London, and that it should be extended to Scotland, Wales and the Provinces.

Meanwhile Marconiphone last month developed a 37-tube televtizer which uses a 3-inch projection tube, working at 20,000 volts, to project an 18 x 22-inch image on a screen. And the B.B.C. advanced plans to telescast the 1938 Oxford-Cambridge boat race and other sporting events. Plans call for the use of mobile units.

In France, work was commenced last month on the installations of underground high-frequency cables, capable of carrying up to 4,000 kc. These cables will link Paris with Limoges, Bordeaux and Toulouse. They will carry television, radio broadcast and telephone conversations simultaneously.

RADIO AND EDUCATION

LEVELAND, Ohio, schools last month began work on a municipal school-of-the-air.

The sum of $42,000 has been allotted to this work, which will include special news broadcasts, broadcasts for children of pre-school age, dramatized school lessons, programs for parents, special events broadcasts, etc.

N. Y. University last month issued an announcement of a summer school to teach preparation and production of radio programs. Besides staging their own shows, students will visit N.B.C., C.B.S. and other studios, will hear lectures, etc. The best student programs will be aired.

(Continued on page 42)
RADIO IN PICTURES

RADIO AFLOAT AT NORTH POLE

Above, and at upper-right, show part of Soviet Russia's 4-man expedition to the North Pole, on an ice floe; icebreakers rescued the men last Feb-

uary (photos reached U.S.A. in April). Radios oper-

ator E. Krenkel is shown (above); inside his radio

station. Touching (upper-right) for a pedal on the

sled-mounted power generator—the wind-driven

power unit may be seen, partly, in background—

for this "furthest North" radio station.

Ivan

Papanin, "Hero of the U.S.S.R."

$35,000 SOUND DISPLAY ON WHEELS!

A 2-point exhibition tour, 7,000 miles, by 3 RCA

officials, in a special Pullman car (A, below),

started last month. Point 1: to show dealers the

many markets for sound products; point 2: to spec-

tacularly show architects, engineers, building own-

ers, entertainment operators, industrial managers,

and school administrators in 24 principal cities of

the United States, the features of new sound equip-

ment. In addition to living quarters, this "itinerant

museum" sports a section (B) for demonstrating

record and film sound and talkie equipment

interphones, school and other permanent sound

systems; and a section (C) for showing portable

sound equipment, various electronic devices, etc.

On the observation platform are mounted mile-

range loudspeakers (arrow, in A, indicates one of

two) to serve up speech and music; same-type units

are finding application, as suggested on joint secure

of Radio-Craft, in the direction of fire-fighters,

ship-to-dock communication, and so-on.

TINY TELEVISION-NEWS CAMERA

We see, at left, how American engineering has

helped perfect European television equipment.

Zworykin's Iconoscope has been utilized to perfect

a television pick-up camera only a foot square and

a half-foot wide! The outdoor television-news re-

porter finds. In this case all the video equipment

he requires, plus a built-in sunshade and dual-lens

focusing device, all in a cast-aluminum case! (The

sound pick-up apparatus, of course, is not included

in this set-up.) A companion small-space television

camera is illustrated on the preceding page, both

cameras being a product of Farnese, A.G. (Berlin,

Germany). Note however that the studio-type camera

is somewhat wider than the outdoor type, and un-

like the latter its television and focusing lenses are

mounted in a parallel plane.

RESISTOR GENERATES INFRA-RED RAYS!

At lower-right you see how a resistor dutifully helps

take its own picture in pitch-blackness! Illustration

serves the dual purpose of demonstrating to ex-

perimenters how infra-red rays may easily be

generated, and how well-made resistors will stand

up under considerable overload. In the test, a

360-ohm Continental Carbon "Ultrawatt"-type re-

istor rated for a normal load of 10 watts was

connected across 118 volts A.C.; and then sus-

pended over the face of the voltmeter recording

the flux potential. An exposure of 30 mins. on

hypersensitized infra-red negative material recorded

the invisible rays radiated by the resistor (over-

loaded 20%), and their reflection from the face

of the meter. (Do you remember? April, '38

Radio-Craft) showed how invisible cathode rays

helped visualise electron flow; and the Sept., '38

issue showed how invisible X-rays made visible

inside opaque containers, faulty wiring, defective

components, etc.)
EUROPE’S UNDECLARED RADIO WAR!

An Englishman tells of the relentless radio propaganda war being fought on the Western Hemisphere.

MICHAEL NORTON

THE use of “wireless” (radio) as a national weapon began during the Great War. In 1916, when the Germans could no longer use their submarine cables, they communicated with their military attaché in Washington by radio messages in code, sent by indirect routes. Unfortunately for them, this code soon fell into the hands of the British.

Toward the end of the War, there was so much use of codes that, when the news of the Armistice was announced from the Eiffel Tower, not in code, several operators refused to believe what they heard, thinking the enemy was playing a trick!

Over here in England, radio sets were forbidden during the War, and it was rumored that listeners had secret antennas fixed in disused chimneys. This may have been true; but I know that a similar thing occurred in Germany just after the War. In the occupied area, the Allies forbade the use of broadcasting and its reception within the area. Some German friends living in Cologne told me that they had an indoor antenna and so did many of their friends. The antenna was taken down when the set was not in use.

The first radio propaganda on a big scale was put out by Moscow. The Russians now broadcast propaganda in about 15 different languages, and they have the most powerful transmitter in Europe. It has the same power as WLW, Cincinnati. Soon, however, the British Broadcasting Corporation is to build 2 powerful shortwave transmitters which will be the most powerful in the world.

The Russians are fortunate in that their time is 2 hours ahead of Central European Time, so that after their own programs, they can use nearly all their stations for broadcasting to the rest of Europe.

The Germans have made great efforts to jam the Russian transmissions. Some German friends of mine had a town house which they were compelled to lease to the secret police. The owners discovered by accident that the police had installed a Störsender, or “interrupting station.” It was intended for the interruption of the transmissions of the Russian station of Minsk, a town less than 50 miles from Russia’s western frontier.

The moment that the propaganda in German starts from the Moscow station, interference begins. On the long waves it takes the form of Morse (code) or a kind of dynamo hum. On the shortwave transmission, the German interference is usually made by the continual playing of a phonograph record. The record is usually one of the waltz Ramona, but the Germans do use one other record, and this is of a slow fox-trot.

I know several Germans who listen to the Russian transmissions. This means that the jamming is not always successful. This is especially noticeable on the short waves, where the skip distance effect may mean that you can hear the transmission but not the interruption. On the medium waves, things are different. Only a few weeks ago, a German told me that he tried to hear the speeches of Herr von Schuschnigg, the former Austrian Chancellor, but that he was unable to because they were jammed by the German authorities.

The most exciting event on the short waves took place last spring when a mystery German station suddenly appeared on a wavelength of 29.8 meters. Some say that it must be outside Germany, but nothing has ever been proved about this station. From 10 till 11 every night, it gives anti-Nazi propaganda, talking, for example, of the “gruesome barbarities of the Hitler regime.” A German told me that the first night after this station was first heard in Berlin, half the population of the town knew about it. The station was said by the announcer to be in Berlin, but it could not be traced.

It was thought that the transmitter was placed inside a car, and the vehicle driven round the town; but when I listened here in England, the signal strength seemed too constant for that to be the case. After a time, the German authorities caused such severe jamming (Continued on page 39).
RADIO CREATES

Mr. Halbran, applying to fashion an amazing and endless variety of patterns created by television facilities, has instituted an entirely new tool for the stylist! Mr. Eichberg's engaging description, of how these patterns—due to a pencil of light moving at lightning speed—may find application in many new fields, will interest Radio-Craft readers.

As told to
ROBERT EICHBerg
By ANDREW W. HALBRAN

TEXTILE designers and others who must produce patterns in infinite variety breathed a sigh of relief when engineer C. E. Burnett of RCA's Television Research Laboratory produced a "radio kaleidoscope" (as the writer dubs it), the heart of which is the good old cathode-ray—or "C.-R."—tube, as used in television and oscilloscope work. (See "New 'Resolution Tester' for Cathode-Ray Tubes," Oct. '37 Radio-Craft—Editor)

As you no doubt know, the patterns appearing on the screen of a "C.-R." tube may be governed by the voltages of various frequencies applied to the horizontal and vertical scanning electrodes. Innumerable patterns can be made to follow each other across this screen, and any that appear to have interesting (i.e., commercial) possibilities can be halted in its mad dash and anchored fast simply by proper manipulation of the controls!

Once it has been observed, it may be altered slightly—or greatly, for that matter—by adjusting the biases (voltages) and frequencies.

Nice though a pattern on a C.-R. screen may look, it is of little value, save to study, unless it can be recorded in permanent form. This is easily done by means of a camera. A photograph of the image is snapped, and that's all there is to it. The tube's controls can be readjusted and a new pattern produced, while the films are developed and the prints sent wherever they are likely to do the most good.

Mr. Burnett is seen with the complete set-up in Fig. A. On the screen there is a pattern which looks much like a series of small cream bottles; it might be suited to sports dresses for country wear or a milkman's uniform, or to paper used to wrap butter, etc. A slight turn of the controls, and the bottle-effect vanishes. The spaces between the horizontal rows of bottles grow larger and the bottles themselves are broken up, while a dotted effect, much like that which would result by weaving a heavy white yarn through a dark background appears to link the larger white blocks. It's practically a Scotch plaid (See Fig. B.), save that
the print is black and white, instead of being in every color of the rainbow, with a few extra added for good measure. As the illustration (Fig. B1) shows, it is an ideal pattern for a guy Tam O' Shanter. And it is also highly suited for use in blankets, golf socks, sport coats, skirts and sweaters—even for the background of the label on a bottle of Scotch!

Did you notice the dots between the blocks? Re-tuning the radio kaleidoscope brings them out as the dominant motif. (See Fig. C.) They make an excellent all-over small-figure pattern, suitable for silk dresses, scarves, neckties, and so forth. (See Fig. Cl.) It is even said that they inspired a wallpaper manufacturer and a producer of china-ware.

RADIO KALEIDESCOPE CREATES "ELECTRONIC SNAKESKIN" PATTERN!

The "electronic snakeskin," used as a pattern for the shoe, may also be traced to a slight re-tuning from the plaid. Its effect is a deformation of the regularity of the blocks, with complete separation between the vertical rows while broken bands run between the horizontal rows. The pattern (Fig. D) may be printed upon or woven into the fabric of which the shoe (Fig. Dl) is made, and a manufacturer has already signified his intention of bringing out such a model!

This finding of patterns through electronic means is by no means an entirely hit-or-miss affair. Research has proven that given frequencies may be relied upon to produce patterns of a certain sort. If, for example, a chain effect of linked lines is wanted, the electronic designer looks at his frequency chart, sets the controls and—presto!—a pattern similar to that used on the bracelet illustrated appears. The basic pattern is seen in two different forms in the accompanying illustrations, Figs. E and F. The former, you will notice, is precisely the design employed in the bracelet (Fig. E1); the latter, which is but little different, opened up an entirely new line of thought. It proved to be the inspiration for a new pattern of decorative stitching, used to edge handbags and wearing apparel. But that was not all! The building and metal industries are expressing their interest in it, for they say it reveals the possibilities of a new type of joint.

Linked lines are also the basis of the basket-weave pattern which the cathode-ray kaleidoscope produces. A designer of women's accessories said, "It will make handbags which are simply fetching, my dear," and promptly drew a sketch (See Fig. Gl.) to prove her words. Designers of draperies also plan to make use of this pattern in black background interwoven with heavy gold thread.

A little shift in the tuning controls breaks up the design into separate dashes which combine to form waves. Notice how the pattern in Fig. H is broken at the edge of the C.-R. tube's screen. A defect? Not at all! The break is utilized as a border for the lampshade shown in Fig. Hi. It gives the logical finish to the design as a whole.

The lines were quite regular in that cathode-ray pattern. Adjusting the frequency robs them of their regularity and provides a new pattern—the zigzag effect of Fig. I. A designer of fans fell in love with it, with the result seen in Fig. II. As the pattern effect is that of a flash, and as it was produced by the use of electronic apparatus, it might be termed the fashion industry's first real Radio Fan.

But the comparatively simple patterns described are not all that this apparatus can produce. It can make (Continued on page 38)
TELEVISION WITHOUT SCANNING?

Will telescopes and periscopes replace our present complicated television scanning apparatus? A well-known television pioneer leaves the beaten path and reasons out a new television concept. Compare Mr. Sanabria’s observations with those of another forward-thinking technician, Mr. W. E. Shrage, whose article, "Ultra-Ultra-Microwave 'Radio' of the Future," in the January 1937 issue of Radio-Craft, too, discards many hide-bound ideas.

U. A. SANABRIA

EVERY television worker has gazed, in his dreams, upon the El Dorado of a television system without scanning. The development of spot-by-spot scanning systems with all of their associated difficulties often cause the tired engineer to think about a system which has none of these objectionable scanning features.

AN ANALYSIS OF PROBABILITIES

When we talk to a television engineer about the possibility of eliminating scanning, he will usually pass off your question with a smile of aloofness and imply that this possibility belongs to fiction writers. One can point out numerous examples in industrial history which reveal that ideal systems in theory are seldom resolved into practical devices. The gasoline turbine which eliminates reciprocating parts for automobile engines has never been perfected; the continuous running film camera and projector without intermittent movements for motion picture science has never displaced the regular jerking mechanism (or has it?—Editor); the flapping wing airplane which takes off and lands like a bird has never been a competitor of the propeller and rigid wing system.

Such illustrations are the thoughts of the pessimist who represents the modern version of the man who thought that the automobile would never displace the horse, or the commonplace observation that "You can’t stop a roaring train with wind" prior to the development of the air brake. In contrast with the above examples we find many seemingly ideal devices: the water turbine, the steam turbine, the induction motor, the circular saw, and hundreds of other examples of how fuss and commotion have been eliminated by the hard work of engineers who believed fundamentally in the slogan, "We can always improve."

The late Clarence Darrow explained that he stopped to analyze carefully the accuracy of his thoughts when he found himself agreeing with the majority in any controversial matter. He was convinced that "The majority is always wrong." He reasoned that basically, higher intelligence is a characteristic of

U. A. SANABRIA

RADIO-CRAFT for JULY, 1938

Fig. 1. Fundamental optics of the predicted television system. Extreme simplicity prevails.

Fig. 2. A periscope in the home window picks up the transmitted television signal!
NEW RADIO SERVICE "CAR"

120 miles to 1 gallon of gas! That is economy which Service Men will readily appreciate. This Motor Scooter and side-trunk is a practical "buggy", especially for suburban use.

G. E. DeNIKE

SINCE the day the Chesterfield cigarette girl suddenly burst forth on posters throughout the nation, posed on a new kind of a contraption which looked like a motorized scooter, popularity of this mode of conveyance has risen by leaps and bounds.

Throughout the country, spread the fad of getting about on these zippy little motor horses. It didn't take long for local merchants to realize that here was the ideal low-cost transportation for light deliveries if some sort of a carrying device could be attached to the conveyance.

The manufacturers of these Motor Scooters quickly grasped the significance of this situation and set their engineers to work, developing the kind of models needed for commercial application. They soon produced several models—of which the best one for radio Service Men is illustrated.

The handsome trunk built into the side-car position offers plenty capacity for the transportation of—least equipment, tubes, manuals, parts, tools, complete small radio sets and large radio chassis and speakers.

Here indeed is the answer for the Service Man to his problem of cutting down the transportation expense involved in service calls.

LOW-COST TRANSPORTATION FOR SERVICE MEN

The maintenance of one of these Motor Scooters is scarcely more than that of a bicycle. The Service Man can ride from 100 to 120 miles on a gallon of gasoline, license costs are at a minimum and it takes very little "elbow grease" to keep the unit sparkling like new—which helps a lot to attract and hold the attention of prospective customers.

(Continued on page 54)

AMERICA'S RADIO COLOSSUS

Here are some interesting and revealing facts, which seldom come to the attention of the general public, concerning Radio's largest and most far-flung organization.

This indeed is one of the most widely spread and owned corporations.

In its structure this organization has some of the finest brains in the country, some recent additions being former Vice-President of the United States, General Charles G. Dawes; and the eminent Engineer and President of the J. G. White Engineering Corporation, Mr. Gano Dunn. To give an idea of its many ramifications we will refer briefly to the principal events which have taken place since the first of this year as outlined at the 19th Annual Meeting of the stockholders of RCA.

FINANCIAL TRANSACTIONS

In accordance with its recently-established policy of concentrating its investments within the United States the company, during the months of January and February, sold its Japanese and Canadian stockholdings. Its holdings in the Japanese Company (Victor Talking Machine Company of Japan, Ltd.) were sold for $2,000,000. This transaction, however, included an extension of licenses, resulting in continuing royalties paid to RCA. Against this amount the company thus far received $1,750,000 in cash, the balance of $250,000 falling due January, 1939.

(Continued on page 59)
SERVICING UNIVERSAL A.C.-D.C. RECEIVERS

By special permission of National Radio Institute Radio-Craft is pleased to present an outstanding article, of exceptional importance to the average radio Service Man, which appeared in a recent issue of N.R.I.'s house organ National Radio News. This article is of unusual value to the practical man not only because it describes time-saving procedure but also because it explains in detail just why this procedure is preferable. Service Men will do well to actually study this article.

J. B. STRAUGHN

ONE of the most common types of receivers brought in for servicing is the "cigar box" type universal A.C.-D.C. receiver using a T.R.F. circuit with 4 or 5 tubes. Sets like these have been widely distributed over the entire country and have been sold at extremely low prices. Since manufacturing costs must obviously be kept down when a receiver complete with tubes is to sell for less than $10, low-grade parts are often employed. Breakdowns are frequent, and Service Men are expected to make prompt repairs.

Unfortunately for the customer, it costs very nearly as much to repair one of these small receivers as a larger set.

When a customer hears the estimate of service costs, he generally explains: "Why, I can buy a new radio for less than that!"

This is true, sad to say, but the business-like Service Man will point out that the parts in the new receiver will be no better than those in the old one, and the same trouble will undoubtedly develop in a short time. On the other hand, if the old receiver is repaired, using first-class parts which the manufacturer could not afford to employ, excellent results may be expected. The cost of service work on one of these sets should really be considered a part of the purchase price, for the value of the receiver will be increased in exact proportion to the value of the new high-grade parts. Such a line of reasoning seldom fails to bring in the job at a high enough price to give the Service Man a fair profit.

Although this article deals primarily with the servicing of "universal"-type (or A.C.-D.C.) T.R.F. receivers for which circuit diagrams are not obtainable anywhere, the procedures described apply equally well to these T.R.F. receivers when circuit diagrams are at hand, and will also prove of value in servicing universal A.C.-D.C. superheterodyne receivers.

The signal circuits of a midget T.R.F. radio set are extremely simple. Generally there is one stage of radio-frequency amplification using a 6.3-volt supercontrol pentode tube such as the 7S, 6I6 or 6K7. The former two types have the same base and are interchangeable, while the latter uses an octal base.

The R.F. amplifier feeds into the detector, which uses a pentode tube having a sharp plate-current cut-off characteristic. Interchangeable, type 6C6 or 77 tubes, or the octal-base 6J7 tube will generally be found in the detector stage.

The audio output of the detector is fed by means of resistance-capacity coupling into the power output tube, which is generally a type 4D pentode. This tube in turn feeds the loudspeaker; although a dynamic loudspeaker is more often used, you will occasionally encounter a magnetic speaker.

In some sets one or more dummy tubes will be found, with only the filaments connected into the circuit. As long as the filament circuit is not open, the condition of a dummy tube is immaterial; in fact, defective tubes are often used originally by the manufacturer to keep costs down while making the customer think he is getting a larger receiver.

TYPICAL "UNIVERSAL" CIRCUIT

In Fig. 1 is shown the typical signal circuit arrangement of an A.C.-D.C. T.R.F. receiver. There are several peculiarities which should be noted; these are: (1) the chassis may not be an electrical part of the circuit, in which case the ground symbols simply indicate that the parts so marked are connected together; (2) the screen-grid of the R.F. tube generally has the same potential as the plate; (3) an external ground connection is not used because one side of the power line (which connects to the receiver circuits) is grounded; (4) the small coil connected to the primary of the R.F. coil windings provide capacitative coupling in addition to the usual inductive, primary/secondary coupling.

The aerial for a midget set is usually of flexible wire, permanently attached to the set and connected to the receiver input circuit through a small tubular or mica condenser. This aerial wire may be grounded to a water pipe or other external ground, in which case the R.F. signals picked up by the ungrounded side of the power line will flow through the primary of the 1st R.F. transformer, then through the antenna condenser and the aerial wire to ground. The R.F. signals passing through the primary induce a signal voltage in the secondary in the usual way.

If the chassis is an electrical part of the circuit and the line cord plug is inserted in such a way that the chassis connects to the hot (ungrounded) side
of the power line, you may get a shock when you touch the chassis if some part of your body is grounded. If you get a shock, reverse the line plug if the source is A.C.; this will connect the chassis to the grounded side of the power line. In the case of D.C. power you cannot reverse the plug, for that would make polarity incorrect; you will simply have to avoid standing on a concrete floor (a good ground), and avoid touching any grounded object while working on the set with power on. With either A.C. and D.C. power, never make a direct connection from the chassis to an external ground, for this may short-circuit the power line and blow the line fuse.

**TYPICAL A.C.-D.C. POWER SUPPLY**

Figure 2 shows a typical power supply circuit used for both T.R.F. and superheterodyne universal A.C.-D.C. sets. A 25Z5 tube is connected as a single half-wave rectifier, but where the low voltage is energized independently of the receiver circuit, there will be a separate connection to each cathode and an extra filter condenser connected directly across the loud-speaker field, as indicated in the dotted circle at the top in Fig. 2.

The tube filaments in a universal receiver are wired in series, with each filament requiring 0.3-amperes. The filaments of the type 25Z5 and 43 tubes require 25 volts each, while the 6D6 and 6CG7 series require 6.3 volts. This makes a total of approximately 63 volts, and means that the filament voltage-dropping resistor must drop 115 - 63, or approximately 52 volts since 0.3-amperes flows through this resistor, it will have an ohm value of 52 ÷ 0.3, or approximately 175 ohms.

If pilot lamps are used, they are usually placed in series with the voltage-limiting resistor. Each lamp is operated at about 4.25 volts, and hence the required voltage drop across the limiting resistor is reduced by this amount. Two pilot lamps connected as in Fig. 3A reduce this required voltage drop by 8.5 volts. (Although the lamps are rated at 6.3 volts, they are operated at 4.25 volts to prevent burn-out on surges.)

Pilot lamps are always shunted by resistors, for these lamps do not draw as much current as the tube filaments. The shunt resistance will be equal to the shunt current (the difference between the 0.3-amperes filament current and the pilot lamp current) divided into the voltage across the lamp or lamps.

**Pilot Lamp Color Code.** On A.C.-D.C. sets, only 2 types of pilot lamps are ordinarily used; these can be identified by the color of the glass head through which the filament-supporting wires pass. A maeda No. 40 lamp with a miniature screw base draws 0.15-amperes and has a brown-colored head. A maeda No. 46 lamp with a miniature screw base draws 0.25-amperes and has a blue bead, while a maeda No. 44 lamp with a bayonet base also draws 0.25-amperes and has a blue bead. A third type of lamp, having a white bead and drawing 0.20-amperes, is infrequently encountered. Replace burned-out lamps with new lamps having the same bead color and voltage rating (6.3 volts). You will occasionally find 2 pilot lamps connected in series directly across the 110-volt line, with no shunt resistor across them. These will be 110-volt Japanese lamps similar to those used on Christmas trees. They are connected in series to operate at half-voltage, thereby having longer life while still giving sufficient light to illuminate the receiver.

**Types of Filament Resistors.** Various types of filament voltage-dropping resistors are used in universal A.C.-D.C. sets. Many of the earlier models use ordinary wire-wound resistors mounted under the receiver chassis. The chief disadvantage of these is that the heat which they radiate causes deterioration of nearby receiver components, chiefly the electrolytic condensers.

Line cord resistors, having the resistance wired dead-end in the box and placed in the line cord along with the usual 2 copper wires, are now widely used because they keep the dissipated heat entirely out of the chassis. Line cord resistors are exactly identified by the fact that they have 3 leads (or 2; the resistance wire is connected to one of the line wires, the connection being made directly to one of the prongs on the line cord plug. The line wire which connects to this same prong may be identified with an ohmmeter, and always goes to the rectifier plates. The other line wire will go to the ON-OFF switch which is mounted on the volume control of the receiver.

When a receiver which uses a line cord resistor is in operation, the line cord becomes quite hot, but this is natural and is no cause for worry. Never attempt to shorten the line cord when it has a built-in resistance, for this would reduce the resistance value and affect the operation of the receiver.

Ballast tubes are even more satisfactory than line cord resistors for filament voltage-dropping purposes. These tubes can now be secured with either glass or metal envelopes, the metal envelopes being the more popular. The resistance element is mounted inside the envelope and connected to prongs on the tube base. Oftentimes taps are provided, with connections to tube prongs, to eliminate need for separate pilot lamp shunt resistors; an example of a ballast tube having one tap for this purpose is shown in Fig. 3B.

When a ballast tube burns out, always replace it with another having exactly the same number. This is necessary because the tubes are made with many different ohmic values and with many different arrangements of prong connections. Ballast tubes become very hot while in use, but as the heat is above the chassis, critical parts in the receiver are not damaged.

Service Men are sometimes asked to replace line cord resistors with ballast tubes; space limitations make it advisable to attempt this, for midget receivers are quite compactly constructed. Incidentally, an ohmmeter provides the quickest way to identify the various prongs on a ballast tube.

**Rectifier Circuit Variations.** A single 1223 rectifier tube or even a type 37 triode with grid and plate connected together may be found in a circuit arrangement like that in Fig. 4. Since supplying field excitation to a dynamic speaker would place too heavy a drain on the rectifier, you may expect to find a magnetic loudspeaker in a receiver having this power pock circuit. The 0.01-mf condenser connected across the power line tends to prevent interference from entering the receiver by way of the power line. Oftentimes a 2,000-ohm, 1-watt resistor is used in place of the more efficient but bulky and more costly filter choke, as indicated inside the dotted circle in Fig. 4.

Sometimes you will find a circuit which uses two 1223 tubes connected in place of a single 25Z5; the circuit will be the same as that in Fig. 2 except that the 2 diode sections of the rectifier tube will be in separate envelopes. The filaments of the two 1223 tubes will be in series and will together be electrically equivalent to the filament of a single 25Z5 tube. This gives the set an extra tube and is therefore an advantage from a sales standpoint. The (Continued on page 46)
SERVICE MEN?—
REPAIR YOUR CUSTOMERS’ SETS
“BETTER THAN NEW”!

A Service Man of over 12 years’ experience, and who for the past few years has personally supervised an average of about 1,500 jobs per year, gives you the benefit of his practical experience. Most important of all he shows you in simple, straightforward fashion wherein lie the moneymaking possibilities of radio service.

GEORGE W. HALDER

MOST radio Service Men look upon themselves as technicians of unquestionable merit who, as a whole are very much underpaid, very much abused and very much under-rated. They believe that they belong to a higher strata of humanity affiliated with the geniuses of the mechanical industry. Why? Because, with the aid of several hundred dollars’ worth of scientific instruments, they can cause a silent radio set to once more give forth raucous sounds, which they proudly explain to the customer, is the same reception one had when the radio set was new.

They believe that by merely replacing a punctured condenser, or an open resistor, they have accomplished a miracle and “repaired” a radio receiver. Probably the variable condenser plates are dirty, the bearings dry and squeaking, the volume control noisy, the speaker rattles now and then, the resistors have changed value up to 50% of their original tolerance, but what of that, their job is done—the “radio” is once more running.

So it is sent back to the customer, and the customer wonders why he had to pay so much money to have a 25¢ part replaced. The customer was probably told he would need it anyway, and of course it is as good as new, and he finds that it is not much better than before it stopped, so, and not without some justification, he calls the radio service business a “racket,” and the next time he has trouble he calls the janitor, or some high-school boy, and probably gets an equally good job for one-fifth of the cost.

THE “SCREWDRIVER MECHANIC”

Service Men wonder why business is not as good as it could be; probably an analysis of their shop methods will explain a lot! Thousands of dollars’ worth of business is lost every year to the part-time worker, and the screwdriver mechanic, who operates from his cellar, or attic, repairing his friends’ “radio,” and just as long as he can turn out as good work as a professional shop, just that long will he continue to do a thriving business. Every dollar’s worth of work done by this type of mechanic represents a loss of $3 to $5 to a legitimate shop. The only way to stop this loss is to turn out work of such excellent quality that he can no longer hope to compete with you—and educate the public to the fact that your work is worth the difference.

No workman in any line of industry is really expert until he is conscientious enough to work on every job, until he has an open mind ready to receive new thoughts, and methods which might be an improvement on his methods, and until upon completion of a job he can honestly say, “This job, barring the customer’s restrictions, is perfect, and as good as new.”

It is not sufficient to just repair a set, it must go back to the customer’s home performing as good, or BETTER than it did when he first bought it. This means a satisfied customer, and a satisfied customer will talk, and word of mouth advertising is the most powerful type of advertising in the world.

Of course there are plenty of shops with full equipment and competent technicians in charge, who turn out perfect repair jobs, but on the other hand there are countless hundreds of shops which turn out very poor work, either through lack of ability, or probably the greater evil, insufficient knowledge of proper servicing methods.

The author has been actively employed in radio service work for over 12 years, for the past few years has personally supervised about 1,500 jobs a year, and naturally enough has developed a certain technique for the handling of these jobs. In the following chapters he will endeavor to take the reader through the servicing of a superheterodyne chassis, using his methods.

SAYS THE AUTHOR:

“The extra preliminary work herein described takes time, so does the proper adjustment of the selectivity curves; but if it makes for satisfied customers, you get fewer call backs, and you are perfectly justified in charging more for your work.

“Don’t be ‘price conscious,’ cleaning and adjustment as described herein is worth $5 to anybody’s money and when you return the radio set to the customer you are proud of your work. Tell him what you have done, explain it to him while you install the chassis in the cabinet, tell him about the oscilloscope. He may not admit to you that the set is any better, but how he will brag about it to his friends—and that is what makes good business—a satisfied customer giving you free advertising every time anyone mentions ‘radio.’”

MODERN EQUIPMENT ESSENTIAL

The radio service shop must, of course, have a complete assortment of testing equipment. The days of a radio shop built around a single analyzer, and a tube tester, are definitely over. Essential equipment is recognized as a good A.C.-D.C. voltmeter, calibrated oscillator, modulator and cathode-ray oscilloscope, tube tester equipped with sound, and some sort of audio oscillator. Probably the most important piece of equipment, and the one that is seldom found in a shop is an air compressor, with flexible tubing attached to an air nozzle, for blowing dust out of the radio chassis. Compressed air is the only way of reaching into the trimmer condensers, coils and switches, for the removal of dirt. Last, but not least, a bottle of Russian (or “mineral”) oil, and a camel’s-hair brush.

The first step is to remove all tubes, wipe them off with a damp cloth, and test these tubes thoroughly; if the tube tester is equipped with sound, rap the tubes severely with a small rubber hammer to locate weak joints and shorts.

With about 80 pounds of air pressure, blow the dust off the chassis, and from between the variable condenser plates; 20 or 30 pounds pressure can be applied to the trimmer condensers, and coils without fear of injuring these parts if a little care is used. This cleaning of the trimmer condensers is very important; dust collects between the multiple plates of these small condensers and due to speaker vibration will shift back and forth, sometimes expanding the adjustment and at other times shifting out, thereby increasing the capacity, and this makes plenty of difference in the overall performance of the radio due to changing the acceptance curve of the intermediate frequency amplifiers, and of course causing the oscillator to drift off frequency, and changing the dial setting.

Probably the two things that impress a customer most is a clean chassis, and a tuning dial that is adjusted right on the dot. If a local station is on an assigned frequency of 1,400 kc—that is where he has a right to find it, if a local low-frequency station is at 570 kc, that is where the pointer should rest when the station is properly tuned-in. Of course the author understands that the radio
set probably never did tune on-frequency, but that in your job, it means a more satisfied customer, who will be a booster for you.

Cleaning the loudspeaker calls for a different procedure. First loosen the cone centering screws, allowing the cone to float freely, then connect 110 V, A.C. across the field coil, then do not elevate the pole piece of any residual magnetism and allow you to blow out not only dust but any metal filings that may have collected in the air gap. Air pressure for this purpose will vary from 30 to 80 pounds, depending on the type and size of the speaker cone. Do not be afraid of blowing the voice coil apart; if it does loosen under the strain of the air pressure, it needed repairing anyway and would have buzzed or rattled at certain frequencies. Loose voice coil wires can be cemented together again with speaker cement, but if there is an air space between the voice coil wires and the paper form upon which they are wound it is best to replace the entire cone. Reassemble the speaker, using shims on both sides of the voice coil, i.e., inside and outside.

**THAT BOTTLE OF "SERVICE OIL"**

Now we come to the bottle of oil. Most of you are dubious or openly skeptical as to what value oil is in the servicing of a radio chassis. Sort of makes a person think of greasing a automobile, but try this method once and you will always use it. Remember, this oil is not a common oil, it is especially suited to our needs; it will pass no current, it will not detract from B.P. gain at high or low frequencies, it does not become gummy, and it does wonders in a noisy or "intermittent" radio receiver. Did you ever have a noisy carbon volume control in the grid circuit of a tetrode tube? Did you ever remove the back cover plate of one of these controls, and notice the number of metal-to-metal contacts that carry the contacting arm on the resistance element to the center terminal on the case? Try a little mineral oil, applied with a camel's hair brush to these contact points; don't be too fussy—the oil will not harm the resistance element, but be sure it reaches 'way in to the center of the circular contacting member. Now try the volume control in the circuit. Quiet! Just like silk, probably better than a new one. One-tenth megohm, or higher value resistance elements seldom wear out, but the brass connecting contacts do get dirty and oxidized. One application of this "service" oil takes care of these points for years to come, by preventing further oxidation. Of course if the control has a defective resistance element, nothing can be done satisfactorily other than replacement, but this only happens about once in 20 times.

Every movable part in the radio set—rheostats, potentiometers, wave-band switches, supporting bearings for whatever mechanism—should be treated with a touch of oil at the bearing point only; do not be too liberal, a little oil applied at the right point is far better than having oil leaking all over the chassis. The variable condensers get their share on both end bearings, and on the brass contacting strips, also put oil under the brass strips where they contact the divisional shielding plates. On old or badly oxidized condensers it may be advisable to scrape or sandpaper the divisional plate before applying the oil.

Next apply oil to the pins of every tube before inserting them in their sockets, this will clean the sockets; connect the speaker to the chassis, and plug the line cord in the A.C. outlet, turn the current on and measure the high voltage from the rectifier plates to ground, to determine if both sides of the power transformer are equal and of approximately proper voltage. Next insert the rectifier tube and let the radio set run while the balance of the tubes are replaced; this allows the radio receiver to be subjected to excessively high voltages from the power pack for a short time, and if a part is definitely weak, it is much better to have it break down in the shop than in the customer's home a week later. If tube shields are used, a little oil applied to the part that contacts the chassis ring will insure a good contact and perfect shielding.

Now we have come to the point where the average mechanic begins work, but we know that tubes, contact elements, etc., are in perfect condition, and that if a noise or some other disturbance is noticed after operation is restored to the chassis, that it is definitely a defective part, and valuable minutes will not be wasted in searching for a poor contact in a wave-band switch or something of similar nature. As far as the testing of a "dead" radio set is concerned, probably anyone's method is as good as the author's. Usually the procedure is to check for approximately 200 V. between ground and the plates of the A.F. output and R.F. plates, then for proper screen-grid voltages and so on. Any shorted condenser causing voltage loss is easily found, as is an open resistor. Replace any defective parts with suitable replacements, making the parts mechanically secure before soldering. After operation is restored, turn off the current, and quickly check the bleeder, coupling and bias resistors for tolerance; replace any that deviate more than 20% from the original specifications.

**ALIGNMENT**

Now we have reached the point where we must align the tuned circuits. Never align a chassis while it is cold, always let the radio set under test run for at least 15 minutes before attempting any alignment adjustments, this same applies also to the oscillator and modulator. Set up the oscillator to a 10 kc. frequency-modulated signal on the I.F. of the receiver and align the I.F. stages according to the manufacturer's instructions, but flat-top those curves. Be absolutely sure you give the customer at least a 10 kc. band-width in the I.F. stages. He bought the radio set primarily for tone quality, and real enjoyment of local broadcasts. Don't send (Continued on page 58)
SERVICING

Continuing the discussion from Part I, two typical electro-mechanical tuning systems are here described for the benefit of all Service Men. Pushbutton tuning is here to stay ... get acquainted with it now, while it's yet new.

PART II

CHARLES SICURANZA

UNDER the general classification of Mechanical Systems of Pushbutton Tuning, we encounter some of the simplest mechanisms in the smaller sets while in the larger sets, we find some of the most intricate and high-precision assemblies ever seen in a radio receiver.

MECHANICAL BUTTON TUNING WITH MOTOR DRIVE

The Stewart-Warner, 18-Station Magic Keyboard mechanism is an example of mechanical button tuning with motor drive. A front view of the Keyboard assembly is shown in Fig. B. The complete mechanism is unusual in several respects and its operation and setting up differ radically from the previous examples cited. Figure C shows the rear view of the mechanism.

As can be seen, 15 stations may be set-up, from the front of the receiver, without tools. Once the buttons have been set up, stations may be tuned-in almost instantly because the dial pointer travels directly to the desired station. In previous descriptions of motor tuning, it was seen that the dial pointer often had to travel the full length of the dial, reverse and return to the desired station. By utilizing an eccentric cam of special design for each button, the driving motor is made to turn clockwise or counter-clockwise, depending upon which station-button is pressed.

As with other modern systems, the station buttons do not have to be kept pushed-in by hand. The button is pushed in and all the other buttons are released automatically, so that even if two or more buttons have been pushed in at one time, all are released by pressing down any other free button. In this connection, it is interesting to note that if two buttons are pressed-in together, the dial pointer will move to the nearest of the two stations and stop.

With other systems, the dial pointer will keep on moving across the whole length of the dial, back and forth, until a third button is pressed, to release the two previously depressed buttons.

Another unusual feature is found in the Manual tuning changeover. In this system, there is no knob to turn when either hand or button tuning is desired. The slightest twist of the tuning selector knob disengages the cam assembly, releasing any depressed button and extinguishing the light signal reading "Automatic" while the Band Indicator and Visual Tuning Indicator light up. The A.F.C. voltage is always turned off for hand tuning and automatically turned on for button tuning.

Hand tuning is of the "spinner" type, effected by means of a weighted flywheel at the end of the tuning knob. This knob does not turn when the set is button-tuned—as it does in other motor systems.

SETTING UP STATIONS

To set up stations on the keyboard, use the following step-by-step procedure:

1) Allow the set to warm up for 20 minutes so that all parts will reach a constant temperature.

2) Remove the large station tuning knob by pulling straight out, exposing a small set-up knob on the same shaft.
PUSHBUTTON TUNING SYSTEMS

(3) Grasp this set-up knob and pull it out as far as it will go, rocking it slightly so that the gears will mesh properly.

(4) The set-up knob should next be tuned to the right (clockwise). The knob will turn rather stiffly and the dial pointer will travel over to the right side of the dial scale. After the dial pointer reaches the right extremity of the dial scale, continue to turn the set-up knob clockwise about ¼ turn until a definite stop is reached.

(5) Push any button you wish to set up for a station. There need be no relationship between the position of the button on the keyboard and the station on the dial. Be sure the button is pushed all the way in. You will note that as the button is pushed in, the word “Automatic” will appear illuminated on the small indicator at the right side of the dial, and the keyboard mechanism will instantly move the dial pointer to some spot on the dial scale, according to the previous setting of the mechanism. This need have no relation, however, to the station for which you desire to set the button.

(6) Grasp the set-up knob again and tune the receiver to the desired station. Tune carefully and watch the dimming reactor tuning indicator for the point of least illumination so that the set will be accurately tuned to the station.

(7) The depressed button is now set to the station and should be labelled at once with the proper tab. The next step is to release the button set-up, and this is done by simply pushing in the next button you desire to set-up.

(8) Then tune in with the set-up knob the next station you wish to receive for the button that is now depressed, again making use of the Visual Tuning Indicator to be sure that you are correctly tuned to the station.

(9) Continue to set up as many other buttons as desired in the same manner: that is, push in the button, tune in the desired station, then push in the next button, and so on.

(10) In order to release the button which last remains depressed (the last one you desire to set up), grasp the set-up knob and push it back into the cabinet as far as it will go and then pull it out again. Do not forget to rock the set-up knob slightly when pulling it out, to properly mesh the gears.

(11) Turn the set-up knob to the left (counter-clockwise); the knob will turn rather stiffly and the dial pointer will travel over to the extreme left side of the dial scale. Continue to turn the set-up knob to the left even after the pointer reaches the end of the dial scale. Apply a firm pressure until the knob reaches a definite stop.

(12) Push the set-up knob back into the cabinet again and put on the large knob that was originally pulled off. The Magic Keyboard is now completely set up for operation.

TROUBLESHOOTING THE "MAGIC KEYBOARD"

Some of the troubles which may occur in the Stewart-Warner models 1845 to 1869—which use the Magic Keyboard—are as follows:

Button Does Not Stay In or Does Not Release: Kickout pointer tip improperly adjusted. Kickout spring bent down too far. Insufficient tension in Key stop bar return spring. Star wheel stuck or not moving freely on tuning shaft. Kickout tip jams against star wheel. Stuck or jammed pawl or key.

Pointer Does Not Move When Button Is Pushed: Reversing contacts on back switch not closing. Motor stalled due to mechanical overload and clutch not slipping. Motor runs but pointer does not move, due to clutch slipping. Pointer drive gear slipping on shaft or out of mesh. Motor does not hum and tuner does not move with button in, due to power contacts on back switch not closing. Power contacts on side switch not closing. Bakedite back switch operating cam binding contact arms or out of position.

Pointer Moves But Does Not Tune Station Properly: Due to improper setting-up of mechanism or not locked up tightly. When no signal is heard it may be due to Mute contacts not opening. Gang condenser drive-gears out of mesh or slipping on shaft. If signal is not heard clearly it may be A.F.C. contacts on back or side switch not opening or A.F.C. not functioning.

Motor Continues to Run when pawl does not fall far enough into station selector cam to cut off power to motor. Pointer stops at a different place each time for a certain button, due to pointer drive gears slipping out of mesh or on shaft. Mechanism not locked up tight or left-end bearing bracket loose.

PHILCO AUTOMATIC DIAL

While it is true that pushbuttons are not used in the Philco dial, nevertheless there are modifications of this same mechanism using buttons, employed by other manufacturers.

As used in the Philco sets, the dial may be set up to tune in 15 or more stations. The method to use in setting up stations is as follows:

Remove the 2-piece tuning knob and the 2 flat-head screws which hold the circular metal plate to the tuning shaft hub. The dial control screws and station tab slits are now exposed. Tune the set to the lowest frequency station, and press in (with a screwdriver) the dial control screw which is nearest to the bottom of the dial. With the screw pressed in, rock the screw left and right until a click is heard. When the click is heard it denotes that the control screw finger has engaged in the tuning gate and the dial escutcheon will move the dial scale back and forth with the motion of the screwdriver. Tune the desired station as accurately as possible with the screwdriver pressed in and then release the screw.

(Continued on page 40)
NEW CIRCUITS
IN MODERN RADIO RECEIVERS

The details of the modern radio receiver circuits that make them "different" from previous designs are illustrated and described each month by a well-known technician.

F. L. SPRAYBERRY

(1) MOST EFFECTIVE AC-DC POWER SUPPLY

Crosley Model 647. Uses voltage-doubling for A.C., obtaining high voltage without a step-up transformer and switches field to one-shunt connection for D.C. providing maximum D.C. available.

In Fig. 1A will be seen the familiar 2-section 2525 rectifier with the plate of one section connected to the cathode of the other section. The remaining cathode thus becomes the high-voltage positive lead while the remaining plate is the high-voltage negative lead. The no-load output voltage is double the A.C. peak input voltage, and the exceptionally large filter condensers (50 mF each) are required, as they must store the complete power between them every half-cycle. They are alternately charged in parallel and simultaneously discharged in series by the load.

For D.C. operation the field is shunted across the line in series with one section of the ballast resistor so that it will carry the correct current, leaving one rectifier section free so that no unnecessary voltage drop will occur in the high-voltage supply. The change from A.C. to D.C. operation is made by switching as indicated in the figure.

(2) A.V.C. WITH POWER DETECTION ACHIEVED WITH NO DIODE OR ADDITIONAL APPARATUS

Fairbanks-Morse Model 5A. Although very much simplified, the circuit has the advantages of diode operation and A.V.C. using only a triode.

The 2nd-detector acting as in Fig. 1B as a power detector with a near-cut-off bias, half-wave rectifies the I.F. signal in the grid-cathode circuit resulting in the grid becoming negative in proportion to the signal strength. The top end of the grid return resistor thus becomes negative in proportion to the I.F. carrier strength in the circuit. A large condenser value (0.25-mF) filters this to essentially pure D.C. and it is used for A.V.C. The positive I.F. pulses or alternations carry the signal to the plate where the I.F. variations are smoothed out by means of the 0.001-mf. condenser; the audio component then remains.

(3) HIGH-GAIN DIRECT COUPLING ACQUIRED WITH CONVENTIONAL TUBES

Emerson Models AR-171, -65, -66, -73, -74, -76, -77, -80 and -85. The simplest possible direct coupling between the next to last and output stages is required in these sets with no auxiliary parts, ordinary plate voltage and conventional triode tubes.

A type 76 input tube of the amplifier in Fig. 1C is arranged to draw its cathode current from the grid of the output tube. Its plate is directly connected to "B+" so that as its grid varies at A.F. the plate current variations will bring about cathode voltage changes. The load for this tube is the grid-cathode circuit of the output tube. The output grid must remain positive at all times and the tube must be fitted for operation at minimum distortion when thus operated.

Grid variations of the 76 cause amplified cathode variations in it. Grid variations of the 6AC5G tube must identically follow these variations of the 76's cathode (the two elements being directly connected); subsequent amplified signals then appear at the output plate.

(Continued on page 56)
MODIFYING OLDER SETS TO RECEIVE THE 4 HIGH-FIDELITY STATIONS

Service Men are finding new earnings in modifying older sets to receive the programs of these superlative broadcast stations.

ROBERT COBAUGH

The Federal Communications Commission announced on December 19, 1933, that it had allocated 3 double-width channels of 20 kc. each in the 1,500 kc. to 1,600 kc. band for experimentation in high-fidelity broadcasting. These channels are 1,530 kc., 1,550 kc. and 1,570 kc.

At the present time only 4 stations throughout the entire United States are licensed to operate in this band! They are: WQXR, New York; KPMC, Bakersfield, Calif., both on 1,550 kc.; KXBY, Kansas City, Mo.; and WBRY, Waterbury, Conn., on 1,530 kc. The 1,570 kc. channel has not been assigned to date. The results of these experiments have shown that high-fidelity broadcasting is successful and practical. (See "High-Fidelity on Short Waves," in January, 35, Radio-Craft, and the February, 35, issue, page 456, for illustration and description of WQXR and the equipment used to obtain and maintain a station frequency fidelity characteristic substantially "flat" from 25 cycles to over 15,000 cycles.—Editor)

All of the new sets on the market and those built within the past 5 years, take in this band. Some of these sets have an additional band from 1,500 kc. to 3,000 kc. for the reception of police and amateur stations, and it is possible to use this second band to pick up these high-fidelity stations. However, about 20% of sets in use today are over 5 years old, and do not include the 1,500 kc. to 1,600 kc. band. (Below 1,500 kc., though, are 4 stations which are free from the "crosstalk"—see Fig. 2—encountered on the higher wavelengths.—Editor)

Although a great number of new sets are being sold, there is a large number of people who, for one reason or other, cannot or will not buy a new radio, but are quite willing to spend a few dollars on their own in order to make possible the reception of these stations. Many Service Men will find that they can profit by this situation. It may, in addition, mean the sale of a set of tubes and possibly an antenna installation. Although the older receivers are not able to reproduce the extended tonal range that the newer type of receivers are capable of, they nevertheless will give good reception of excellent program material available. Ninety-five per cent of the radio sets manufactured before the year 1929 were unable to tune above 1,500 kc. Approximately 15% did not even reach 1,400 kc. due to large stray capacities such as shielded grid leads, etc. The improved design of radio receivers in recent years has made it possible to build sets with a tuning range from 550 kc. to 2,000 kc.

ADJUST THE TRIMMERS

Most sets are equipped with padding condensers and trimmers having a range of capacity from 10 to 40 mmf. The most satisfactory way to extend the high-frequency tuning range is by adjustment of the trimmer condensers. (See Fig. 1A.) The ratio of the trimmer capacity to the main condenser capacity will determine the percentage of error introduced into the original dial readings. The error will be greatest at the high-frequency end of the dial and will decrease toward the low-frequency end of the dial by reason of the increasing ratio of the large variable capacity to the smaller fixed trimmer capacity. Adjustment of old sets using 3-element tubes such as the type 26 tube is not always satisfactory because of the poor selectivity of such circuits, especially at the high-frequency end of the dial where the C/L ratio is so low.

REMOVE TURNS

In some cases where the set is not equipped with trimmer condensers it may be necessary to take turns off each coil.

(Continued on page 88)
ANY advances have been made in A.F. amplifier design in the past year or so—to mention just a few, the beam-power tube, negative feedback, volume expansion, infinite baffles, peri-dynamic and bass reflex baffles—each of which has its place in the development of really high quality reproduction of music and speech. Such an amplifier equipped with good tweeter (high-frequency) and woofer (low-frequency) speakers in an acoustically-treated auditorium or theatre is far better than that obtained with all but the best of modern radio receivers.

This statement may bring the wrath of some well-known radio engineers down around the writer's ears, but it is true—as critical listeners can verify. And also true is the fact that a radio receiver is capable of the same high fidelity as that obtained from audio amplifying systems, from the better stations—if certain existing conditions imposed by the listening public can be dispensed with. And these conditions can easily be removed by any rabid seeker after high quality.

It was with these thoughts in mind that the writer set about to design and construct a tuner unit which—without being too complex—would have fidelity characteristics equal to those of a good, modern, Public Address amplifier.

First, a good deal of research was done among the commercial circuits, books and other sources of information on "high fidelity." Many circuits were analyzed and some were built into bread-board setups to answer certain questions. Finally a combination of well-known circuits, some old and some new, were chosen and built into a tuner which satisfies all conditions.

NEGATIVE MUTUAL COUPLING

First, the well-known "negative mutual coupling" system of tuning which was used in the Western Electric 10A receiver was chosen. This selector system consists of 4 tuned circuits coupled into 2 pairs of band-pass filters by means of "negative mutual couplings" and capacity in such a manner that a substantially constant band of frequencies is passed, over the entire broadcast band. In other words, if the coupling is such that a 10-kc. band is passed at 550 kc. practically the same band separation will be indicated at 1,400 or 1,500 kc. In addition, the pass-band can be easily changed by simply varying the capacity of the coupling elements.

The tuned circuits are over-coupled and while this results in the usual curve of resonance peaks with a dip between, the dip is less than 2 db. which is taken advantage of in flattening the over-all acoustic output of the set, amplifier and speakers. (The last mentioned ordinarily has a dropping off of output at high frequencies which are compensated-for, to some extent, by slight exaggeration in the tuner.)

INFINITE-IMPEDANCE DETECTOR

A new type of detector is attached to the R.F. end of the receiver. This detector has been named the "infinite-impedance detector" by the RCA Laboratory, where it was designed. This new form of demodulator displays improved characteristics over the diode which—up to now—has been considered in one form or other the criterion in detectors.

The diode has the disadvantages of reflecting a definite—and unfortunately rather low—impedance back into the preceding tuned circuit, thus preventing selective characteristics to be utilized. Also, it is capable of a maximum of some 80% modulation, thus cutting off some of the modulation peaks of a deeply-modulated signal. And last but not least, it resulted in actual attenuation of the signal—instead of a signal voltage gain as found in most detectors.

Contrasted to this, the "infinite-impedance detector" reflects very high impedance back into the preceding tuned circuit—it thus permits full selectivity to be realized. It is capable of practically 100% modulation—thus being a better detector than the diode, and it produces a signal gain instead of loss!

Some explanation has been given to the detector as, in the writer's opinion the detector is the bottle-neck or weak link in the chain of individual parts which make up a "hi-fi"

How to Make

Latest developments in radio tuner design are incorporated in this new 4-tube instrument—for the radio set builder, P.A. specialist and Service Man—for the faithful reproduction of local radio programs.

C. W. PALMER
A HIGH-FIDELITY TUNER

- Tuned-Radio-Frequency Circuit
- Negative Mutual Coupling
- Adjustable Band-Pass
- Infinite-Impedance Detector
- Tone-Compensated Volume Control
- Automatic Volume Control
- Visual Tuning Indicator
- Monkey-Chatter Frequency Trap
- Controlled Flat-Top Response
- Individual Voltage Dividers

radio set. However, no theoretical explanation of the action of the "infinite-impedance" detector will be given since an article probably will appear in this publication shortly, giving full data on this new and improved demodulator.

TONE-COMPENSATED VOLUME CONTROL

Following the detector is a form of volume control which has become popular in Europe, but has been neglected in the U.S. in favor of bass boosters, bass compensators and speakers which exaggerate bass response.

This is the "tone-compensated" volume control which consists of a potentiometer tapped part of the way down its resistance with an inductance, capacity and resistance connected between this tap and ground.

The A.F. filter thus formed is tuned to a low audio frequency—about 40 cycles—to increase the low-frequency gain at low volume levels where exaggerated bass response is desirable (for instance, to compensate the falling characteristic of the human ear to low-frequency response at low intensities).

On higher volume levels, bass compensation should not be necessary—or desired—so that the bass boosters sometime employed should not be required. Experiments verified this assumption—at least as far as the writer's ears are concerned.

The set is equipped with a small degree of A.V.C. though no attempt is made to completely control the gain of the R.F. end of the set—with the thought in mind that complete control would introduce harmonic distortion. In conjunction with this partial A.V.C., a tuning-eye tube is included to permit accurate tuning to facilitate obtaining the high quality possible with the tuner.

The final unit of the set is a 10,000-cycle filter consisting of a tuned trap in the output of the detector to eliminate the "monkey chatter" (cross-talk) which would otherwise be heard in any of the metropolitan areas where the local stations are separated by only 10 kc.

CONSTRUCTION

From the above sketchy outline of the set's make-up and background it can be seen that much effort and thought have been given to the design and selection of the parts which go to make up the tuner.

Some readers who have become used to the superheterodyne circuits which constitute 9 out of 10 of our modern receivers, may question the use of a T.R.F. circuit in this tuner. The answer to this question is that where constant pass-band can be obtained in a T.R.F.-type set, in a receiver that is designed particularly for "local" reception, and where a flat-topped response that is readily controllable can be obtained, there is no need to increase the complexity of the set by introducing "frequency shift" (superhet) circuits.

An examination of the circuit (Fig. 1) of the set shows the various parts which have been discussed; plus a few which have not been mentioned, such as the use of an untuned coupling circuit between the 2nd R.F. stage and the detector, the use of a dual-triode in the detector circuit, one section of which is the infinite-impedance detector and the other the diode A.V.C. rectifier.

It will be noticed that individual voltage dividers are used for the screen-grid feed circuits. This is done to avoid further delaying the cut-off point of the R.F. tubes so that they will be as linear as possible consistent with the needed remote cut-off action.

The cathode of the 1st R.F. tube is biased with a 300-ohm resistor which permits full amplification of weak input signals at this point. A 600-ohm resistor is used for the 2nd R.F. stage, to prevent overloading at this stage on large input signals. This difference is desirable due to the incomplete A.V.C. action in the set.

The inductance for the compensated volume control can be made at home if desired, or a 420-millihenry coil may be obtained. As shown in Fig. 2, the coil (Continued on page 41)

Fig. 3. Circuit of a high-fidelity amplifier which will do justice to the quality of the signal obtainable from the high-fidelity tuner.
"BI-FONIC"

Not since the "infinite baffle" made its appearance has there been the marked progress, in the principles of sound reproduction, exhibited by this new system — IN WHICH THE BACKWAVE IS UTILIZED.

THE job of a loudspeaker is to reproduce all musical instruments, the human voice and various other sounds, with as little deviation from the original as possible.

To build a loudspeaker which would accurately reproduce one musical instrument is a man-sized job; to build a speaker which will accurately reproduce a whole symphony orchestra is truly asking for a Twentieth Century Aladdin's lamp.

If we are to reproduce accurately the various musical instruments, is it not logical that we MUST use the same basic principles of tone generation in our speaker as are used in the various instruments? These fundamental principles are as follows:

FIRST — Every instrument is composed of 2 elements.
1. The vibrating element. (Such as the string of the violin, the reed of the saxophone, the string of the piano, etc.)
2. The phase-inverting and tone-developing element. (Such as the tone box of the violin, the sound board of the piano, the air column of a trumpet, etc.)

SECOND — Every instrument has an air displacement in ratio to its place in the musical scale. For example, in the string instruments, the violin, viola, cello and bass violin each operates in a different section of the scale and as they progress downward in frequency they get larger. The bass viol is not louder than the violin but its notes are much heavier. This same principle applies to any other family of musical instruments.

THIRD — No instrument contains any means of absorbing the back-wave of the vibrating element. Where the back-wave exists, its envelope is inverted by being reflected from a soundboard, or by being resonated in a tube.

Using these principles as guide posts, and having studied music for 9 years, the author started experiments in speaker
SOUND MAGNIFIER

ROBERT LIVINGOOD

design, over 2 years ago, which have culminated in the creation of what he terms Bi-Phonic Reproduction (Hereinafter spelled "Bi-Ponic."—Editor). See Fig. 1, which illustrates the improved frequency response and increased volume this system achieves.

BASIC PRINCIPLES OF BI-PONIC REPRODUCTION

In the Bi-Ponic Reproducer, shown complete in Fig. A, a conventional cone acts as the vibrating element. The Reproducer acts as the tone-developing element. Together they consist of a box having a cross-section as indicated in the phantom view, Fig. B. The surfaces enclosing the cone are broken up with a series of half-round wood strips. The surface directly in back of the cone, as shown in Fig. C, is composed of several series of alternate vertical and horizontal half-round strips of wood. A slot is left between the bottom and back surfaces. This slot feeds into the first of 3 parallel "tubes" of equal length and cross-section, and constructed of wood, but having end-plates of "lignin plastic" (masonite).

Before explaining the theory of operation of the Bi-Ponic Reproducer, the author desires to stress that each of these theories was checked, in both theory and practice.

FIRST—In a body of air of given temperature and pressure, sound travels in a straight line and can be reflected like a ray of light.

SECOND—The band of audio frequencies reflected can be controlled by regulating the size of the reflecting surface.

THIRD—If 2 air columns of the same length, material and cross-section are made to resonate at the same frequency, but 180 degrees out-of-phase, the resulting audio output—providing the tubes are laid side-by-side—is zero.

Using these theories, the following functions take place in the Bi-Ponic Reproducer.

(Continued on page 50)
MATCHING TO TAPPED

A. COBLENZ

One fact is obvious immediately. The watts power consumed at Z-1, or delivered by Za equals 3 x 0.5, or 1.5 watts. The watts power at Z-2 is 10 watts, and that at Z-3, twice 3 watts, or 6 watts. That makes a total of 17.5 watts, so that the amplifier can take care of the drain.

Now, it can be shown mathematically, that Z of any tap Watts sec. tap supplies as Z of its load Total Sec. watts As it is unnecessary to just waste the additional 2.5 watts, the primary will be designed to supply 17.5 watts. In formula form:

\[ Z_s \cdot P_t \]
\[ Z_o \]

Where P-t represents the watts power consumed at any one tap, and Ps equals the power in the secondary, or supplied by the primary,—17.5 watts. (The losses in the transformer are neglected.)

Or, Zs equals P-t x Zo/Ps.

Thus, for tap a, its impedance is then 1.5/17.5 x 1.667 equals 141 ohms, approx.

For tap b, Z-b equal 10/17.5 x 10, or 5.76 ohms (approx.).

For tap c, Z-c equals 6/17.5 x 7.5, or 2.57 ohms (approx.).

Now that's all very well indeed, but how do you know you're right, and where does the reflected impedance shine in? And what is "reflected impedance" anyway? And what do you mean by saying that the impedance of the secondary tap is such and such number of ohms? One at a time, please.

WHAT IS "REFLECTED IMPEDANCE"?

Definition: Reflected impedance is the resistance in ohms, at the particular frequency under consideration, which the plate or plates, of the output stage face, resulting from the load placed across the secondary. Please note that if the secondary load is 0, so is the reflected impedance.

Now about this impedance question. When the impedance of a unit is specified in audio work, some manufacturers mean that the impedance has been measured at 60 cycles, others 400, still others 1,000. That is, Z equals 2pI fL, or 1-2pI fC, and therefore, unless f is specified, Z can be anything from 0 to infinity! Following the practice of the majority, in specifying Z at a low frequency, and letting the impedances take care of themselves, as they will, for higher frequencies, and also from considerations of convenience, f is considered as 60 cycles. However, even if not specified, all that is necessary is to bear in mind that all impedances are measured in terms of the same frequency, and, as ratios of Z are most important in audio work, the frequency will cancel anyway. So, when we say the impedance of the secondary tap is x ohms, we mean that 2pI fL equals x ohms. f being 60 cycles, and L, referring to the inductance when leakage, mutual inductance, etc., are all figured in. Now to show you where the reflected impedance harps in!

Every radio man knows (or should know!) that Np/Ns as Ep/Es (primary-to-secondary turns ratio equals primary-to-secondary voltage). He also knows that Np/Ns as Vzp/Zs (primary-to-secondary turns ratio equals the sq. root of the primary-to-secondary impedance ratio). But do you know that the impedance a tap on the secondary reflects into the primary bears the same relation to its load as the impedance of the primary (as the tube plates see it), bears to the impedance of that tap?

Stated in formula form: Zr/Zo equals Zp/Za. You will note that Zp appears in this formula, and it might look like a case of circular reasoning. But it isn't. For each tube, or tubes, for optimum efficiency, there exists a Zp and
LOUDSPEAKERS
TRANSFORMERS

Many heretofore unpublished "mysteries" of input, output and reflected impedance are here divulged, by a N.Y.C. Police-radio technician, for radio and Public-Address men.

The loads on the secondary are always designed so that this is taken care of. While each tap will not reflect, per se, 6,000 ohms, or Zp in this case, into the secondary, all combined together, their reflected impedances functioning in parallel, will reflect the correct impedance. Witness:

Zra equals 6,000 x 1,667/141 or 70,200 ohms (approx.).
Zrb equals 6,000 x 10/5.7 or 10,560 ohms (approx.).
Zrc equals 6,000 x 7.5/2.57 or 17,520 ohms (approx.).

Now we'll just put these 3 in parallel, and presto! we get 6,000 ohms within 1 or 2 per cent, allowing for small inaccuracies in the arithmetic.

A USEFUL NEW EQUATION

There is another method, a simpler one, although the one above is really quite neat, if you care to delve into the mathematics behind it. This second method takes voltages, and ratios, as follows:

Since E equals VZp, the voltage at the primary, and that at the various loads is readily computed. Thus:

Ea equals V1.5 x 1,667 or 60 volts
Eb equals V10 x 10 or 100 volts
Ec equals V7.5 x 6 or 67.5 volts
Ep equals V17.5 x 6,000 or 324 volts

Now we'll just recall one of the formulas every radio man should know, shown above. Namely:

VZp/Zs equals NP/NS equals Ep/Es and obviously Zp/Zs equals Ep/Es

And away we go:

Za equals 2,500/10,500 x 6,000, or 141 ohms
Zc equals 100/10,500 x 6,000, or 5.7 ohms
Zd equals 45/10,500 x 6,000, or 2.87 ohms, remarkable, my dear Watson. But to check, you must go back to our old friend shown above, namely Zp/Zs equals Zp/Za.

The author cannot refrain from noting, in conclusion, that this last given formula he has never seen or heard of, from any one, and no publication that has come to his attention, after exhaustive hours in the 42nd St. Library, Technology Division, has even hinted of its existence. That it is a logical outgrowth of the well-known formula of turns-ratio and impedance-ratio is granted, but just in this form, so useful for these common computations, he has never seen it.

"WATTLESS" or "QUADRATURE" POWER

One more very interesting observation. To such misguided, but well meaning, radio men who picture impedance matching as x ohms across x ohms, the sight of, say, 1,667 ohms across 141 ohms, as in tap A, or of 2.57 ohms across 7.5 ohms, as in tap C, must be a horrible sight indeed. It has been the author's experience that radio men picture impedance matching as ohms for ohm, and allay their objecting con-sciences by saying, "Well, I'm talking impedances, ain't I?"

But please consider this: A pure inductance or capacity neither absorbs nor gives out power. It is only the component of current in-phase with voltage that represents power loss, "the component in quadrature" is what we call wattless, or "quadrature" power. You do not match impedances to that because it has no power to deliver. True, the component of current in quadrature with the voltage increases the resultant current, and increases thereby copper and other losses. But, in power transfer, you only match to the component of the inductance which represents actual power, its current in-phase with the voltage, and the impedance of the entire inductance is not entirely effective in delivering power. Hence, the fact that 141 ohms is paralleled by 1,666 ohms, or 7.5 by 2.57, does not of necessity indicate a mismatch. In fact, this particular system as given is quite well matched.

EXAMPLE OF SEEMING MISMATCH

To illustrate even more strikingly an arrangement which the average radio man would immediately condemn as a glaring example of poor engineering involving a mismatch, consider the following diagram (Fig. 1B). By actual measurement, at 60 cycles, Zp equals 20,000 ohms, Zs, 5,000 ohms, and Zt, 1,500 ohms.

Every radio man knows that for maximum power transfer from tube to output, the load Z must equal Rp. Now what self-respecting power tube, in common use, and delivering 2 watts, or more, say, has an Rp, or rated load Z, for maximum output as given in tube charts, of 20,000 ohms? All right, you say for "optimum fidelity" the load should be twice Rp? Fine. Look at your tube charts, and see that for power tubes as common as 6L6, 10, 50, 45, 2A3, 2A5, and, of course, for higher power tubes as used in transmitters, Rp varies from 1,500, to 5,000. Thus (and the same tube charts will also tell you this), for stated output, the load Z approximately equals double this value. And what's worse, look at the secondary—Zs is equal to 5,000 ohms; and load, 1,500. How awful! Well, it isn't awful, and there is no mismatch here; in fact, it's a mighty good matching arrangement! Let's see:

According to the little formula involving reflected impedance as given above, the impedance reflected into the primary as a result of the load, is 1,500/6,000 x 20,000, or 6,000 ohms. (Continued on page 51)
UNIFIED P. A. EQUIPMENT

In this article the author answers 2 questions: (1) in what way does modern sound equipment differ from earlier apparatus; and, (2) in what manner does modern sound equipment help increase earnings?

HARRY PARO

HAVING grown from an experiment to a mature industry, the Public Address business now requires that sales and merchandising procedures, and even technical problems, be handled differently than they were only a few years ago. To maintain a proper level of profit, the identical Public Address job is done differently than it was in the past, and on a far more business-like basis.

For example, it was common enough in earlier days to spend $50 worth of time experimenting over a rental installation that paid only $50 altogether. A job of that sort might be summed up this way: value of time, $50; true value of equipment rental, $25; sales cost and overhead, $25; $100 worth of value given, $50 payment received. By considering his time and skill worth nothing, the P.A. man just broke even; by charging his P.A. overhead and sales costs to other business activities, such as Radio Repair or Sales, he might delude himself with the fictitious idea of a $25 "profit". That was one of the inevitable penalties of pioneering; and not all loss, for the P.A. man who undertook such deals was at least acquiring experience in a field which (then) was not so well known.

PUBLIC ADDRESS GROWS UP

Profits today are more substantial. The entire business is on a different basis. For one thing, there is more of it, and overhead, charged properly where it belongs, is minimized by division among a much larger number of P.A. rentals and sales. Sales cost also is lower; there is more competition, but much less canvassing among a disinterested public inclined to regard P.A. as an unreliable toy. The general public now knows and wants P.A. and competitive features are provided by the manufacturers of equipment at no appreciable cost to the P.A. merchant, as will be seen.

Above all, there is practically no need now for experimentation on the job, except in extraordinary cases. (Continued on page 52)

WAX & OIL CONDENSERS IN RADIO SERVICE WORK

Given a defective radio set, with trouble traced to a defective wax- or oil-dielectric condenser, what steps would you take to determine the capacity, rating, or other unknown data, needed in making replacement?

WILLIAM BAILEY

In servicing radio equipment of modern design, let us assume that faulty condensers are found without much trouble. We will deal strictly with the next step—that of determining the type of unit causing the disruption of operation. For instance, there are (referring to the dielectric material) wax, oil, mica, electrolytic and air (trimmer) condensers.

In this article we will consider only the first 2 types, "wax" and "oil." It is obvious that there is a marked electrical difference between these 2 types, although their physical appearances, as the illustration above of representative types shows, are not so different as to facilitate their identity.

Of course, if the unit is plainly and properly marked, there is little trouble today in securing the replacement, providing the set being serviced is one of reputable make. However, should this means of identification be lacking, it then becomes the Service Man's job to find out the electrical characteristics of the unit itself, namely: capacity tolerance; inductive and non-inductive sections; and whether the unit is a "wax," "oil" or "electrolytic."

CHECKING FOR "WAX" OR "OIL"

Many wax and oil units closely resemble electrolytic condensers in external appearance. The Service Man should make absolutely sure which are electrolytic and which are wax- or oil-impregnated units before attempting to make any definite replacement. This can easily be accomplished by checking the leakage through the condenser. If the leakage is in the order of milliampere, it is of the electrolytic type. If in the order of microampere, it is paper.

In making tests, the Service Man should test for open-circuits, short-circuits or, should the condenser be of a dual nature, shorted sections. Other possible conditions to be checked are: shorted section with ground; high terminal leakage; oil or wax leakage; and, overloading due to some high transient setting up a peak voltage, when the peak (Continued on page 54)
OPERATING NOTES

—ANALYSES of RADIO RECEIVER SYMPTOMS

RCA Victor 121, 122. Intermittent reception on these models has been traced to open-circuiting 0.05-mf. bypass condensers, employed as grid filters in the R.F., 1st-detector—oscillator and I.F. secondary-return circuits. The intermittent condition is characterized by a sudden drop in volume and resonance hiss. In one instance, an open-circuited I.F. grid filter condenser introduced a certain amount of motorboating and oscillation upon the high frequencies.

When any one of these receivers is serviced for the complaint of stations being received at two points about 20 kc. apart with distortion between these two points, check the I.F. grid filter condenser for a short-circuited or leaky condition. These symptoms will be apparent only with the volume control turned well up when this failure occurs. See Fig. 1 for location of these condensers.

Bertam M. Freed

RCA Test Oscillator Type TMV-97. When this instrument goes "dead" you will find the primary winding of the modulation transformer "open" which is caused by electrolysis arising out of the difference of potential between the core and the primary winding.

In replacing the transformer it is best to remove the difference in potential between the core and the primary winding by insulating the core and the mounting strap from the chassis by using suitable fibre washers, and by wiring a jumper wire from the mounting strap to "B+" so that the core is at the same potential as the primary winding, thereby eliminating a source of electrolysis. It is suggested that this precaution be taken before the instrument goes dead.

Leo J. Draus

Airline 62-106, 62-107, 62-121. Where a condition of very low or no D.C. voltage at all exists at the tube socket terminals, check for a shoted 0.1-mf. tubular bypass unit connected from the plate supply lug of the 3rd I.F. transformer to ground. This condenser is rated at 400 volts and is really connected in parallel with the first filter condenser (10 mf.) at which point the voltage surge exceeds 400 volts each time the set is turned on. Be sure to use a 600-volt replacement. See Fig. 2.

Airline 62-134, 62-139. Another short-lived tubular bypass condenser is found in these models. This is a 0.25-mf. unit rated at 200 volts and is used in parallel with a 6 mf. electrolytic condenser from screen-grid to ground. Replace with a rating of not less than 400 volts.

Apex 7. In these receivers above Serial No. 1,074,054 the oscillator 600 kc. trimmer has been omitted and is replaced by a condenser of fixed value. Quite often this condenser will lose some of its original capacity and cause very weak reception from about 750 to 550 kilocycles.

If this condition is encountered, replace this condenser with approximately a 775 mmf., mica-type unit shunted by various small capacities beginning with 20 mmf., until the right combination is found, or better still, add an 85 mmf. trimmer in parallel with the 775 mmf. condenser and adjust for maximum signal at approximately 600 kc.

Atwater Kent 82. Noise when chassis is tapped, similar to that of a microphonic tube. Coil shield over I.F. transformer may be loose. This must be absolutely tight. It is wise to drill these shields to pass an aligning tool. Replace shield, and bolt or solder it to chassis. Check alignment of I.F. trimmers at 130 kc.

Ephophone 84-1. Oscillation not due to dirty condenser wiping contacts or faulty bypass condensers may be cured by replacing the 0.5-meg. resistor from detector screen-grid to ground. This resistor is the smallest one mounted on the resistor panel and when open will increase the detector screen-grid potential by about 15 volts, thus producing circuit oscillation and low volume.

Victor I. Dudley

Majestic 15, 15B. A common complaint with these receivers is a dead set due to open I.F. transformer primaries. This is apparent by a lack of plate voltage at the autodyne detector or at the I.F. amplifier.

A peculiar motor-boating hum at the extreme low-frequency end is due to an open input filter condenser. Inspect the grounding connection before removing the unit. This condenser may blow, the 80-tube's plates will then get red-hot.

The grounding plate at the rear of (Continued on page 55)

Fig. 4. Chevrolet Model 500, 565; the dried-out 10-mf. electrolytics replaced with single 8-mf. unit.

Fig. 3. Spartan Model 912; open A.F. transformer bridged with resistor and condenser. Works OK.

Fig. 2. Airline 62-106; replace shorted 0.1-mf. condenser with one rated at 600 V.W.

Fig. 1. RCA Victor Models 121, 122; intermittent reception traced to open 0.05-mf. bypass condensers in the grid-return circuits of the Antenna, R.F. and 1st I.F. circuits.
USEFUL CIRCUIT IDEAS
Experimenters: Here is Your Opportunity to win a prize for your pet circuit idea, if it is new, novel, and useful.

AWARDS IN THE CONTEST
FIRST PRIZE $10.00
SECOND PRIZE 5.00
THIRD PRIZE 5.00
Honorable Mention

HONORABLE MENTION
RESISTANCE-CAPACITY BOX. I have been a reader of your publication for a number of years and enjoy it very much. I am hereewith enclosing a diagram of what I term one of the handiest pieces of equipment around our shop. As can be seen from the diagram any resistance value from 200 ohms to 5 meg., may be had by merely setting the switch; but in addition to this, any one of these values may be varied to any desired value by the variable control in the right hand leg of the circuit. The 3 decks make it possible to name a deck for low values of resistance, a deck for high values, and a deck for condensers which means that the whole thing is in one box, with only one switch. See Fig. 4.

A neat, 3 scale dial plate can be drawn for the switch and the volume controls may be calibrated or the regular pies saved purchased for them.

When repairing a set I manipulate my condenser switch for different values of condensers at different points of the receiver. You will be surprised at how much improvement you can make in the receiver with a few extra condensers.

A another place where the condenser resistor box saves time is in cases of open or low value resistors. If you are in doubt about a resistor of high value and your ohmmeter will not measure that high, then use a resistor switch to the value needed and go directly across the resistor in doubt. You also sometimes you will find an open resistor which is in color-coded and the service manuals do not give the value. From your tube characteristics chart or other data may determine what voltage or current you should have, call a volt or current meter to the circuit and place the test lead directly from your condenser resistor box across the open resistor and vary the resistor switch until you find a resistor that gives you the voltage or current wanted, if necessary you may cut in the volume control and bring the exact amount of resistance in. Also you can experiment with resistors in load circuits and greatly improve a receiver.

You will find many additional uses for this condenser-resistor box.

E. A. MARCHANT

HONORABLE MENTION
HOME-MADE VERSATILE TEST METER. Here is my pet circuit of a very useful instrument which can be used in many different ways. Am submitted here is a circuit short-cut in your contest. See Fig. 2.

First the 6-5 (or any other voltmeter with suitable scale) may be used externally from your meter and 1, 4 may be used to increase range of volt- meter. Also 1 and 5 may be used for next high- est range adjustment of all services in each.

(Continued on page 40)

30

RADIO-CRAFT for JULY, 1938
A WIRED-RADIO "NURSEMAID"

Does Baby need a diaper change? Is Baby breathing normally? Every mother is a logical prospect for this "Nursemaid," which gives instant reports of remote happenings. Saves steps.

HERE, illustrated above, is a variation of the wired-radio type of inter-communicator, in which only 1-way operation is possible, which Radio-Craft has termed the "Wired-Radio Nursemaid."

This 2-unit, super-sensitive sound amplifying system utilizes at the pick-up end a "Guardian Ear" which contains a condenser-type microphone, speech amplifier, and modulator-oscillator circuit as shown pictorially by inside view in Fig. A and schematically in Fig. 1. The generated signal is conducted—from baby's room, let us say—by means of the lighting circuit—to mother in the kitchen, perhaps—and intercepted by the "Radio Nurse" unit shown by inside view in Fig. B and by diagram in Fig. 2. The latter unit is composed of a detector, audio amplifier and reproducer.

Total amplification from microphone to speaker is on the order of 500,000 times. This gain provides a measure of sensitivity capable of amplifying the slightest sounds. Being purely a sound amplifier no attempt is made to attain high fidelity or high power output. This device is NOT an inter-communicating system nor intended to be used as such. Its use is primarily for the nursery or sick room. Any attempt to obtain great volume by speaking loudly directly into the Guardian Ear will result in serious distortion and speaker rattle.

To test or demonstrate the Radio Nurse elsewhere than in a home the Guardian Ear must be placed in a soundproof box or separate room. This will prevent howling or feedback which normally results from an amplifier where the speaker and microphone units are in close proximity.

The R.F. carrier of 300 kc. is generated by the oscillating S.G. and plate circuits and coupled to the light (Continued on page 38)

INTRODUCING—A 5-METER CONVERTER

At long last we are able to announce a self-contained, add-on converter which enables any T.R.F. or superhet. receiver to tune-in 5-meter experimental programs.

MOST radio sets today are capable of tuning-in not only the extended broadcast band of about 540 to 1,570 kc., but also one or more short-wave bands. However, very few modern radio sets are capable of tuning-in stations below a frequency of about 30 megacycles (10 meters).

An add-on unit which therefore is welcome, and which makes it possible to receive stations transmitting in the 5-meter (50-megacycle) region, is the 2-tube "5-meter converter" here illustrated pictorially (Figs. A and B) and by diagram (Fig. 1).

Of what use is this converter?—What sort of stations will this converter tune-in?—Does any special interest attach to the programs of these ultra-shortwave stations? We will brief the replies to these questions.

1) A converter of the type here shown affords a particularly convenient means of transferring 5-meter signals to a wavelength slightly below the standard broadcast band. The converter is completely self-powered and is interposed between the regular antenna and the broadcast set. Consequently it is unnecessary to tamper with the inside wiring of the set either to supply power to the converter tubes, or to connect the converter to the input circuit of the regular radio set.

(Continued on page 49)

RADIO-CRAFT for JULY, 1938 31

Fig. A. It's now easy to tune-in 5-meter music on broadcast sets.

Fig. 1. A simple but effective converter circuit is used.
THE LATEST RADIO EQUIPMENT

Technicians utilize this department to keep posted on the newer and better ways of doing things in Radio, Electronics, and Public Address.

NOVEL SET DESIGN INCORPORATES UTILITY (1615)

WHAT is said to be an entirely new thought in radio cabinet design is here illustrated (top, exterior; bottom, interior). The "miracle dial" is concisely designed to facilitate reading from any sitting or standing position; the scales and numerals are clearly calibrated and the entire dial floodlighted. The loudspeaker has been styled to match. Chassis utilizes 6 tubes and an A.C.-D.C. superhet. circuit, for American and foreign reception. Has A.V.C, tone control, bemi power tube, jeweled band indicator.

NEUTRALIZING CONDENSER HAS MICROMETER ADJUSTMENT (1616)

A NEUTRALIZING condenser with a capacity range of 2 mfd. to 8 mfd., and a precise means of adjustment, is now available for the radio amateur and experimenter. Plates are 5/16-in. thick, and ground and polished to provide for maximum breakdown voltage with minimum spacing between plates. A knurled lock-out holds the movable plate rigid.

IMPROVED ADD-ON RECORD PLAYER (1617)

(RCA Manufacturing Co.)

THE MODEL R-93-C, new low-priced record player, here shown, is designed to provide a good-quality record reproducer for new converts to recorded music and for high school and college student record enthusiasts. The Service Man easily converts this unit into an electrically-operated radio receiver. Device incorporates lightweight crystal pickup; tone arm is true-tracked; newly developed motor has bearings and supports cushioned in rubber for long life; volume control and power switch are in one unit.

ADD-ON POWER STAGE (1618)

(Allied Radio Corp.)

THERE is now available in either 25-W. or 60-W. rating a power stage which may be added to any existing radio set or P.A. amplifier. Allows proportionate increase of output power without the expense of purchasing an entire new amplifier. Both units employ 2 type 6L6G beam power tubes, inverse feedback, built-in driven stage, speaker selector switch and facilities for using any P.M. dynamic or self-excited electrode-dynamic speakers. Tube complement: 25-W. power stage—1-6N7G, 2-6L6G, 1-5EG4; 60-W. power stage—1-6R8, 2-6L6G, 1-5V4G, 1-83.

MIDGET TRANSFORMERS GET MODERNISTIC COAT (1619)

(Amplifier Company of America)

A COMPLETE series of compact audio-frequency transformers, designed for all circuits operating up to a ±10 db. level, has just been announced. These units employ a permalloy core and are designed for frequency response of ±3 db. between 40 and 13,000 cycles. Dimensions, 1 1/2 x 1 1/2 x 2 inc. Special units are designed to order; and with (illustrated), or without, modernistic-styled magnetic shield.

PUBLIC ADDRESS TUNER KIT (1620)

(Meissner Manufacturing Co.)

HERE is a practical, sensitive P.A. tuner you can build yourself and which will give high-fidelity reproduction of broadcast programs. Frequency range is 530 to 1,650 kc. The T.R.F. circuit uses shielded iron-core R.F. transformers and 4 grant- tuning condensers; also provided are A.V.C., separate output channel for headphones monitoring, manual audio gain, and tone control. Detector output adaptable to any audio (power) amplifier input circuit. Incorporates 3-XK7, 1-6H6, 1-4P6G, and 1-524 tube. Measures ½% square x 1½ ins. deep; permits 2 units to be mounted in a single relay rack panel. Tuner is self-powered, 110 V., 60 cycles.

With this kit you can build high-grade radio reception into sound distribution systems for schools, hotels and other public gathering places.

NEW 70 TO 100 WATT "TRANSPORTABLE" SYSTEM (1621)

(Wholesale Radio Service Co., Inc.)

THE 70 to 100 W. transportable system, in a new line of coordinated sound equipment suitable for the largest indoor and outdoor installations, is shown. Especially designed for easy remounting in various installations; the complete system, including amplifier, 2 microphone floor stands, A.V.C. terminals, P.M. speakers, all cables, etc., is contained in 3 handsome, airplane luggage-styled cases finished in Spanish brown leatherette with contrasting dark-brown striping.

The amplifier occupies its own case and features 4 beam-power tubes, A.V.C. and automatic volume expansion, automatic "eye" output indicator, complete mixing and fading facilities for 4 input channels (including 2 high-gain and 2 low-gain), "neo-dial" controls, variable tone control. A total of 14 tubes is used in the 4-stage circuit.

PORTABLE P.A. SYSTEMS GO TO HIGHER POWER (1622)

Newest in cabinet touch-up kits are sold by dealers and Service Men is the "right swanky" unit here illustrated. Kit contains quantities of the various cabinet refinishing items used on all types of cabinets as well as all kinds of lacquer finishes in general. The kit is furnished complete in an attractive leatherette carrying-case. The dimensions are 6½ x 12½ x 11-5/16 in. long. Complete instructions for use of the 22 different items in the kit as well as repair procedures for various types of cabinet-finish troubles are supplied.

THE LATEST RADIO EQUIPMENT

At last one manufacturer has altered conventional receiver design in presenting the above illustrated set. (1615)

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NEW UNIT CONSTRUCTION IDEA IN AMATEUR RADIO TRANSMITTERS (1623)
(The Hammarlund Manufacturing Co., Inc.)

MECHANICAL arrangement of amateur transmitters has always presented quite a problem, since not all amateurs have available the equipment necessary to make the variously-shaped pieces of metal required for modern-type construction. Too, many amateurs are not mechanically inclined. The unit, here illustrated, a push-pull R.F. power amplifier designed to use any of the popular triode tubes having ratings of from 100 to 300 W. output per pair, in the modern and effective solution to these problems. All parts associated with the amplifier proper, are joined together with brackets of various shapes. This hardware is available in kit form and the only tools necessary for assembling and wiring are a screwdriver and soldering iron. When finished, it is a self-supporting unit which can be bolted to a panel with the mounting screws furnished with the variable condenser; no chassis is necessary.

Although RCA 80s are shown in the photo any of the popular triodes may be used depending upon the desired power output. A circuit of the completed unit is reproduced, on pg. 48, in order to better visualize the relation of the components. Allowable dimensions are 13 x 8½ x 8 ins. deep.

WAVER-THIN CRYSTAL MICROPHONE (1624)
(American Microphone Co., Inc.)

The new B-0 crystal microphone here shown edge-on is a small, lightweight, crystal microphone, with good response and high output. It is semi-directional and notably free from feedback. This unit has a wide range of applications, enhanced by the available accessories. The B-0 is similar in that it is equipped with a plug at the microphone, thus making cable replacement a simple operation. Chrome finish. Complete with plug and 8-FL cable. Standard 5/8-27 fitting. This unit features an extended useful range in which the bass is efficiently reproduced, an unusual feature in diaphragm-type crystal microphones.

NEW REGULATORS SAVE PILOT LIGHTS (1625)
(Amperite Company)

Radio sets in the new "H" series of A.C.-D.C. replacements, illustrated, are equipped with a patented starting resistor which prevents overloading of pilot lights when the set is first turned on. Service Men should be able to go to town on this item. At the present time there are said to be over 300 A.C.-D.C. ballast replacements, and of course any method of simplifying these is welcomed by both Service Men and jobbers. These type KL-25A units will replace all ballasts in one make, starting with K, L, M or BK and having numbers between 11 and 28, and ending in F, G or H. In other words it will replace a K-48F, L-18G, etc. Similarly, KL-701F will replace all ballasts starting with K, L, M or BK with numbers 67 to 106 and ending in F, G or H. For example it will replace K-75H, L-100G, etc. Because the regulator is a real ballast, it can take care of a wide variation in the number of tubes used in a set. It also keeps the tube filaments at ±5% with line voltages from 100 to 140 V.

New, combined automobile and radio control unit. An achievement in molded plastics. (1628)

New "splicer"-colored insulating tape—eliminates unsightliness of old-style methods. (1629)

PORTABLE SOUND RECORDER (1626)
(Sound Apparatus Co.)

Recording on the versatile unit here illustrated, is extremely simple; and presents no problems even to persons without technical knowledge or inclination. The record is placed on the turntable, the clamping screw at the end of the flexible shaft is screwed down. After turntable is brought in mesh recording arm is moved to the edge of the turntable and recording head is placed on disc. Reproduction of the recorded disc is immediately possible. Instrument includes a control panel with mixers, master gain control, recording and reproducing switches, monitoring jack, speaker jack, door control and equalizer; a recording chasis with motor, recording lamp (to eliminate turntable and cutter), provision for continuous recording, record-cutting mechanism and reproducer; an 8-in. dynamic loudspeaker; crystal microphone; and 10-W class A amplifier. This machine is built in an attractive leathertone case of 18 x 14½ x 15½ ins. and it is equipped with locks and handles. Complete machine weighs 80 lbs. Operates on 115 V., A.C.

NEW LINE OF MUTUAL CONDUCTANCE TUBE TESTERS (1627)

A well-known instrument manufacturer announces a new series of (patented) dynamic mutual conductance tube testers with new square meters having translucent, illuminated meter dials. (The counter-type or model T-53-C is shown) & a type T-63-P portable unit is available. Said to be the only dual-reading units (Continued on following page)

RADIO-CRAFT for JULY, 1938 33
SAFETY INSTRUMENT UNIT INCORPORATES RADIO CONTROLS

New in automobile plastic moldings is the so-called "safety unit" here illustrated. The right-hand end of this molding incorporates radio controls as illustrated. To make the molded shell of this new control unit a "canon" exerts 700-000 lbs. pressure at 360 deg. F.

AT LAST THE SPICE GOES MODERN

K NOWN as a "spire" the modernistic wire-spool installation here illustrated has come to case the way of the technician who strives to do a next-circuit job. Adhesive tape seldom presents anything but an unsightly appearance whereas the new spires or individual pieces of colored insulating adhesive, afford not only electrical protection sufficient for Underwriters' requirements but also permit matching the appearance of the main conductor (power card from wall outlet to radio set, etc.).

BUILT-IN RADIO ANTENNA AUTOMATICALLY RISES AND LOWERS

W HAT is claimed to be a distinctly new development in automotive radio aerials is a "Col-May" Operative Aerial here illustrated. The use of the word "operative" in the name of the aerial indicates that the aerial is operated as needed, being out of sight when not in use. A touch on the instrument-panel button causes the aerial to rise or to recede into its case (the operation is controlled by the vacuum created at the car's intake). It may be stopped at any desired position.

A feature of unusual interest is the very low-loss urethane-insulated wire, being only 16 in. long, the advantage of which is readily understood by those familiar with auto-radio reception. The 5/8-in. tube is made of non-corrosive brass alloy topped by a bronze knob, triple-plate with copper, nickel and chromium; the final chrome plating being tested under 50-hour salt-spray test. Antenna extends above car to a length of 44 ins., in one model, and 39 ins., in a second; capacity (including lead-in) is approx. 55 mmf. in both types.

IMPROVED ALL-WAVE "MULTICOUPLER" (1631)

RADIO SERVICE MEN are finding added income in the sale and installation of modern, noise-free antenna systems; a vitally important element of such systems is the "coupler" unit which serves to match the antenna lead-in to the radio receiver. Out of a number of these couplers, the "Multicoupler" shown here is a second unit, of different characteristics, is used at the antenna-end of the lead-in.

For buildings 16 to 25 stories high, one antenna may be used for operating 16 to 25 radio sets. For buildings 10 stories or less in height, two downstems may be connected to one antenna, to serve up to 20 outlets. The sale of even a single apartment-house antenna system to feed, say, 20 outlets (each outlet terminating in its individual Multicoupler), is indeed a profitable bit of business. Note that the new Multicoupler unit may be recommended for use where improved performance is desired on any wave-length covered by the designation "all-wave."

IMPROVED GANG SWITCHES (1632) (Centralab)

A COMPLETE line of selector switches assembled with an insulating insulation has just been announced for the radio amateur operates safely at potentials up to 1,000 V., D.C. and up to 100 W. The second group, of interest to design engineers, is available in all the usual multiple position types.

CENTER-TAPPED WIRE-WOUND RESISTORS (1633) (International Resistance Co.)

A line of new center-tapped wire-wound resistors is available in values between 10 and 200 ohms. Carrying capacity is up to 5 W. A chassis-wound and 2½ W. open-air mounted. Resistor is enclosed in molded bakelite.

TWO NEW 3½-INCH LOUD-SPEAKERS (1634) (Utah Radio Products Co.)

TWO NEW 3½-inch speakers have been announced by a well-known manufacturer. One unit is a permanent-magnet dynamic (illustrated), and the other is an electrodynamic type. The manufacturer claims "great improvement" in the performance of these small speakers, one improvement being the proportioning of the generated harmonics in the tone surface to enable these small speakers to produce exceptional tone quality.

The announced specifications of the electrodynamic unit are as follows: field coil, 450 ohms; voice coil, 5½ ohms; output, 5 W.; frequency range, 200 to 8,000 cycles. The permanent-magnet of the P.M. unit is designed to give a flux density in the air gap of 0.4 G. the speaker practically the same performance as the electrodynamic with a saving of from 3 to 6 W. current consumption.

14-WATT PORTABLE SOUND SYSTEM (1635) (The Webster Company, Chicago)

JUST announced, is a new 14-W. portable sound system, using an inverse-feedback circuit. It is claimed that within its rated output, distortion has been kept within 2 percent. This model features a full-length microphone stand with screw-type microphone connections, tone control and 2 permanent-magnet speakers, all housed in composite leatherette-covered carrying case. This model PA-714 amplifier is said to have been tested and approved by the Underwriters' Laboratories. (Continued on page 48)
SERVICE QUESTIONS & ANSWERS

RECORD PLAYER CONNECTION

(69) Earl Vance, Lebanon, Ky.
(Q. We have sold an HPAA Victor record player for a Philco model ST-116 receiver and want to know how to make the hookup for best tone and volume. Please state best method of reducing needle scratch.
(A.) For best results, connect the B.G. record player into the volume-control circuit of the Philco model ST-116 receiver as shown in Fig. Q.69. The double-tube double-switch arrangement is essential to avoid any possible hum, which converts electrical impulses into audible sound. A coil or a high-resistance tone control will be desirable to bring out the best from this receiver. Leads should be as short as possible. With the switch in the phone position, the diode load or radio input is grounded, thus preventing the possibility of radio interference. In this manner, the receiver volume control with bass compensation network and tone control may be used during phone operation. Needle scratch may be reduced by manipulating the tone control.

Where it is found that insufficient output is obtained by connecting into the volume control circuit, a "phonograph oscillator" is in order. This type of oscillator is nothing more than an unmodulated R.F. oscillator, tuned to some frequency within the broadcast band, usually at the high-frequency end. The receiver likewise is adjusted to this frequency. The phone pickup modulates the oscillator. These attachments are available commercially. The phone unit connects to the oscillator input, the output of which goes to antenna and ground of set.

FREE — A 1-year subscription to RADIO-CRAFT to each person who submits a WITTIQUIZ that in the opinion of the Editors is suitable for publication in RADIO-CRAFT. Read the following WITTIQUIZES; can you spot the correct answers? Now send in YOUR idea of one or more good WITTIQUIZES based on some term used in radio, and win an award. (Contest rules at end of dept.)

(85) A choke is—
(a) A patented device, in expensive radio sets, used to choke undesirable sounds. (b) A coil of wire used to filter a direct current. (c) A coil of wire used to filter an alternating current. (d) A coil offering a high resistance to an alternating current.

L. BRUCK

(86) Hand capacity is—
(a) The biggest handful of bypass capacitors that can be wiped from your neighbor's radio junkbox without being caught. (b) When the capacity between the hand and some component is measured, (c) The amount of high voltage that the hand will take without drawing back. (d) The number of radio signals that can be hold in the hand without spilling over (breaking into oscillation).

PAUL BROOM

(87) Condenser resistance is—
(a) A device constructed by persons engaged in the manufacture of condensers. (b) A regeneration effect obtained by the use of a condenser, (c) A measure of the opposition offered to the flow of A.C. (d) A heating effect which occurs when a condenser is short-circuited.

J. A. GIERBON

(88) A radio speaker is—
(a) A person that gives radio instructions. (b) Anyone who talks over "the radio." (c) A person that's always talking about radio receiving. (d) A device which converts electrical impulses into audible sound. (e) A member of Congress with a knowledge of radio.

PAUL FIZETTE

(89) A quartz crystal is—
(a) The crystal by freezing one or more quarts of water. (b) A recently-invented device for fortelling the future by radio activity. (c) An oscillating crystal used in stabilizing the frequency of a transmitter. (d) An obsolete tubeless receiving device used in the early days of radio.

FRANK H. TOOKER

(90) Every Service Man knows that a soundhead is—
(a) A bald-headed man who owns a costly radio set. (b) A headphone used by a sound technician in a studio. (c) A sound engineer. (d) An instrument invented just below a projector for the reproduction of the recorded sound on the film. (e) A valvetron in a correspondence radio school.

JESUS CHICO

(91) Service Men should know that a ballast is—
(a) A line voltage regulator. (b) The extra weight placed in a ship's hold to maintain stability. (c) A device used to steady the receiver chassis, preventing vibration.

(92) And that a potentiometer is—
(a) A meter used in testing for different potentials. (b) An instrument used by chemists to determine the potency of certain drugs. (c) A variable resistor, having 3 terminals and used as a voltage divider, or volume control.

J. VANYISSE

(93) The emission of a tube consists of—
(a) The stream of electrons emerging from the cathode. (b) The elimination of static discharges which are shunted through a condenser to ground. (c) The incoming signal entering the grid.

MILTON SCHER

(94) Do you believe that a commutator is—
(a) A news-flash announcer? (b) A system of collector rings on an A.C. generator? (c) A ring of segments which control the brushes on a D.C. generator to make the current flow in one direction? (d) A band-switch?

HAROLD FOX

(95) A plug must be—
(a) Used for stopping the grid-leak. (b) An

(Continued on page 96)

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(a) Used for stopping the grid-leak. (b) An

(Continued on page 96)
MOTOROLA MODEL 8-80 (GOLDEN VOICE) CAR-RADIO SET

8-tube Superhet; pushbutton tuning; spot tuning; "Acoustinator" control; A.V.C.; Output (max.) 13W.; Battery drain 8.5 amps.
(See Data Sheet No. 230 for additional information)
RADIO -CRAFT

Push-Button Tuner Adjustment
To set the stations, proceed as follows: (1) Turn the set on and select a plug for 30 MINUTES, to assure all electrical circuits reaching a constant operating temperature. (2) Select 6 stations to be set and arrange the 6 magnets to the approximate station frequencies as indicated on the scale to make the transformer connection near the middle. (3.) Press the "SET" key to "WEAK" STATIONS. (Fig. 1.) Press the first button half-way in (far enough to energize the magnet, but not far enough to start the motor or move the set.) (4.) Slide the magnet in the direction of error until a "click" indicates that the latch bar has engaged the stop. (5.) Turn manually to the exact peak of the station, using the tuning knob in the control head. (6.) Press the first button half-way in (far enough to energize the magnet, but not far enough to start the motor or move the set.) (7.) Repeat the above steps until the entire range so the receiver will track with the calibrations in the control head.

F. R. AND ANTENNA ALIGNMENT
(1.) Connect the signal generator to the antenna lead through a 0.00015-mf. condenser. Push the "wobbulator" to control-grid of Osc.-Mod. tube (6AT or 6ASQ) through a 0.1-mf. condenser, having first removed the grid cap from the top of the tube. Connect a 0.5-meg. resistor from the grid of the tube to the grid cap on the lead just removed from this tube. (See Fig. 3.) Set signal generator at 1,500 kc. and, with condenser gang completely out of mesh, adjust for maximum deflection on the output meter. (2.) Set signal generator at 55 kc. Turn condenser plates completely in and out of mesh and return the signal generator to the output meter, the trimmer in the oscillator can labeled 1,400 kc. (3.) Set signal generator at 1,400 kc. Turn condenser gang until signal is heard. Adjust trimmer on the antenna coil can labeled 600 kc. for maximum deflection of output meter. (2.) Set signal generator at 1,400 kc. Turn condenser gang until signal is heard. Adjust for maximum deflection of output meter. The trimmer in the antenna can marked 1,400 kc. (3.) Use the trimmer for adjustment of output meter. The trimmer in the R.F. can marked 1,400 kc. (4.) Recheck steps 1, 2, and 3, for accuracy.

Use of Oscilloscope in Aligning I.F.'S
EQUIPMENT REQUIRED: Cathode-ray oscilloscope and a frequency-modulated signal generator. (NOTE: if your signal generator is unmodulated, a frequency modulator will be required to adapt it for use with the oscilloscope.)

PROCEDURE:
(1.) Allen I.F. and diode trimmers in the regular manner as outlined in preceding paragraphs. (2.) Connect "wobbulator" to control-grid of Osc.-Mod. tube (6AT or 6ASQ) through a 0.1-mf. condenser, having first removed the grid cap from the top of the tube. Connect a 0.5-meg. resistor from the grid of the tube to the grid cap on the lead just removed from this tube. (Fig. 3.) Connect oscilloscope to the top or high side of the diode load resistor. Repeat in this manner, the volume control, I.F. and diode trimmers. Adjust the "wobbulator" frequency to 262 kc. and observe the picture of the I.F. resonance curve as shown on the oscilloscope "screen." Correct alignment will result in a flat top curve, as shown in Fig. 4A. (5.) Should the curve appear sharp at the "near" with a shelf on either side of the peak, as shown in Fig. 4B, adjust the PLATE trimmer of one I.F. transformer, until the curve best approaches the condition shown in Fig. 4A. If the regular I.F. alignment has been properly carried out, it will be necessary only in rare instances to adjust other than the I.F. PLATE trimmers.

*OPERATING VOLTAGES*

V1 +2 0 V2 +255 0 0 V3 +255 0 0 V4 +255 0 0 V5 +255 0 0 V6 +255 0 0

ACOUSTINATOR, lower-left, is set mounted on set.

All readings except rect. plates are from chassis ground to socket terminals indicated. Measurements made with 1,000 ohm/volt milliammeter. Battery drain 0.6 V. Voltage at Receiver—6.0 V.

Current Consumption—8.5 amps.—Output max. 13 W.

*NOTE:* The numerals heading the columns refer to socket terminals (see schematic diagram, Fig. 5.)

Automatic Signal Notes
MOTOR FAILS TO START
(1.) MOTOR CONTACTS IN ACOSUTINATOR NOT CLOSING. Open the Acousticator and inspect all contact points. If the gap is too great, contact will not be made when the button is pressed. Adjust by bend-finishing the contact points.
(2.) POOR CONTACT AT ACOSUTINATOR PLUG. Inspect the contacts between the socket and the connector plug and the re-entrance on the chassis.
(3.) DEFFECTIVE REVERSING SWITCH. A defective switch would prevent the voltage from reaching the motor winding.
(4.) OPEN-CIRCUIT IN MOTOR. Check all connections to motor and check motor winding for continuity.
(5.) MOTOR BRUSHES NOT MAKING CONTACT. Check contact between brushes and commutator.
(6.) LOW BATTERY VOLTAGE. A weak or defective battery in the car would not deliver sufficient voltage to start the motor.
(7.) FLEXIBLE TUNING SHAFT BENDS. Binding夫妻 flexible tuning shaft places additional load on the motor. If this load is great, it will prevent the motor from turning the mechanism.
(8.) MAGNET FAILS TO RELEASE. If the magnet which has previously been energized fails to release the latch bar for any reason, the motor cannot turn the mechanism.

FAILS TO STOP AT MAGNET
(1.) OPEN MAGNET WINDING. Check for continuity and replace if necessary.
(2.) MAGNET CONTACT IN ACOSUTINATOR NOT CLOSING. Open Acousticator and inspect contacts. Adjust or clean if necessary.
(3.) ROUNDED HEAD ON MAGNET CORE. The head of the magnet should have sharp corners. Rounded corners may cause the latch bar to slip going in one direction, although it will usually catch in the reverse direction.
(4.) LATCH BAR DEFECTIVE. Inspect latch bar to make sure that it has not been damaged. Replace latch bar and gear assembly, if necessary.
(5,) POOR CONTACT AT ACOSUTINATOR PLUG. A poor contact between the plug and socket will reduce the pulling power of the magnet.
(6.) IMPROPER SPACING OF LATCH BAR. Check the spacing between the latch bar and the magnet. It should be somewhere between 0.91/4 and 0.005-inch. If the spacing is greater the pulling power of the magnet is reduced.

RADIO-CRAFT for JULY, 1938

Radio Service Data Sheet
MOTOROLA MODEL 8-80 (GOLDEN VOICE) CAR-RADIO SET
8-tube Superhet; pushbutton tuning; spot tuning; "Acousticator" control; A.V.C.; Output (max.) 13W; Battery drain 8.5 amps. [See Data Sheet No. 229 for schematic and other diagrams.]
A WIRED-RADIO "NURSEMAID"

(Continued from page 31)

The trimmers have a tuning range of from 250 to 450 kc. If interference from another Radio Nurse is encountered, it may be eliminated by readjusting either pair of units in the following manner: one Radio Nurse (Bakelite unit) slightly or until the interference drops out. The bakelite shell of the Nurse must be removed in order to reach the trimmer. The Guardian Ear of the pair is then tuned to resonance as previously outlined.

3-WIRE SYSTEMS

In cases where the electric service to the home or apartment is of the 3-wire, 220-volt type, and the transmitter is on one 115-volt circuit and the receiver on the other, it is sometimes necessary to install a bridging condenser across the 220-volt leads to form a path for the signals. To accomplish this, a special bridging condenser was developed. This condenser is a special oil-immersed unit made for continuous operation on 220 volt A.C. and has a 2.5 ampre fuse sealed inside the condenser case.

The condenser is connected to the line by first removing a fuse on one side of the 220-volt circuit and inserting the metal tab into the shell of the fuse socket so that when the fuse is screwed back into place the metal strip makes contact with the shell of the fuse. The remain-

(Since Fig. 1B.) This will cause a more serious error in the dial readings than the adjustment of the trimmer condensers. However, if the dial is calibrated in arbitrary numbers such as 0 to 100, the Service Man can leave a list of the new dial readings so that the set owner can memorize them. Do not take out plate of condenser to reduce the minimum capacity as it will also reduce the maximum amount of capacity and will probably reduce the tuning range of the receiver instead of increasing it. In this case the maximum error would then be at the low-frequency end of the dial.

In adjusting the trimmer condenser of a heterodyne receiver, the oscillator trimmer will be the most critical if it is to function properly. The padding condenser can then be readjusted for proper tracking. If correctly done, the original dial settings will not be changed appreciably. If the superheterodyne is not equipped with a padding condenser, but depends upon an especially-built oscillator condenser, there will be a slight tracking error, but it will not be serious.

MODIFYING OLDER SETS TO RECEIVE THE 4 HIGH-FIDELITY STATIONS

(Continued from page 21)

SHIFTING THE I.F.

Another way to make a superheterodyne is by shifting the intermediate frequency. (See Fig. 1C.) Sometimes this will work, but will cause a tracking error that may or may not be permissible. As a general rule, the high-frequency end of a receiver is the most irreparable. It is very difficult, then, to get the highest signal-to-noise ratio possible for quiet reception; especially is this true when the high-frequency circuits are to be received. Many sets operate satisfactorily without an antenna, or with a poor one on the high-powered, low-frequency stations, but unsatisfactorily on the higher-frequency stations. Make every effort to set up a good outdoor antenna for best reception. If a good ground is not available, sometimes better reception will be had by not using one at all. (See also, "The Problems in High-Fidelity Design," in December, '34 Radio-Craft, for additional information on what to do to the set, once high-fidelity programs can be tuned-in, to get the most from the receiver.—Editor)

RADIO-CRAFT creates amazing fashion patterns

(Continued from page 11)

designs which would drive a surrealist artist more frantic with envy. But space limitations do not permit us to reproduce them. One of the more complicated designs so favorably impressed the designer of machine-made tapestry that he drew up a sketch of window curtains using the pattern. A lace factory is also interested in it, with the idea of producing curtains. Thus not only novelty manufacturers find new avenues of expression opened up, but also the producers of more bulky items, for instance these curtains and floor-coverings, etc., now have at their command a machine that is capable of producing patterns in inexhaustible variety.

Infinite in number and variety are the patterns produced by this new RCA cathode-ray kaleidoscope, and plans are already under way to inaugurate an "electronic pattern" service to the leading dress, textile, plastic, wrapper, and jewelry designers of Paris and America. This invasion of the field of art by electronics adds a milestone to radio.
EUROPE'S UNDECLARED
RADIO WAR!
(Continued from page 9)
that it became very difficult, almost impossible, to hear this station. But it still broadcast, and is now to be heard on a wavelength of 23.8 meters, according to a recent report.
The Spanish trouble has added greatly to the war on the air. First of all, Moscow transmitted news that Spain had been signing a treaty with the Comintern. Next, the British government announced that it would no longer recognize General Franco as the legitimate ruler of Spain. Then General Franco captured the power of the Salamanca station to unknown kilowatts and transmitted on the same wavelength as Madrid.

Another feature of the struggle has been the entirely illegal use of the amateur wavelengths on the 40-meter band for news and propaganda. And within the last few months, one or two stations have begun transmitting on the 20-meter band. Both sides use this.

It is generally believed that the Germans have made contact with the Spanish government, but this has not been confirmed.

A strange happening in the Spanish war is the radio propaganda from a station in itself "Radio Verdad," and broadcasting in Spanish. (Verdad is Spanish for truth.) As they use several Italian wavelengths on the 40-meter band, I thought that either the Italians were closing down their stations to allow the Spanish station to broadcast its "truth" propaganda, or that the Italians were responsible for the whole thing.

They are an address in Salamanca to which listeners are asked to write. I wrote, but I had no answer. When listening to Rome at 7 o'clock G.M.T., I heard the station signoff, and then the carrier disappear, before Radio Verdad made its transmission. But Radio Verdad's announcer has a slight Catalan accent, which shows he does not come from Salamanca. This made me suspicious. Then a friend used directional antennas on the transmission, and Radio Verdad proved to be the Italian masquerading as Spaniards.

This is perhaps not very surprising, since I have seen it stated that broadcasting in General Franco's territory is virtually entirely under Italian control. Oddly enough, the only Italian I know had a job with the Italian broadcasting company in Rome, and then he went to Salamanca, General Franco's headquarters.

Italian used to be the only major European language in which the Germans never used Communist propaganda. I wrote to Moscow and asked why, but, though they answered my letter, they refused to answer this question. It has been suggested that a clause between the two countries forbade the broadcasting of propaganda. In addition, there was a rumor that Mussolini had so successfully jammed all the Russian stations that they ceased their propaganda in Italian. However, lastly, Moscow has been giving propaganda in Italian—just another radio mystery.

The Italian broadcasts from Rome and Bari in Arabic have raised much protest over here in England. But in addition to those in Arabic, there are others in Chinese and other General languages. It is these Arabic transmissions that have compelled the British Broadcasting Corporation to broadcast in Arabic in order that Palestine should have a source of radio news other than that broadcast from Rome.

And so the B.B.C. feels compelled to broadcast in foreign languages; it began with Arabic early this year. When I first listened to these broadcasts, I could almost hear the chittering of a hexagonal machine there was so much effort being made to jam them. I could hear the cackling of Bollocks perfectly, but I'm sure that when the Arabic announcement was made, it was overwhelmed by interruption. Whether this interruption was successful in preventing intervention in the East, is another matter. Last night I listened to the British transmissions in Spanish and Portuguese. The half-hour's newscast came in uninterrupted.

(Radio-Craft feels that its readers will be particularly receptive to this article, which contains first-hand information.)

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0-500 volts D.C. 0-500 ma. D.C.
10-500 volts D.C. 0-50 ma. D.C.
0-50 ohms
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SERVICING PUSHBUTTON TUNING SYSTEMS
(Continued from page 19)

It will be found that some stations cannot be tuned exactly to the dial marking, but if they are within 10 kc, it will be taken care of by the A.P.C. which should always be turned on when the automatic dial is in use. Remove the star tab from the escutcheon hole directly beneath the screw which has been set up and insert the proper station tab. This operation is repeated for as many stations as are required.

Figure 13 shows the appearance of one of these dial control screws and the dial escutcheon which holds them. The indexing finger on the control screw sometimes breaks off due to being forced or stuck in the tuning gate, in which case a new screw may be installed without dismantling the dial mechanism. The trick in doing this is to press in on the broken screw while the dial is not set for the station marked by the broken screw. The screw should be turned until the index finger falls into the shape-squared slot and upon releasing the screwdriver the screw may be pulled out and the new one inserted in reverse order.

Other troubles which may be encountered in this dial system are: Stuck or broken tuning gate; no A.P.C. action. This may be due to the setting of the gate; the armature plate switch actuated by tuning gate; no signal, or intermittent signal due to Audio shorting. The correct adjustment is to press the rocker action, up and down with the screw in place.

(5) Excessive side-play in scanning arm blade, causing the knife relay blade to rest on the escutcheon hole. Next, see Fig. 11 and note that the rocker pin flanges are adjustable by means of a screw in the rear of the escutcheon arm. Correct adjustment provides a rocker action, up and down with no side play.

(6) Not enough tension on scanning arm. Loosen collar on shaft at the rear of the sector and push scanning arm toward the sector face, then tighten the collar on the shaft.

(7) If the Button contacts do not close, or else fail to make good contact and hence motor continues to scan dial without stopping at desired station. Bend or clean the button contacts.

(8) Sector has warped away from its vertical position, causing one or more buttons to skip stations. Since the metal is very brittle no attempt should be made to correct a warped sector. The best remedy is to replace with a new sector.

(9) Centralab shaft grounds against the dial and pushbutton escutcheon. If this happens the relay remains energized and the motor will not run.

(10) Open or shorted coil in motor causes motor to turn very slowly, if at all, and only in one direction. Replace motor or repair coil.

The convenience and advantage of pushbutton tuning need not be restricted to today's receivers only. Button tuning of the trimmer type can easily be added to sets of the superhet type of the past few years.

As a money-making adjunct for the Service Man, two types of switches are available at present and are shown in Figs. 14 and 16. The circuit-closing type shown in Fig. 15 can also be used in low-impedance test equipment. Figure 16 shows the construction of the "latch" which is common (in one form or another) for practically all pushbutton switches.

The circuit transfer type shown in Fig. 14 uses an ingenious method of switching that is, a series circuit is maintained up to the point where a button is pressed in, whereupon the series circuit is broken and the relay coil energized by the parallel circuit of that button. The author has added a Metisner 8-button assembly of the type just described, to a high-fidelity tuner (Centralab RadioCraft). The troubles which may occur in latch switches are very few and easily located.

(Concluded by the author's timely, informative and easily understandable article.—Editor)
HOW TO MAKE A HIGH-FIDELITY TUNER

(Continued from page 23)

consists of 4,000 turns of No. 32 D.S.C. wire wound on a bakelite or hard rubber form of the dimensions given. The wire should be wound evenly but not in layers.

The layout of parts can be seen from the photographs (Figs. B and C) and no actual drilling layout is given because of the difficulty of spotting holes exactly. When substitute parts may be employed with a resulting shift of hole locations, etc.

When all parts have been secured to the chassis, the wiring can be done, using well-insulated wire and heavy flexible leads for the filaments which must be fed from the amplifier chases. The wiring should be as short and direct as possible consistent with a neat and workmanlike job. The A.F. output leads should be shielded and the lead from the potentiometer to the grid of the first tube in the amplifier should consist of a heavy shielded wire, the shielded leads sold for auto-radio antenna leads. This will keep the capacity between the lead and shield at a minimum and prevent bypass (loss) of the high-frequency signals.

With the coils used in this set (it is not advisable to make the coils at home if constant-flat-top resonant curves are to be expected) a coupling capacity of 0.05-mf. produces a selectivity of approx. 30 kc. and with the addition of the 0.01-mf. capacity (in parallel) with the 0.05-mf. units, the band-width narrows to approximately 15 kc. The use of 0.02-mf. in place of the 0.01-mf. condensers, the band-width narrows to approximately 12 kc., permitting adequate control of selectivity for most situations encountered in the U.S.

If desired, a switch can be included to cut off the 10,000-cycle filter out of the circuit so that this attenuation of the higher order harmonics may be eliminated when the noise background and monkey-chatter permit. This is not shown in the circuit as the set was made to be used close to New York where the interference is notoriously bad.

THE AMPLIFIER

The actual amplifier with which the tuner is used depends not only on the personal preference of the builder, but on the volume level required, and on the types of tubes.

The circuit used by the writer employs coupling transformers which are not commercially available. However, several very fine input and output transformers are available and this should not deter any builder from duplicating the amplifier used in the original model, diagrammed in Fig. 3. Some readers may prefer the use of the triode output tubes to the beam tubes—but be as far as availability of instrumentation, the writer's ears are concerned, the beam power amplifier gives equally good response and low harmonics, with one less stage than the triode amplifier. (This may be due to the closer match between tube and transformer impediances in the beam amplifier.)

No constructional details are given for the amplifiers as this article is limited to the design and construction of the tuner.

SUITABLE LOUDSPEAKER SYSTEMS

However, the subject of speakers and baffle should be mentioned as this is the second "weak link" in the chain (the detector being the first, as you will remember). There are several speakers on the market which will respond up to about 5,000 cycles, but to the writer's mind it takes a really good double speaker unit, using woofer and tweeter speakers, to bring out the capabilities of this wide-band tuner.

Also, there is little advantage to be gained in increasing the H.F. response of a set without also increasing the L.F. end. And with this point in mind, a large baffle or the use of the infinite baffle, bass reflex or per-dynamic principle to increase the "low" cannot be too highly recommended. However, such a set would be worked out by the builder in conjunction with the amplifier and actual installation.

This tuner is capable of fine reproduction when used with constant amplifier and speaker equipment—and that is the main part of the battle, as mentioned in the beginning of this article. The completed job in its cabinet is illustrated in Fig. A.

(Continued on page 45)

MOTO-SCOOT FOR SERVICE CALLS

FREE THE NATIONAL UNION WAY

- Here's a grand idea for quick, low cost transportation for the service engineer. The Moto-Scoot with side van attached, provides ideal transportation facilities for test equipment, radio or radio chassis.

The Moto-Scoot is safe and easy to operate and unbelievably economical to run. You can get about 130 miles to the gallon of gasoline. The unit is supplied complete, ready to go with no accessories to buy. It is completely equipped with a powerful lighting system. Get it FREE for your business. Ask your distributor for complete details or write.

USE NATIONAL UNION QUALITY TUBES • QUALITY CONDENSERS

- Thousands of topnotchers in Radio Service are depending on National Union Quality. These tubes and condensers have the kind of precision and value that makes good friends for you too.

- National Union will help you to own "the finest radio service lab in town." Everything you want is offered you on a "Free Deal" Plan. It will help you to get the equipment you need now to do better work and faster work and make more sales. That's the National Union way. Over 100,000 completed deals . . . . for more details, just write . . . .

SEE US AT BOOTHs 205-207—Hertz Ave.
CHICAGO RADIO PARTS SHOW

Be a Radio Expert—Learn at Home

RADIO SPECIALISTS NEEDED

Modern receivers with their complicated circuit systems have knocked out the old time cut-and-try radio flier. Trained men with up-to-the-minute knowledge are needed to service these new sets.

PRACTICAL TRAINING AT HOME

Our home study course is practical "on the job" training combined with a thorough set of practical lessons prepared by experienced Radio Service engineers. Your working outfit is an extra feature.

MAKE SPARE TIME MONEY

Our training is of service and practical. We show you how to make money almost from the beginning and to increase your earnings in your own way. Investigate now, write for free rack of details.

FREE OF EXTRA COST

To start you making money without delay, we send 'Originator' and 'Point Resistance Tester.'

WHAT R.T.S. STUDENTS SAY

Joseph Hardin, Jr., Yorkville, Ohio
I have connected with a large firm as Radio Service Manager and wish to extend my thanks for your help.

Terry L. Harr, Toledo, Ohio
From Aug. 1 to Dec. 1, we repaired 75 radios and put up 75 sets of wires. We are very good for part time work while studying your course.

RADIO TRAINING ASS'N OF AMERICA
Dept RC-78, 4525 Ravenswood Ave., Chicago

Please Say That You Saw It in Radio-Craft
THE WAR OF WORDS

THOSE nations which are not actually engaged in the pastime of hurling lead and gas at each other, e.g., some of the neighboring yards, were throwing words at each other's nationals, according to last month's advice. So for that matter, Europe was worried last month.

Britain last month inaugurated a "news service" in Spanish and Portuguese for listeners in the Latin-American market. The service, described by the Buenos Aires Herald as "short-wave broadcasting," was sponsored by the service of stock market reports and Press-Radio news, directed at Europe. Frank E. Mason, N.B.C. vice president, has announced that a service spreading "American culture and ideals" to Europe and South America, news, entertainments, and other features, will be started in France. At last report, was being broadcast a station which purported to be in Paris, and which took its name from the newspaper, the "Voix du Paris." The word of this station has been received since Blum was supplanted by Daladier; maybe it stopped transmitting, or perhaps the French just ceased to care. From Latvia came reports of a short-wave station which advocated the overthrow of Stalin; and no one knew whether it was in Russia or in one of the nearby independent states. But, for that matter, what owns it Japan? Japan announced plans for the greatest radio coverage of the 1940 Olympics in history; the transmitter is being installed at a station in Baragri which will be enlarged and improved in time for the games. A Pan-American short-wave service, "stirring good will," was inaugurated over WIXAL.

An international convention on "broadcasting in the cause of peace" was held at Geneva last month. Twenty-eight states signed the pact. Among the absentees were Germany, Japan, Italy and the Union of South Africa; the latter states pledged themselves to devote broadcasting which might reform not only in other countries, to invite war, to harm innocent neighbors, to promote untruths. There appears to be no reference to any form which might be done to each relation by the broadcasting of a few well-chosen truths.

SOMEBODY'S MAKING MONEY

ENCOURAGING reports drifted in from scattered radio stations during the month of March. For February, the N.B.C. grossed $2,681,735, an increase of 18.4% over 1937; N.B.C.'s gross was $3,495,653 which was 6.1% up; and Mutual increased its gross to $255,312. In March, the picture was not quite so uniformly better. C.B.S. had a gross of $2,374,184, or 19.47% over a record month, Mutual slipped slightly. The figures, with percentage of change from March, 1937, are: C.B.S. 6.000,000; N.B.C. 5,943,383; Mutual 3,806,831, up 5.5%; M.B.S.: $240,637. These statistics are quoted from Radio News. The broadcaster's monthly payroll, or the amount he paid his employees, was $1,500,000.

Radio manufacturers, too, made money. Electrical exports were 24% up for 1937, that being the best year since 1930. Radio exports totaled $32,102,070, an advance of 13.52% over 1936. But the month of February was the best yet, February, 1937, though above the preceding month, according to last month's reports. Incidentally, any radio exports up 15% does not receive the U. S. Department of Commerce bulletin, World Radio Markets and Electrical and Radio World Trade Review. It is true, some great gurus have tips on market conditions at the end of the year.

Last month the Radio Manufacturers' Association announced a meeting on sales promotion to be held on April 21, and on the 26th to discuss minimum selling price of radios. Both of the industry. The R.M.A. fight to prevent or reduce the excess tax failed, but leaders concurred themselves with the thought that it would probably expire in 1939, anyway. The Association also released figures on its employment situation as of January. There was a net decrease of 21.6%. From December, Radio factory employees averaged 20,88 per week, which is slightly less than a dollar under the average wage of all manufacturing industries.

General Electric Company's annual report, released last month, showed a profit of $32,740,000 in 1937; dividends were $2.25 per share. During the year General Electric sold: 1,620,000 Jordan 5% bonds for $32,350,000; 254,700 $1,000 bonds for $254,700; 345 to $231,268,000; employee earnings up 86% to $1,458,350,000, and average annual wages $1,935,000, an increase of 10%. A period of about two-and-one-half million dollars in pensions. About a month after this report, the company announced that over a period of 50 years running over $2,000 a year would receive pay cuts ranging from 0.5- to 20%. The plan was to increase the working force.

Last Minute Flash—G.E.'s orders for first quarter of 1938 were 38% below those for a like period in 1937. Last month 264,000 stockholders received 36c a share; year before, 193,364 stockholders received 4c a share, as their quarterly dividends.

RADIOOFFICIAL REGULATIONS

Your Reviewer, who is able to top off a bottle without receiving any sensation, and who can cross the English Channel in a single breath, always has a dizzy spell when plowing through the quires of paper emanating monthly from the F.C.C.Commission.

Robbed of most of their treasures, genial Chairman McNinch announced last month that the board committee would "encourage broadcasting and monopoly in the broadcasting industry" and to prepare for and hold hearings in order to relax the regulations limiting the power of stations on clear channels. The Committee will recommend action to the F.C.C.

Police stations were adequate provision must be made for checking and maintaining frequency.

Orders were advised last month that certain transmitters designed to produce 200-watts output would not have the 500-watts output when A2 transmission was employed, and must be altered.

Last month F.C.C.Commissioner Craven made public a criticism of the F.C.C. investigation into Telephone communications. Pointing out that he was not a member at the time, he deplored the fact that the press received news of the report before Congress did. He also deplored the fact that the inquiry was made by the telephone company and the phone company been permitted the right of cross-examination and rebuttal. He suggested that the commission should have the power to demand the Senate and the I.F.C.C. of the House. This was denied.

Commended Walter S. Gifford, President of A.T.T., in part last month's H.C.'s "reduced report" on the telephone investigation: The investigation went on to be one-sided from start to finish. We were denied not only the right to cross-examine investigation witnesses and to be heard in our own behalf, but were denied the right to have included in the record written material which we had prepared and considered necessary to point out serious and important errors affecting most of the investigators' reports. Commissioner Walker's report was appropriate in light of these facts.

"We have not been given a copy of a Commission Walker's report, said to contain 1,000 pages, to the end of it. If we had seen the report, we would have improved with the same unfairness that characterized the investigations proceedings."

The report, which runs to 22 pages, cost $1,500,000 being derived from a complete record of 8.44 pages and more than 2,000 exhibits. Last month's comments were not designed to encourage the government to greater power to regulate the operation of telephone companies, with a view toward reducing the cost to the American public. Otherwise, however, the investors must be protected, and that the jobs of telephone workers must be insured.

The same Commissioner also released data on his questionnaire, being sent to all stations to secure information as to their earnings and investments. The M.B.S. announced its approval of the F.C.C. investigation into chains, and pledged its support, last month.

Please Say That You Saw It in Radio-Craft.
Another ruling of last month extended for 6 months (from March 15) the time in which to vacate the last month's effective decision to prohibit low-power radio transmission in the 16-meter band. On the other hand, the Radio Law Administration has been asked to consider the request of the National Congress of Columbia to extend the time for the construction of new stations.

Meanwhile, the ratification of the international radio treaty, arranged at Geneva last May, is still delayed. The F.C.C. is expected to issue a ruling on the matter at any time, but the treaty will not be in effect until it is ratified by the Senate. The treaty will provide for the establishment of a new international radio service, to be known as the "International Broadcasting Station," which will operate between 4,000 kc. and 42,000 kc., and will be allocated for such service.

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SEEKING RICHES FROM THE EARTH BY RADIO

STEADILY the technique is developing for the location of precious ore bodies and other mineral deposits in the earth by using radio. A very comprehensive article has been prepared, based on several methods and methods, all based on verified experiments, giving full insight into this fascinating and promising field. By using methods now fully disclosed, gold coins, buried by pre arrangement, were recovered, to the consternation of many anxious discoverers.

All the world over, the eager search for the riches reposing in the recesses of the earth goes on. Success attends those efforts that scientifically determine the non homogeneous character of the earth. Interpretation, however, is for the future. It reaches the straight path to precious deposits.

Acquaint yourself with the full facts about these methods and the exploration by radio devices by those seeking riches, through the pages of the article with the requirements for successful apparatus. Join in the treasure-seeking yourself. The full details are revealed in the article that treats of this historic development of methods of detecting hidden riches on the earth, from the first divining rod to the latest high-powered heat oscillator.

RELIEABLE RADIO COMPANY
143 West 45th Street, New York, N. Y.

Greatest Screwdriver
A Radio Man Ever Used in Servicing or in a Laboratory

USE this FLEXIBLE SHAFT SCREWDRIVER—the screwdriver that actually goes around a corner—in your radio servicing or laboratory. It has a thousand and one uses—ideal for repairing radios, refrigerators, automobiles, all kinds of machinery, shop equipment, electrical appliances, vacuum cleaners, marine equipment, household tools, etc. The FLEXIBLE SHAFT SCREWDRIVER has a shaft of laminated steel and brass plated bit. Rigid, but flexible, it can reach all the places, POSTPAID $1.00

GRENFPARK COMPANY 1229 Park Row Bldg., New York, N. Y.

THE RADIO MONTH IN REVIEW

(Continued from preceding page)

month last month their appeal on a radio program brought new conviction. The fine remains at $1,000.

French prisons adopted a radio mattress-tunner last month. It finds knives, guns, saws, files, etc., with such gadgets are concealed in convict beds.

To keep skiers from becoming lost, a beacon system was established in a Swiss resort last month. It sends out a beam, which the skier-equipped skiers can tune to, for guidance. This may mean unemployment for the St. Bernard dogs, even though no one has invented a radio wave which is able to carry a mask of brandy.

The Bellabeled Pen Company, Sheffield, England, installed a room-maid machine last month. It makes the hundred girls work faster.

Paul Wilson, Illinois farmer, no longer has to haul his hog to market. Last month they learned to come when he tunes in a hill-billy program on his barn radio. So now you know who likes hill-billy music. (F.S. Has cows and horses, too.)

Money-making through radio! A woman living next to the M-G-M studio received $100 per day not to run her radio last month. The sound interfered with the films.

Ancient alchemists sought means to transmute base metals into gold. Scientists at the University of Rochester, New York, last month obtained proof that a million volt atom smasher last month and turned the switch. The gold became mercury. As the Two Black Grenadiers say, "You can make any money like that!"

When you tune-in an all-request phonograph program at night, how do you enhance your chances of being answered? You are listening to some secret code for the rackets, according to reports of an F.B.I. investigation last month. The alleged coded messages included messages of combinations of song titles, recorders' names and addresses. Many stations now emit odd telegrams, this having been a popular form of caging.

British programs, being government-regulated, carry no advertising. In the United States, suggested last month that British advertisers buy time on American short waves. Those from Christie and Picture Palace, the critics said, are heard in England regularly, and with good volume.

Caught on the Fly

New York's mayor, F. H. LaGuardia, last month expressed his regrets at his inability to attend the United States' Communications breakfast. At home, he listened-in on his radio. Former Judge Blenkly, speaking at the breakfast, criticized the recent anti-radio campaign. Mayor LaGuardia leaped into his car, sped to the breakfast, and broadcast his reply.

The municipal radio-telephone service program is the weekly broadcast of the deliberations of the City Council, according to a statement issued last month by S. N. Sinclir, director of WNYC. The station receives about 1,000 letters per month. "Some of the letters are derisive," Dr. Siboni admits. "The meetings are called circuses."

Radio boosters for the New York World's Fair were started over a local station last month. Plans were announced for the inauguration of network publicity, as well.

The Golden Gale Exhibition (1939 World's Fair, West Fair) likewise made advances last month. The Exhibition will feature television, electronic music, demonstrations of "atomic smashing" and so forth.

N.B.C. month before last, devoted a complete News Service program to its view of the Toscanini series. Release showed the mild maestro and the orchestra; quoted tributes from press and public.

Pitcairn Island, isolated since 1760, hit the news last month when a Swiss Airlines plane erected a station. Last month, Cofo-Coil engineers increased its power from 50 to 650 watts. Station operators insisted on praise for giving engineers at the station wall up wave lengths. Britain issued orders restricting Island's communications last month. Banishing all stations but 80 or 90 miles of each other. Red-faced, N.B.C. canceled arrangements for Island broadcasts.

New York candidates for teachers' positions last month faced a microphone and recorder for oral speech tests, while examiners listened. Examiners graded what they heard, then listened to the same tape. Formerly examiners had heard on their first listening. Disgruntled candidates demanded re-exams. Alibi: "Radio bugs..."

Every year since the advent of the radio, some newspaper prints a story about the use of the radio in making and breaking up love affairs. Last month the N.Y. Daily Mirror was no exception.

In Hawaii last month, Japanese and other government officials were broadcasting a confirm of love affair to vessels in the harbor during naval maneuvers. War games took in the civilian population, who were asked to listen on a special wave length "which might be used in case of an emergency or catastrophe." They were urged to use automatic and other other battery-operated receivers.

"If we power companies had been destroyed,"

Radio may speed up communications, but it becomes a "hobby" when the hobby is one of many who listened to W9XBF did not behave normally; took 10 minutes longer to fly 30 miles. Commentators say this study of effect of radio waves may be extremely important. It doubtless will be to the pigeons whose time is so wasted.

"Here-station" outside of Paris, France, was reported as coming along nicely last month, with the antenna nearly completed. The station will use the latest high and long-wave.

Last month Vienna police took on the appearance of camera fans. Selected officers were provided with camera, film, and instructions to be worn slung over their shoulders. Batteries were carried in their pockets. Yet anchors took place, just the same.

In Egypt last month, the King's bounty brought happiness to the poor, but honest subjects. He commanded that 5,000 radios be distributed among impoverished peasants in the Nile Valley. Only that he also decreed an increase in educational broadcasts.

H. W. Tenor Morton Downey, returned from Europe last month, praises American broadcasts. He remarks that European broadcasts are propagated—"for profit"—and that the American stations long of their allotted time—that there are long pauses between them. Yet there are times when your radio listener would decide on an off-again pause for an over-long commercial.

English spellers, defeated by an American group in a trans-Atlantic spelling bee early this year, came back last month to average their defeat. The score, 27-14.

Amateurs may recall Eric Palmer, operator of W9GBZ, and author of "Riding the Airwaves." Mr. Palmer, now a member of the Coast Guard, No nesting, married Miss Lillian Kaprat last month.

When a Navy bombing plane was lost last month, among its crew were George T. Williamson, radio engineer,44th class, and C. E. Outland, radioaman, 3rd-class.

The police of Hove, England, were given radio equipment last month, so you'd better stay away from there if your conscience harts.

RCA stockholders last month passed a motion increasing RCA President David Sarnoff's retirement. More "Mike persons" in the future, according to reports received last month, the room will illustrate why singing in the morning has become a great beneficiary of indoor sports.

In March last month, radio receiver licences were upped 4 bits to $2.50 despite the wails of listeners. A Toronto organization made a survey of the health broadcast last month, to show the increase justified. Others protested that they listened to U.S. stations most of the time anyway, and that radio "means" something upon to contribute more heavily to the Canadian system. Extra loud howls came from owners of more than one set—who must pay $2.50 on each. Battery set owners were less bothered: their fee remains at the $2.50 mark.

GRENFPARK COMPANY 1229 Park Row Bldg., New York, N. Y.

Please Say That You Saw It in RADIO-CRAFT

www.americanradiohistory.com
TECO TEST EQUIPMENT
Sold with a GUARANTEE & 10 DAYS FREE TRIAL!!!

Buy direct from the factory on 10 Day Trial. If the Instrument you buy does not meet your needs, return it for full credit on any other TECO equipment. Buy TECO and SAVE the difference!

TECO POCK-O-METER
AC and DC
A new pocket size volt-ohm-milliammeter that includes AC measurements and is the lowest priced, full-service instrument ever offered! Has 5" d'Araldite movement 0-1 milliammeter. Comes with etched panel.

SPECIFICATIONS
5 DC ranges: 0/15/30/75/150 volts.
5 AC ranges: 0/15/45/75-200/1200 volts.
3 DC current ranges: 0/1/10/100/500 ma.
3 resistance ranges: 0/5/50/500,000 ohms (low ohms read to 1 ohm).
Pock-O-Meter supplied complete with batteries, test leads, and instructions. Size 4¼ x 3½ x 2½". Shpg. wgt. 5 lbs. Our net price...

$8.45

NEW TECO TUBE TESTER
Model T-10
A genuine achievement! Work has d'Araldite moving coil meter, Tests all types of tubes. For use on 110 V., 60 cycle AC.
Features • Tests all 4, 5, 6, 7c, 7t and voltage base tubes. • Tests for the well established emission defect for tube quality, directly read on the face. • Has tone scale of the meter. • Affords separate front test for leakage and shorts between elements. • All series performed with 5 controls at maximum—many tests not requiring all controls. • Modern, attractive etched panel housed in rugged Castortite carrying case with removable lined cover and handle. • 60 cycle AC operation. • Supplied with instructions and reference table covering all types of tubes. • A safety meter to service. Size 11½ x 5¾ x 2¼". Net Price...

$11.75

Free New Catalog Just Off the Press—Shows Entire Line—Send for Yours to

TEST EQUIPMENT COMPANY
of America
139 CEDAR STREET
NEW YORK, N. Y.

KILLED BY RADIO
A warning about using electrical apparatus in the vicinity of water was issued yesterday by the Stockport coroner.

Recording a verdict of death by misadventure, Catherine Victoria Lightfoot, aged 36, of Bramhall, who was found dead in her bath with a wireless ('radio') set partially submerged in the water, the coroner said he wanted to warn the public about the little-known dangers with which they might be confronted when handling electrical apparatus.

It was apparent, he added, that the woman had received an electric shock through handling the wireless set while she was in the bath.

Medical evidence was that death was due to shock from electricity of a high voltage.

(The above item, reprinted from a recent issue of the Sunday Referee (London, Eng.), is offered with the idea that "an ounce of prevention..." etc.)

FLASH—NEW TELEVISION RECEIVER ANNOUNCED!
As we go to press we learn that a manufacturer has announced the immediate availability of a 41-line cathode-ray type television receiver. Read August Radio-Craft for more details!

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LIST OF PARTS
• One set of coils, type 472A antennas, 472RF, 172 DP hand pans. (2) EL06 negative mutuals, and 472UT, untuned, L1 to LT incl.: One 4-turn 350 mmm. variable condenser, C1 to C4.
• One 9 inch section position switch (open-circuit type). Swl, Sw2.
• One replacement 10 kc. filter type 464-21t with C102 85 mmm. condenser. L8.
• One Centrabl 0.5-meg. vacuum control (A.F. grid taper), with switch VC.
• One 420 mhy, coil, home wound, L3.
• Three Cornell-Dubilier mica condensers. 0.05-mf.; 0.005-mf.; 0.02-mf.; Second Cornell-Dubilier mica condensers. 0.01-mf.; 0.005-mf.; One Cornell-Dubilier mica condenser. 0.005-mf.; One Cornell-Dubilier mica condenser. 50 mmm.
• Seven Cornell-Dubilier paper condensers, 0.51-mf.
• Four 400 V. D.C.
• One Cornell-Dubilier paper condenser, 1 mf.
• Three Continental Carbon resistors, 0.1-meg., 2W.
• One Continental Carbon resistor, 20,000 ohms, 2W.

Please Say That You Saw It in Radio-Craft

HOW TO MAKE A HIGH-FIDELITY TUNER
(Continued from page 41)

Three Continental Carbon resistors, 25,000 ohms, 2W.
Two Continental Carbon resistors, 3,500 ohms, 2W.
One Continental Carbon resistor, 300 ohms, 2W.
One Continental Carbon resistor, 600 ohms, 2W.
Two Continental Carbon resistors, 0.5-meg., 2W.
One Continental Carbon resistor, 1 meg., 2W.
One Continental Carbon resistor, 75,000 ohms, 2W.
One Continental Carbon resistor, 4,000 ohms, 2W.
3 Three octal wafer sockets.
* One 6-prong wafer socket.
* One dial (type to suit installation).
* One mounting and escutcheon plate for tuning eye tube.
* Two 2-contact terminal strips.
* Two screen-grid clips.
* One glass tube shield.
* Two RCA type 667 metal tubes.
* One RCA metal-glass type 6CBG tube.
* One RCA 6GS tuning-eye tube.
* One 8 x 8 x 5 in. deep chassis.
* Miscellaneous grommets, wire, screws, etc.

Most Radio mail order houses can supply this item if properly identified as to title of article, issue (month) of Radio-Craft and year. www.americanradiohistory.com
SERVICING UNIVERSAL A.C.-D.C. RECEIVERS

(Continued from page 15)

Having located the leads and determined the function of those three condensers, you are ready to place on your sketch the approximate capacity values for each circuit and the results of the following general rules as your guide:

FILTER CONDENSERS—any value between 10 mf. and 20 mf. rated at 200 volts D.C. working voltage; Output Filter Condenser—any value, but if the receiver is used as a universal T.R.F. working voltage; Loudspeaker Field Condenser—between 4 mf. and 8 mf., rated at 25 or 35 volts D.C. working voltage.

While voltages smaller than the minimum values given should not be used, the maximum values may be exceeded without impairing the performance of the receiver. The operating characteristics of vacuum tubes can likewise be higher than the minimum values given.

Your electrolytic condenser block sketch now gives you the necessary data for ordering a replacement unit. If a unit having the desired internal connections and values is not available, make up separate leads for each section. If even this is not available, make up your condenser block by using two or more parallel condenser units, having the desired capacity and voltage ratings. When ordering separate units in this way, be sure to check the individual spark and choose units which are small enough to fit this space.

JUSTIFIED COMPLAINTS

Is the Customer's Complaint Justified? The oft-repeated question is often asked of service men as to whether the customer's complaint is justified. These little receivers are designed primarily for reception of powerful local stations which are weak or lost in the broadcast. The receivers have little selectivity and cannot work well except in large cities where the stations are separated by less than 100 kc. may be expected to interfere with each other. The receivers likewise have poor sensitivity, and the reception of distant or even semi-distant stations will therefore be unreliable. Where the complaint of the customer simplies involves one of these factors, no service problem exists. Likewise, good fidelity and freedom from blasting at full volume should not be expected. Service can only be justified if it can be evidenced that the customers' complaints are justified.

The complaint must, therefore, be substantiated. First, take the various complaints, check them, and determine whether or not they are justified. If the complaint concerns deadness, check the filament and tube voltages, and determine whether or not the tubes are operating properly. If the complaint involves a hum, check for condenser leaks, and determine whether or not the hum is caused by one of the filters. If the complaint is a distortion or static, check the tubes, and determine whether or not their operating conditions are correct.

Franklin A. Graham

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volts, while with the net plugged into a D.C. outlet, this voltage may be as low as a volt.

If no voltage is measured here on D.C., try reversing the position of the line plug; proper polarity must always be observed on D.C.

A low ohmmeter output voltage on A.C. operation is an indication of defective filter condensers. One of the filter condensers may be checked in turn, by disconnecting one of its leads and then checking the condenser for leakage with an ohmmeter. If the reading is lower than is the normal value for a condenser of similar size, the condenser is defective and requires replacement.

If the reading is normal then it may have deteriorated from overloading or discharging the electrolyte, with a resultant lowering of its capacity. Try a new electrolytic condenser in the same position, and while the old unit is disconnected. Separate 8-mf, 475-volt test condensers should be kept on hand for testing. If the tester-tube output voltage comes up to normal when a new condenser is inserted, this is a sign that the old condenser was defective.

Even when only one section of the old electrolytic filter condenser is bad, a new block should be installed in order to have the best possible chance that the other sections of the block will soon fail in a similar manner if left in the receiver. When using a test electrolytic condenser in this manner, you must, of course, observe polarity very carefully, for connecting an electrolytic condenser to a source with improper polarity will in most cases ruin it.

If the rectifier-tube output voltage of the "dead" receiver is normal, check the D.C. voltages between the "B—" point in the circuit and each plate of the tube. Repeat this test for the corresponding tube socket lug: failure of the two readings for any one tube electron stream indicates a break between the tubes and the socket prong connection, making the installation of a new socket necessary.

Improper voltages on any tube electrode will point to the source of trouble. Just as in the case of an ordinary A.C. receiver, the circuit diagrams in this article will give you an idea as to what voltages to expect; obviously the detector tube voltage should be zero; the control-grid voltage on the power tube will be quite low due to the high values of resistance in these circuits.

Simple continuity checks of various receiver circuits often prove the speediest way of locating trouble in a "dead" receiver. There should be continuity between all sections of the plates, as well as screen-grids, of all other tubes in the receiver, with the exact ohmmeter reading depending upon the sizes of the resistors in the various circuits. There should be continuity between each section of the fuse power switch to the control-grids, as well as the cathodes, of all tubes in signal circuit.

Rotor and stator plate voltages all condensers are particularly important in the case of the rotor and stator plate voltages, and the insulator inspection will often reveal such a short, but if doubt exists, disconnect the coil lead from the stator of each section and check each section individually with an ohmmeter. There should be no continuity between rotor and stator plates of a section.

To check the bias resistors in the cathode leads of the detector tube and the power tube, disconnect the electrolytic cathode bypass condensers and then check the resistor with an ohmmeter. These condensers often have sufficient leakage to maintain an open circuit condition.

While making this test, check the leakage resistance of the bypass condenser with the ohmmeter.

Circuit disturbance tests on these receivers are limited to applying a small amount of current with the finer or removing the caps, for pulling out a tube opens all filament circuits and masks the effect of trouble. The above test should reveal in location of the trouble in any "dead" universal-type receiver which uses a conventional T.R.F. circuit.

ADDITIONAL DATA

Servicing Weak Receivers. Essentially the same tests are made on a weak receiver as on a dead receiver. In addition, the dynamic loudspeaker field may be checked by applying a screwdriver to a pole piece; absence of tone indicates either no poling or no magnetic voltage to it. The continuity of the cable should be checked with an ohmmeter, and the trimmer condensers should be replaced for maximum output. Weak reception can often be cured by moving the control-grid leads around enough to secure a small amount of regeneration.

It is a good idea to check the line voltage in the customer's home when weak reception is suspected; if this voltage is below normal, report the matter to the local power company. Ordinarily there is nothing you can do to a receiver of this type to offset low line voltage. Excessively high line voltage is not serious in these small receivers, for the tube filament and the pilot lamps are designed to stand up under all normal fluctuations in line. With D.C. power lines particularly, the line voltage on peak loads may drop to a point where no reception is obtained, and again the trouble is not the fault of the receiver.

Servicing Receivers for Hum. A certain amount of hum is to be expected in any receiver operating on an A.C. line. Many Service Men forget this fundamental fact and spend hours trying to eliminate perfectly normal hum which they observe after correcting an apparent defect in the receiver. Hum should never be so loud, however, that it becomes annoying when listening to the output of the receiver.

A leaky coupling condenser between the detector and the grid of the output tube is another likely cause of distortion. If you can measure a D.C. voltage across the grid resistor of the output tube when the voltmeter probe is connected to the grid end of this resistor, a leaky coupling condenser is indicated; replace with a 0.50-mf, 380-volt condenser if you cannot determine the value of the original part. Check the ohms values of the cathode bias resistors, and check cathode bypass condensers for leakage in the manner already described, for these are also possible causes of distortion.

Distortion often occurs when the volume control is turned up too high when tuned to a strong local station; this is a normal condition due to overloading of the receiver stage or of the loud-speaker, and the remedy obviously is for the customer to keep the volume level below the point at which distortion begins.

Curing Oscillation. A certain amount of oscillation is to be expected in receivers when the volume control is advanced to its maximum setting, for the designers of these sets do not provide for any regeneration for high gain. Oscillation at low volume control settings can be due to open bypass or filter components, as well as to defective lead-in to the source. Shielding of the control-grid leads of the power tube, if these leads are over-exposed, or changing the locations of these leads are likely cures. Connecting the aerial to the local station, or from an external ground is sometimes effective in eliminating oscillations. Cramming the aerial into a small space will often cause regeneration; keep this wire stretched out to its extreme length. As a last resort, when oscillation cannot be cured in any other way, detune the trimmer condensers until it ceases.

Intermittent Reception. Any of the usual causes of an intermittent receiver also apply to these receivers and must be expected in these machine, but my experience has shown that in most cases either a defective type 43 output tube or a defective coupling condenser between this tube and the detector stage will cause intermittent trouble. Try a new output tube first of all, then try a new coupling condenser. If the trouble persists, try a new tubular condenser in the receiver in turn with your hand in an attempt to make the trouble appear. If this is not successful, resolder all connections in the receiver. If the volume control is noisy in its action, install a new control. Check the aerial with an ohmmeter while holding it slowly back and forth through its entire length, for this will sometimes reveal a break.

General Suggestions. Unless you are thoroughly familiar with the socket connections of the tubes used in these receivers, always have tube base layouts at hand for ready reference. These layouts are particularly helpful when making point-to-point voltage or resistance tests and when locating various parts in the receiver.

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THE LATEST RADIO EQUIPMENT
(Continued from page 34)

CABINET PATCH KIT [1636]

HERE'S a very handy complete kit of shellac patch sticks that will suit almost every demand. With this kit you can patch wood as well as the new plastic and bakelite radio cabinets, and white refrigerators. Simply heat the patch sticks on the alcohol lamp, and melt the shellac sticks into the nicks at scratches, and smooth off with fine steel wool or hot spatula. Apply a little polish and the job is done!

SPECIAL PRODUCTS FOR TECHNICIANS [1637]

The unique properties of several chemical products developed for use in the laboratories and factories of a well-known company are very interesting in that they are being made available for general laboratory and other applications. As illustrated, these materials include the following:

1. A metal etch solution, D, which provides means for printing permanent markings on brass, copper and silver, as well as for marking tube bases, etc. A safety etch paste, for frosting glass surfaces in 5 or 6 minutes (glass to be etched in first parallelly or in a square and then cleaned off in the design to be frosted); an acid frost material, J, which affords convenient, rapid etching or frosting of glassware in from 10 to 15 seconds (may be used to produce a satin finish on glassware); glass etch material, I, that produces permanent white markings or monograms on glass; may be applied by rubber stamp and dries rapidly when heated.

2. A vacuum cement, A, which seals vacuum-tube joints vacuum-tight; also may be used to seal joints between metal and glass surfaces; does not become brittle with age, and adheres to, almost any surface.

3. A fluorescent chalk, H, that gives in pitch-black darkness when illuminated by ultra-violet rays, appears white in daylight; used on a blackboard it may be made to disappear by using a sunlamp or a black-light bulb.

4. A stopcock grease, C, No. 6, for lubricating glass stopcocks which may be subjected to high temperatures while at the same time maintaining a vacuum-tight joint; stopcock grease, C, No. 7, is particularly adapted for use on stopcocks which are connected in high-vacuum exhaust systems; No. 8 is used in obtaining vacuum-tight joints and also in providing lubrication when rubber hose connections are made with the metal types of vacuum exhaust pumps; No. 10 is recommended for general laboratory use at atmospheric pressure.

5. Glass marking ink (black), G, which may be used with a steel pen for applying letters to various glass surfaces; glass marking ink (white), H, also may be used with a steel pen for lettering glasses; silver monogram ink, E, may be applied to glass surfaces by means of rubber stamp; black monogram ink, F, which drive in about 2 minutes, also may be applied to glass or metal surfaces by means of a stamp.

TWO NEW SPARK SUPPRESSORS [1638]

(Continental Carbon, Inc.)

To accommodate modern spark plug and distributor wire designs, 2 new designs in molded-bakelite, carbon-type spark suppressors have been announced. One unit (A, in photo) is a 5,000-ohm suppressor which snaps directly onto the ferruled brass stud of the spark plug.

SERVICING QUESTIONS & ANSWERS

(Continued from page 55)

on the dial. How can this be corrected? (A.) Reception of 20-meter broadcast at both 14 mc. and 13.1 mc. is entirely in order. This condition is due to image-frequency "interference." Response at 14 mc., however, should be far greater than that at 13.1 mc. in order to correct this difficulty, band D must be re-aligned. The correct method of aligning this band consists of "rocking" the tuning gang condenser with indicator set at 18 mc., and the signal generator tuned to this frequency, while adjusting the trimmer for this band for maximum output.

Please Say That You Saw It in Radio-Craft

THE LATEST RADIO EQUIPMENT
(Continued from page 34)

PLUG-IN METER RECTIFIERS [1639]
(The Triplet Electrical Instrument Co.)

All testers that use one instrument to measure both D.C. and A.C. require a rectifier to change A.C. to D.C. The usual practice has been to build in copper-oxide rectifiers. Line surges, accidental misuse, etc., frequently cause burnout of the copper-oxide rectifier and this has heretofore required not only the problem of opening up, getting at and replacing the copper-oxide unit, but also recalibrating. This new plug-in rectifier makes this problem as simple as renewing a burned-out fuse. The rectifier is mounted in a small plug with regular tube-base prongs. In the shell with the rectifier are the necessary calibrating resistors, making possible the interchangeability of the plug-in unit.

New plug spark plug resistors include: a 5,000-ohm unit, A, and a 10,000-ohm suppressor, B, both of copper oxide type (1638).

Schematic circuit of the Hammarlund unit-type amateur radio transmitter illustrated photographically and described on pg. 33. This factory predesign of the assembly helps insure best results. (1621)
(Continued from page 31) INTRODUCING—A 5-METER CONVERTER

The converter delivers an I.F. of just over 300 megacycles. It is fed directly to the antenna of the broadcast receiver on which the dial is set to the above frequency. The converter has an on-off switch and a switch to connect or disconnect the antenna directly to the broadcast receiver when the converter is not in use. This means that once hooked up the converter need never be touched.

PLACING THE CONVERTER IN OPERATION

This converter is designed to be used in conjunction with any receiver, either superheterodyne or tuned-radio-frequency type, which tunes in the standard broadcast band and frequencies up to 1,520 megacycles.

Place the converter preferably on a table, as close as possible to the receiver. If placed directly over an intersection, microphonic noises may result.

The converter is easily installed and contains its own A.C.-D.C. power supply. A mixer circuit in the converter delivers an I.F. of just over 300 megacycles, which is fed directly to the antenna of the broadcast receiver on which the dial is set to the above frequency. The converter has an on-off switch and a switch to connect or disconnect the antenna directly to the broadcast receiver when the converter is not in use. This means that once hooked up the converter need never be touched.

FLYING TO THE MOUNTED TOASTER

(2) Experimental programs of several types, including special high-fidelity broadcasting over about 7 meters; and the audio channels of the ultra-high-frequency television stations, may be heard.

(3) It is also possible to "keep tabs" on programs of stations which cannot be heard in. Ultra-shortwave broadcast programs may be heard, with high-fidelity characteristics, when regular broadcast reception is at a standstill due to static.

The Kaletote No. 210 converter is designed to convert any broadcast receiver—superheterodyne or tuned-radio-frequency—for reception of frequencies from 30 to 45 megacycles. The primary interest in this range lies in the broadcast band at 40 to 41 megacycles. Many of the regular stations in large cities are installing transmitters to operate in this newly assigned band. They feature programs of special interest with emphasis on educational programs, sporting events and special "from the scene" broadcasts. Many of the stations are entirely on a non-commercial basis with no advertising allowed on their programs.

These stations are practicable only in large cities, as transmitters on these ultra-high frequencies, regardless of power, cannot cover a radius of much over 50 miles with the ground wave. The skip distance is so great that the sky wave will only be heard across the continent or in Europe. This means complete absence of interference between stations even though they operate on the same frequency and are only a few hundred miles apart. Atmospheric interference is much less noticeable on these frequencies. When there is more than one station in a city, they are required to operate on channels 40 kilocycles apart. This gives an opportunity for true high-fidelity broadcasts which are impossible on the regular broadcast band with only 100-kilocycle separation.

In addition to this broadcast band, the converter tunes many special government services and the 50-megacycle frequency transmitters throughout the country. The converter is easily installed and contains its own A.C.-D.C. power supply. A mixer circuit in the converter delivers an I.F. of just over 300 megacycles, which is fed directly to the antenna of the broadcast receiver on which the dial is set to the above frequency. The converter has an on-off switch and a switch to connect or disconnect the antenna directly to the broadcast receiver when the converter is not in use. This means that once hooked up the converter need never be touched.

THE FIRST 10 STEPS IN RADIO SERVICING

How do you go about servicing a set? One well-known radio engineer submits the following as the first 10 steps.

(1) See that power supply to receiver is satisfactory. Check loudspeaker leads, antenna and ground connections.

(2) Operate the set if possible. If trouble is not obvious, remove tubes and check them.

(3) Touch the grid cap of I.F. tube or tubes with metal object, such as a screwdriver, and listen for click in speaker.

(4) Check speaker transformer, voice coil and cone, and make certain they are satisfactory.

(5) Remove chassis and check power supply completely.

(6) If power supply is OK, next measure all filament voltages, plate and screen-grid voltages, and bias values—compare with specified values in circuit diagram or tube data book. If voltages on individual tubes are high or low, test components in the feed circuit.

(7) Make certain that the audio circuit is functioning properly. If it is not, then proceed to work from the detector to the antenna, one tube at a time, until the fault is located.

(8) If no apparent trouble can be found, examine carefully all wiring, grounds, switch contacts, socket contacts and controls.

(9) Use meters and check values of all components, especially those in the battery section.

(10) Check, clean and adjust all wave-change switches, and if necessary, clean dirty tie points which would otherwise cause low insulation resistance to ground. Clean insulators on glass condensers and resolder all weak connections in set. Replace noisy controls. Adjust alignment of receiver.

Please Say That You Saw It in Radio-Craft.

Figure 8. This is the compact chassis of the 5-meter converter. It supplies its own operating power.
"BI-FONIC" SOUND MAGNIFIER

(Continued from page 25)

ACTION AT HIGH FREQUENCIES

Figure 2 shows graphically how the very high-frequency waves are reflected in whole off the halfround blocks. Some of these waves are reflected back through the air and others are reflected to another curved surface. To avoid confusion only 2 patterns of these waves are shown; actually, there are many hundreds.

At the very high frequencies, 2,000 to 15,000 cycles, the shape of the waves inside the cone is not the set of halfround surfaces directly in back of the cone. Because of these surfaces being curved some of the waves are reflected and others are projected against the walls of the enclosure where they are further broken and weakened, thus creating a series of reverberation within the reproducer. The glass or varnish on the curved surfaces determines the rate of this reverberation.

ACTION AT MEDIUM FREQUENCIES

Figure 3 shows graphically how the frequencies are large enough to cover more than 1 halfround reflecting surface and are therefore broken up into many parts. Some of the broken wave reflections are reflected to an angle as to be projected through the cone.

At the medium frequencies (200 to 2,000 cycles) the broken curved wave faces are such that these waves are broken by the alternate vertical and horizontal strips on the back surface of the cone. As these parts are projected against the side walls where their strength is further divided. At these frequencies the period of the wave is so small that all of the extreme "highs." This avoids any cabinet resonance which generally lies within this band of frequencies.

ACTION AT LOW FREQUENCIES

Figure 4 shows the shell of the reproducer minus the reflecting half-round surfaces, since they are not in use at the low frequencies.

This figure shows how the wave is reflected from the largest possible area of the reflecting half-rings. This way the sound waves are spread over the largest possible area of the speaker. It is this way to which sound waves are scattered by the enclosure of the speaker. As frequencies increase the pressure causing the sound waves decreases. In this way the wave is automatically coupled to the mass of air contained in the tubes at the low frequencies. The low-frequency wave projected into the first tube strikes the mass on the side of the cone. However, being reflected from the mass surface common to these tubes, the phase of the wave is inverted.

The sequence takes place between tube No. 2 and tube No. 3. The current in tube No. 2 is projected down tube No. 3 OUT-OF-PHASE with the front-wave of the same component. Snipping the direct current or the reflecting surface at the end of tube No. 3 the wave is projected into free air IN-PHASE with the front-wave. This has the effect of creating an equivalent of a reverberation period at the low frequencies. The length of the tubes and size of reflecting half-round surfaces so choose that frequencies high enough to cause half-wave cancellations are not projected back into the air.

At the resonant frequency of the tubes the resonating wave is cancelled out within the tube. This is due to the phase inversion taking place within the tubes.

As a result of these functions the cone is undamped and gives a more solid feeling at the very low frequencies the cone automatically sets a much larger body of air into motion, giving proper air displacement in the low notes. Also, and for the first time (to the knowledge of the author), the back-wave is inverted and used at all frequencies.

The author has several of these reproducer in operation in New York City and other places to date with a very good reception and the following results were noted:

1. The sense of music coming from a cabinet or display case is very much increased.

2. Bass notes were present in correct proportion at all volume levels.

3. Bass notes were not boomy but solid and save the foundation body so necessary to music balance.

For a given acoustical output about one-half the power was required that would be necessary with an infinite baffle.

In actual tests a 12-inch permanent-magnet cone mounted in a Bi-Fonic Reproducer housing cut performance in an acoustic cabinet by the field dynamic cone mounted in an "infinite baffle." (See "Tests About the Infinite Baffle," Radio-Craft, May, 35.)

CONSTRUCTION NOTES

The "Bi-Fonic" Reproducer (suitable for mounting cones from 6 to 12 inches in diameter) is shown in Fig. A. It stands 36 inches high, 20 inches wide, and 18 inches deep, and is constructed of ¼-inch pine plywood and mahogany. The half-round pieces are of spruce or pine and glued and treated with an oil- and varnish. The back is varnished and then coated with wax. The other surfaces are painted. A few precautions are necessary to prevent certain joints from being air tight and solidly made or they will break open and rattle.

The author of demonstrating, comparatively, to music critics just what the Bi-Fonic Reproducer could accomplish, a switching system was devised whereby a listener could be disconnected and an equivalent-sound unit, in a Bi-Fonic housing, driven by the output of the original permanent-magnet speakers. The Bi-Fonic set-up the "highs" became more brillian and full bass was produced, the midrange being carefully balanced enough to give the effect of the proper operation of the reproducer.

The "Bi-Fonic" Reproducer, with the Bi-Fonic Cord, is available at the free-mail offers price of $2.75.

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For instance, a very fine installation can be made, where the customer already has a fairly good radio set, by removing the loudspeaker from its cabinet and installing it in a Bi-Fonic Reproducer housing. This "trick" has the effect of making the set apparently more sensitive to weak signals. By the same time almost doubles the effective power of the set; these things, aside from the increase in bass response and general liveliness of tone. Invite prospective customers to hear a set-up of this type in your display room or shop, if necessary.

Another good sales-getter, and one which we have found very effective, is the following description, to take a medium-size mantel set (such as illustrated in Fig. A), and connect the volume control into the plate coil of a P.M. speaker installed in a Bi-Fonic housing. With this idea you can make very satisfactory recommendations.

Public Address specialists will be interested to note that the Bi-Fonic Reproducer's field of application is practically unlimited; the unit's response is uni-directional over an angle of about 120 deg., and is most effective in the very low and very high frequency range (and hence is not suitable to apply in those cases where a high directional quality is wanted and only the speaking voice is to be used, as a horn or projector), but where music is to be reproduced and wide-angle radiation is desired, it is unbeatable, either indoors or outdoors. It is exceptionally suitable to a broad-cast or monitor speaker. Here are a few ideas, for your consideration, concerning the application of "Bi-Fonic" sets.

Churches, Lodges, Clubs, Theater Sound Systems, Doctors' and Dentists' Offices (waiting rooms), Schools (auditoriums), Parks (summer-time municipal park concerts), Restaurants.

Because of the increase in the efficiency (more efficient loading) one cone mounted in a Bi-Fonic Reproducer housing, about 1/2 the power is needed to produce the same loudness as a cone of the same size in an infinite baffle. As a result, you can use lower power for the same degree of intensity, and in most cases, use class A amplification (with its inherent lower degree of total harmonic distortion) instead of A or B.

In conclusion the author desires to emphasize the following points:

(1) The back-wave is utilized at all frequencies.
(2) There is no noticeable resonant point.
(3) Bass cut-off is limited only to the cut-off characteristics of the speaker unit.
(4) In addition to greater air displacement at the lower frequencies, equal efficiency is raised over 3 db. in the middle register, over 5 db. in the extreme high register, and from 5 to 10 db. in the bass register!

MATCHING LOUDSPEAKERS TO TAPPED TRANSFORMERS

(Continued from page 21)

And check:

Zrs equals 4/2.42 = 5,000, or 5,200.
Zrb equals 8/3.82 = 5,000, or 5,125.
Zre equals 2,000/3.79, or 564,200.

Putting these in parallel, because that's how they look to the tube output, we obtain 4,080, which is close enough.

It is worthy of note that the impedance that a load reflects into the primary is a function of the ratio it bears to the impedance of the secondary transformer from which it is supplied. Thus, in the extremes, if the load is infinite, the reflected Z is infinite, because infinity divided by any number, except infinity (which is one, or a number at all, but a concept) is infinity. If the load has 6 ohms impedance, theoretically, on a short-circuit, the reflected impedance is also 6 ohms, or the theoretical short-circuit, because 6 divided by any number, although mathematically impermissible, is in actual practice, 0. If you have a month's spare time, look into the mathematics of this.

SERIES VS. PARALLEL CONNECTION

One more point deserves mention. Why not put the two speakers in this problem, or the speakers in the first illustration, in series, instead of parallel? Quite feasible. Thus in the problem, each diagram would look so follows: (See Fig. 1D.)

Only the upper tap is altered; the others remain just as they were. Now the load Z is 16 ohms, still 8 watts, and, applying our rules, Za equals 9.68 ohms. Since 16 is to 9.68 exactly as 4 is to 2.45, the reflected Z is the same, and, apparently, the problem is unsolved.

But, suppose now one of these two speakers is removed, either because unnecessary, or due to failure in operation. In the series arrangement, this opens the load on Za and the whole kaboodle is thrown out of balance. How much? Well, if it fails in operation, the remaining reflected impedance is now 11,200, hence the tube output is materially decreased, and other speakers will suffer. If it is removed, and the one in series connected across the whole winding, it will be overloaded slightly, begin to work, and the reflected Z will be 3,120, slightly overloading the tube and cutting the balance of the whole arrangement.

In the parallel arrangement, if one fails or is removed, the total reflected impedance will be 6,700, which will not upset the arrangement enough to cause worry. Moreover, the remaining speaker will not be overloaded. In practice, there is little advantage in connecting them in series, and the parallel connection is most commonly used.

It is hoped that the above discussion, in which test cases were used as examples, will be useful as a practical reference on the subject.

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RADIO-CRAFT for JULY, 1938

For the technical information and data needed by the radio enthusiast, observer or student.
UNIFIED P.A. EQUIPMENT

(Continued from page 28)

1 microphone power supply unit
1 speaker field power supply unit
1 speaker line matching transformer
or total output of the apparatus

 undone for 69 of this issue. It IS OF GREAT INTEREST TO YOU.
A WIRED-RADIO "NURSEMAID"

(Continued from page 38)

If it is found difficult to trace the wiring of the fuse box, simply try the condenser under various conditions in a combination that properly closes the 220-volt circuit, or until a combination is obtained which produces a satisfactory operation of the Nurse. This condenser is fully protected by its internal fuse, and even if improperly installed will cause no difficulty whatsoever from short-circuits, etc.

IMPORTANT INFORMATION

If the Nurse Radio lacks Sensitivity: The Nurse Radio is designed to operate under normal home conditions. When it is operated in a commercial setting, lack of sensitivity may result due to heavy light loads, heavy power loads, high line capacities, split wiring circuits and heavily bypassed or filtered wiring commonly used to reduce line disturbances in radio receivers. The Nurse Radio being a radio-frequency-operated device depends on freedom of loads or capacity on the line which factors partially or completely bypass the signal. To override this condition and obtain proper efficiency from the Nurse Radio in commercial installations, the various factors must be eliminated. If, however, this is not possible then isolated power line must be used. Isolation can be accomplished by placing an R.F. choke in each 110-volt lead of the wall outlet and running the 110-volt leads from the chokes to both the Guardian Ear and the Nurse Radio direct. Do not determine that the Nurse Radio lacks sensitivity unless such isolation has been made, and the units separated far enough, and well isolated by an R.F. choke to avoid howl with the volume control set at maximum.

Interference from A.C.-D.C. receivers. Due to the type of circuit, and rectification system employed in A.C.-D.C. receivers, they may cause a loud interference in the form of a hum to be heard in the Nurse Radio. This can be overcome by using the same filter at the socket to which the A.C.-D.C. receiver is attached. A soldering iron may also cause this interference in which case the same filter units may be applied to the interfering device.

Names of manufacturers will be supplied upon receipt of a stamped and self-addressed envelope.

HUM IN PUBLIC ADDRESS INSTALLATIONS

With the introduction of the base reflex speaker and its consequent improved low-frequency reproduction, the question of hum in Public Address installations is becoming of greater importance.

The manufacturer of sound equipment in this respect needs very little assurance of the installation organization to the end that the installation should be properly made. It is very important with the low-level microphones that are now being used that the continuity of the signal be maintained. In other words, even a break as small as 1/10 inch in the microphone wire shielding will introduce a serious amount of induction pick-up in the system.

The amplifier should be grounded to eliminate the floating chassis condition. The selection of the proper ground is also important. It is an unfortunate matter that many of the radio tubes available on the market today, while ideally suited for tube heating, are of too noisy a character for general Public Address work. The construction of the tube heater structure has much to do with the amount of hum that will be generated by the amplifier. It is a fortunate fact that the manufacturers of tubes are appreciating more and more the importance of humless tubes for public address work and to this end a number of manufacturers have worked very closely with Webster-Chicago to supply tubes particularly adapted to radio applications. It is to be hoped that in the future tubes will be available with some type of designation marked thereon indicating that they have been developed for high-quality sound work.

On some of the smaller light plants, where the waveform is not particularly good and the power supply contains harmonics of the order of the 17th, 19th, etc., inductive ringing becomes a problem that requires close attention to input shielding and grounding.

Please Say That You Saw It in RADIO-CRAFT
WAX AND OIL CONDENSERS
IN RADIO SERVICE WORK

(Continued from page 29)

<table>
<thead>
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<th>VOLTAGE AND CAPACITY CONSIDERATIONS</th>
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In the replacing of wax- or oil-impregnated paper "capacitors"—as they are known today to the trade—the Service Man is concerned with voltage, capacity, and the proper working voltage, capacity tolerance, inductive or non-inductive sections, power factor, capacity of the unit, the manufacturer, and the actual capacity of the unit. These factors do not pay close enough attention to capacity tolerances, and mark units anywhere from 25 to 150%, from their actual capacity values.

The actual capacity marking should be carefully checked by the Service Man before final replacement is made in the set. After locating and repairing the trouble, the Service Man can check against the rating of the new condenser, if the condenser is one where the capacity value is at all critical. This applies especially to the smaller-type condensers which are used in oscillator circuits. If the capacities are not of the proper value, the oscillator will not properly operate as originally intended by the set manufacturer.

CHECKING FOR "WAX" OR "OIL"

When selecting the proper working voltage at which the units are to be operated, the Service Man should take into consideration the likely possibility of receiving a high peak voltage due to line surges and other faults beyond the control of the usual operation of radio receiving equipment.

In the manufacture of wax- and oil-impregnated condensers, each unit is originally flashed for future use as the working voltage. A representative unit of each group manufactured is placed on life test at 3 times the rated working voltage to determine the actual capacity of the condenser. These conservative ratings of condensers by reputable manufacturers assure the Service Man freedom from future breakdown provided they are used when replacements are made in a radio receiver.

The choice of inductive or non-inductive sections for replacement work can easily and quickly be chosen by careful observation of the unit which has failed. A non-inductive section is usually wound with an extending margin of foil on either side of the paper or dielectric. The inductive type of winding appears as though the paper extends beyond the foil, with tabs as connectors.

POWER FACTOR

The power factor of a wax- or oil-impregnated condenser is of considerable importance. It is a measure of power loss in a condenser when placed on A.C. or radio frequency, and is especially present to a greater degree under the higher power input. The effect of poor power factor in a condenser may be likened to that produced by building in a series resistor with the load, thus reducing efficiency.

Poor power factor in a condenser may be caused by a number of reasons. For example, a poor or low grade of paper, poor or low grade of wax and oil, improper impregnation, high-resistance leads of the condenser caused by tarnish or the use of solder, poor sealing, and many other small sundry reasons which close production control can eliminate.

Condensers today are available in many styles, shapes and containers. The particular type is a consideration of the space and mounting room available in the radio receiver.

In replacing condensers, a Service Man sometimes places the condenser close to a resistor or vacuum tube. The results are noticeable in a short time. The heat of the resistor or vacuum tube is absorbed by the condenser, melting the wax filler. The condenser is then forced to "breathe" by expansion and contraction as the set is turned on and off. If the condenser is mined, moisture enters the unit and in short order the unit is made ineffective. Condensers should never be placed too close to a resistor, tubes or any other heating elements. Many manufacturers in designing equipment make the mistake of laying out the chassis with the tubes below the condenser, where convection currents of heat pass around the condenser, causing it to heat up. Melted wax, and the ultimate invasion of moisture results in direct failure.

SERVICING MULTI-BAND SETS

In the servicing of multi-band receivers today, the Service Man will notice that the original manufacturer has had to resort to a few new tricks. Among those he saw was the difficulty in properly bypassing the radio-frequency current at widely different frequencies. In many cases, special condenser construction was required, such as in the shape of the unit, the casing or mounting, and the length, width and size of the leadings.

Usually in replacing such a unit which has failed, it is necessary to use an exact duplicate plate. If the trouble is serious or very simple, the Service Man can check against the rating of the new condenser, if the condenser is one where the capacity value is at all critical. This applies especially to the smaller-type condensers which are used in oscillator circuits. If the capacities are not of the proper value, the oscillator will not properly operate as originally intended by the set manufacturer.
the ganged tuning condenser should be removed, and contact and shaft polished with fine sandpaper. This will rectify any tendency toward the shorts that are hard to locate.

The tone control is situated in the circuit contacts. It will be necessary to remove the filter block to reach the sockets of the types 80 and 47 tubes. Always replace the tone condenser before replacing the tone control. A leaky condenser here will ruin an expensive control.

Sparton 913. There are many of those old sets still afloat. One of these with an added inductor may give some cold reception. The aid of a new socket analyzer the trouble was found in the primary of the audio transformer of the added stage. This was replaced by capacity coupling. See Fig. 3.

To remove the filter condensers the receiver is first turned off and the Primary of the 182B filament layout is floated. The layout of the 182B filament circuit are additional weak points.

This set may be retubed with types 27 and 21 tubes. If oscillation is encountered bypass the plates as above.

Chevrolet 500-555. Vibrator noise drowned-out the locals on this set. The vibrato pack was removed and a "B" eliminator substituted. The set was heard. It was found that the filter condensers had dried out. They were removed. See Fig. 4.

As a final note, a "haywire job" on an 8-mf. midriff electronic was wired across the input. The vibrator noise almost vanished.

Small A.C.-D.C. miitets. Oscillation is a common complaint. It can be cured by shielding both the transformer and the chassis. The detector grid-leak lead may be too close to the 4L.

Hum may be due to either electrolytics as above. Cut loose the "B"-plus lead at the rectifier cathode or cathodes. Run this to the "B"-plus of another to connect 44-2 to chassis. Don't ground either chassis. If you are on a concrete floor don't touch any bare shafts.  R. DECK, JR.

Stewart-Warner R-172A. Firestone (Air Chief) R-164A Chassis. Weak or no reception on the broadcast band. Short-wave reception OK. A short at the broadcast antenna short trimmer on top of the center section of the 3-gang tuning condenser has caused this trouble in a number of cases. A soldering lug on the condenser framework is too close to the trimmer and should be bent up clear. This defect is hard to check and requires very close inspection. On one Stewart-Warner this lug was just close enough to cause intermittent reception. It is advisable to check up on all models using this same tuning unit.

Victor R-32, RE-45, R-52. Quite often the 110-volt bulb is found burned-out in these receivers. This may be due to the fact that the bulb is not on at the same time it is a good idea to rewire for a 2.5-volt pilot bulb as these are always on hand and give sufficient light. The total cost of a new socket and bulb is no more than the 110-volt bulb and future replacements will be the same. These sockets are made of the type 45 amplifier socket supply.

Zenith 50 and 60 Series. When any one of these receivers is very weak and an attempt to balance the trimmer condensers at any particular setting still weakens the rest of the tuning range, remove the tuning condenser, slip the plates and center each section separately while fully meshed. Check the spacing again with the test meter. When this is done, it may be necessary to bend a plate here and there to obtain satisfactory clearance. Replace the shield and re-balance. If these changes are carefully done results are almost astonishing. An annoying hum at low volume levels in these sets may be suppressed by adding a tone condenser from the detector cathode to ground.

RCA Victor 125, 224. The peculiar condition may be encountered on these models where the receiver is totally inoperative except at one point on the broadcast band. A powerful station at 600 kc. is heard weakly at this setting, with another station which regular assigned frequency is 710 kc. heard as a background. The trouble, unquestionably one in the oscillator circuit, will be found due to a short-circuited oscillator section of the tuning gang, which is occasioned by the shorting of the heavy flexible copper landing lead, between gang condenser and chassis, to the burr or burr slater lead of the oscillator section. This pigtail is unnecessarily long and since the tuning gang is floated, trouble at this point is unavoidable.

The symptom of choked, irregular and distorted reproduction has been traced to a short-circuited or leaky 407 cathode bypass condenser. This is a 4-mf. electrolytic unit mounted on the terminal strip located near the rear wall of the chassis under the 407 socket. The degree of distortion will depend upon the leakage of the electrolytic condenser. The correct resistance to be obtained by using a condenser from the cathode of the 407 socket to chassis is approximately 4,000 ohms.

As in the models 121, 122, reception of the most strong stations at two resonance peaks about 20 kc, apart, with distorted, muffled reproduction between these two points is due to a short-circuited or leaky 0.05-mf. secondary-return bypass condenser of the I.F. stage. This condition will continue, to ground the volume control is advanced to a higher level than usually maintained.

HUBERT M. FRIED

NEW CIRCUITS IN MODERN RADIO RECEIVERS

(Continued from page 20)
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CONTEST RULES
(1) An award of a 1-year subscription to Radio-Craft will be given to each person who submits one or more WITTIGUZZES that the Editors consider suitable for publication in Radio-Craft.
(2) WITTIGUZZES should preferably be typed; use only one side of paper.
(3) Submit as many WITTIGUZZES as you care to—the more you submit the more chance you have of winning—but each should be submitted on a separate sheet of paper.
(4) Each WITTIGUZZ must incorporate humorous elements, and must be based on some term used in radio, radio address or electronics. Each WITTIGUZZ may have 4 "answers," only 1 of which of course will be correct; and, only 1 of which is non-radio.
(5) All answers must be grouped, by question number and correct-answer letter, on a separate sheet of paper.
(6) All contributions become the property of Radio-Craft. No contributions can be returned.
(7) This contest is not open to Radio-Craft employees or their relatives.
(8) The contest for a given month closes on the 15th of the month following the contest's publication date. The winners will be notified in the next issue of Radio-Craft.

RADIO PUBLICATIONS, Inc.
907 Hudson St., New York, N. Y.
TELEVISION WITHOUT SCANNING?

(Continued from page 12)

the minority of people rather than the majority. If we take this recognition into engineering, we might then say, "In a new science, there is the possibility that the minority of engineers are doing the wrong thing.

Let us therefore, join the minority and detach ourselves and come out from under the influence of tradition. Let us make a new channel of thought; let us dare to look at El Dorado. Can we think a television system without scanning? Can we think of a very good and very logical way in which television may be transmitted without electrical and electronic means without scanning?

When I first considered these possibilities, they were as foreign to me as the moon was to the farmer who for a thousand years has been busy cultivating the soil. The farmer is accustomed to a certain routine of life, and the thought that there might be an unimpressed image of people reading a script before my eyes, without the aid of some sort of medium, was a strange one to me. The thought that time has passed, I have been inclined to look at these possibilities more and more seriously. I have found that the minute one is willing to think, the unimpressed image of television must not be counted as an addition to a radio set where one will see the comparatively uninteresting images of people reading a script before my eyes. The thought of a television system is not to be unimportant to the user of television how the pictures get onto the screen in his home. He will be satisfied to have them arrive via telephone or pipe as long as it is clear and not too expensive.

Therefore, let us look into a system which is extremely simple in principle, comparatively inexpensive, and equal in brilliancy to the present scanning type of television.

A "SCANNER-LESS" SYSTEM OF TELEVISION

Let us assume that we go to the top of a tower in the center of a city and set up a large monitor projector with a wide angle projection lens. Further assume that we may use a powerful source of infra-red radiation which is not even visible when used on cloudy or foggy days for illuminating the city. We project the image directly out from space to the projector just like we do in projection vision, but all the time using no screen or objective lens. Again assume that we, and all of those projections, are all in different directions so that we cover a complete circle. Let us imagine a television system of this kind.

If these projectors were set into operation and expanded to the rear of his house and looked through a pair of binoculars, he would see a clear and distinct view of the motion pictures just as though he were watching them on a screen or a telescope. He might actually project a very small picture on a screen behind the eyes of some places. The image becomes dimmer and smaller as one moves farther away from the original projection. If we could construct a periscope in combination with his telescope, he could then view inside the house without going to the roof and see the motion pictures. This might be called a form of "peephole" television. The optics of such a system are shown in Fig. A. Like all telescopie images, they would be small and lack brilliancy.

We can see at a glance that all we need is the combination of the amplifying radio tube and loudspeaker in radio broadcasting systems. See Fig. 2. The light intensity in the brilliancy of the light and project a small picture received upon a large screen, we have a rather natural image with no loss of brilliancy and transmission, providing the light amplifier is not too complicated. Certainly the cost of the equipment is less than the projector in the case of the ordinary tower is insignificant compared to a television transmitter and receiver. If the light amplifier is replaced by a loudspeaker, the system is completed.

Furthermore, the definition of the picture is as good as that of the motion picture and there is no loss of definition with the exception of the obstacles of dust, smoke and fog which would obscure the image. And if one is very far away from the projector, if, however, the light amplifier could work on long, infra-red rays, the image could be seen from a distance and for a long time.

To convert this infra-red radiation into visible radiation directly just like a radio receiver converts long waves into audible sound waves, then we could see the image at all times of day or night regardless of weather conditions, and at a distance. The radio receiver is the "light amplifier" of our radio receiver for a distant television station.

PROBLEM: THE "LIGHT AMPLIFIER"

It is readily apparent that this entire plan depends upon a successful "light amplifier" which will amplify the size and brilliancy of the picture on the screen. The system of modern electron image tubes appears to answer this requirement very nicely.

By reference to Fig. 3, we see a form of electron image tube; as described in a past issue of Radio-Craft, a sensitive photoelectric coating is deposited upon one end like a camera plate film. The lens focuses an image of a performer upon this photoelectric surface. Electrons leave this surface in proportion to the strength of the light falling thereon, that is, many electrons leave the points where there is considerable light and no electrons leave from the black parts of the picture where there is no light.

In a television set, these electrons are accelerated in straight lines through the rings charged to a positive potential in front of the photoelectric coating which is illuminated by the light and focused upon the photoelectric surface at the other end of the tube where we obtain a reproduction of the image focused upon the photoelectric material at the other end.

Since the brilliancy of the image is proportional to the intensity of the light on the screen and as the number of electrons released, it is only necessary to apply higher potentials to the screen to increase the brilliancy up to certain limits. Therefore, a feeble image—small, and dimly illuminated on the photoelectric end—becomes a strong, bright image on the fluorescent end of the tube. This image is computationally undistorted and is limited in quality only by the fineness of the photoelectric screen and the fluorescent screen.

If, after one stage of amplification through a tube of this kind, the image is still too small and too weak in brilliancy, we can add another tube just like we do in a radio receiver or amplifier when the sound is too weak. We then place the photoelectric material in one tube right up next to the fluorescent screen of the other and amplify the picture. We can repeat this operation again and again just as we add one tube after another in radio practice until we reach the limit of amplification.

A complete illustration of a machine for picking up this extremely weak image and projecting it upon a wall is shown in Fig. 4. Such a device only requires a source of voltage from a rectifier and negligible power as compared with a radio receiver; and there is nothing about the light amplifier tube to wear out for many years. There is no scanning; there are no controls for synchronizing or tuning; there is only the necessity for one control and this is a mechanical device such as the diaphragm on a camera which can be automatic or manual in design depending upon your receiving conditions.

There is no electrical interference, and briefly, no fans and commotion.

We are so seriously interested in the possibilities of this equipment that we are giving it considerable attention in our laboratory. We have every reason to believe that these laboratories actively engaged in television development are doing the same thing.

ANSWERING QUESTIONS

There is one point that I am sure you are wondering about, and I almost selected to explain. The natural question at this moment is, "How could we pick up sporting events or any detail that can be seen, with this equipment immediately without reducing the action upon film first for projection through the tower lens?" The answer is, "Because you pick up a signal from a speaker's voice in a microphone and build up to a large enough energy to broadcast it everywhere from a powerful radio station."

The answer to this is, "We amplify it. Obviously then, we are the same kind of amplifying projectors to pick up the original event. We amplify the light and we project it. Certainly, we use larger tubes and bigger periscopes and telescopes, but we can pick up any action and rebroadcast it. We use infra-red rays for light and sound."

Now you may say, "This system is limited by (Continued on following page)"

Please Say That You Saw It in Radio-Craft
TELEVISION WITHOUT SCANNING?

(Continued from preceding page)

the horizon. Any building will shadow reception and we shall have to extend our periscopes up high enough to see over them. To this, my answer is, "These same conditions apply to ultra-short-wave television under scanning. If one's antenna is not high enough to pick up the satellite, how about the coaxial cable for ultra-short-wave television?" The tubing for the periscope is actually larger and more expensive than for the satellite."

If one says, "How about the lens on the roof?" We answer, "It is cheaper than the dipole antenna required for good television reception."

Then if one asks, "How about the light amplifier tubes?" We can say, "They should certainly be less expensive than a modern television receiver."

CONCLUSION

In conclusion, even though the modern scanning television system is highly practical and useful, we have herein another way of doing the same thing in an equally effective manner and at a much lower cost. And that is why we are enabled to give you an accurate simplified, technical review of oscilloscopes and television receivers in such an easy manner. We may have given the manufacturer the idea for making the, modern television receiver."

We answer, "It is cheaper than the dipole antenna required for good television reception."

Are we serious? Do we expect to announce such a discovery in the near future and make a demonstration of it? Time will tell, and I am willing to wager that upon reading this article, several Eastern Laboratories are going to say something about putting on double speed to beat us to it.

SERVICE MEN! REPAIR YOUR CUSTOMERS' SETS "BETTER THAN NEW!"

(Continued from page 17)

back a chassis that tunes-in notes on resonance, and high-frequency and the shieldings, give him the whole musical scale at once, that is what you are being paid for. If the customer wants a radio set for distance work, sell him a professional communications job.

When spreading the I.F. curves you will probably find some gain, but because the sensitivity is more than offset by the improved tone quality, the set will probably make a good receiver. The objective purpose of an oscilloscope in service is to give you a visual indication of the selectivity of the radio set for your test. Just put the oscilloscope in line with the I.F. stages for maximum gain can be done just as efficiently with an ordinary output meter.

Next we adjust the wavemeter for minimum peak, and then align the R.F. and oscilloscope circuits. If necessary, bend the oscillator condenser plates to insure proper tracking of the pointer to the dial calibration; once again it will probably be necessary to sacrifice some sensitivity in order to keep the dial pointer on calibration at the low-frequency portion of the dial, but it will please the customer to know that he can now tune-in stations exactly where the newspapers say they are. Now take an overall selectivity check of the receiver, tune in a 1,400 kc. signal to the antenna terminal, and make any slight adjustments necessary to the I.F. trimmers to give a nicely balanced wave form.

Now the job is practically finished, connect the outside antenna, set the controls for the voice channel, and supply a 450-cycle audio note to the output of the 2nd-detector, check the resultant image for sidebands, and apply pure waveforms to the screen; if bad distortion is noticed, check the audio regeneration, detector, coupling, and bypass condensers and transformers until the faulty part is located. Shut off the oscilloscope and run the audio generator through the entire receiver to check the detector for cone rattles. Now connect the radio receiver to an antenna equivalent to the one used by the customer and let the set run for a half-hour on a local station as a check on fading, while you prepare the next chassis for the oscilloscope.
Its stockholdings in the Canadian Marconi Company were sold for $1,725,000 in cash. The profit from this transaction will be credited in this year’s account to Earnings Surplus.

Of the company’s total assets approximately 84 per cent is invested abroad, of which the United States, only 6 per cent remaining in interest in plants and equipment, nearly all of which are wholly-owned subsidiaries, are largely confined to South and Central America. This does not mean that they are withdrawing from the foreign field, for they have patent license and engineering service agreements with leading companies in the principal foreign countries, resulting in payment to it of substantial royalty and service fees. The RCA Manufacturing Company, however, we export business in many parts of the world with radio receiving sets, tubes, broadcast transmitters, sound motion picture equipment and related products.

Among its liabilities is $10,460,000 of notes payable to banks. Ten million dollars of this amount was borrowed from banks in 1936 to finance the retirement of the company’s 7% “A” Preferred stock. Twenty-four million dollars of this amount was paid off in notes to banks, reducing the remaining liability to $8,980,000 and saving thereby $860,000 a year in interest charges.

TAXES

This huge corporation does not thrive without paying for its business privileges; and it pays well. RCA last year paid in taxes a total of $257,000. The total of all taxes for the year 1937 equaled 42 cents a share on the Common stock of the company—almost exactly the figure earned on these shares. The government received more than twice the amount in taxes that the stockholders of Common stock received during the year. The radio industry is not only a large tax-payer but has become a substantial member of the American business community employing millions of workers and bears its huge share of civic and social responsibility.

MANUFACTURING

At the present time the company is operating at a profit in all of its divisions. This is a steep climb during recent months of the nation’s volume of business and profits has affected its income and expenses. Nevertheless, it is estimated that the net profit for the first-quarter of this year will be more than adequate to cover the normal dividend requirements, leaving a small balance applicable to the Common stock.

In manufacturing divisions have developed and produced a widely diversified line of modern products. Radio receiving sets, although an important item, does only a partial service of its sales. Records, phonographs, combinations, and record players represent an important and profitable line which has grown rapidly in recent years due to recording and reproducing improvements based on radio inventions.

RCA Photographic equipment for motion picture studios and theatres is now strongly entrenched in this field. If you have seen “Snow White and the Seven Dwarfs,” you have seen one of the more important pictures which are completely RCA-equipped (so far as sound is concerned).

Other products include transmitting apparatus for broadcasting stations, sound systems for schools and auditoriums, aircraft and airport equipment, police radio systems, equipment for amateur use, and tubes of all kinds and for all purposes.

RESEARCH

All these products are the fruit of research which is constantly going on in their elaborately-equipped laboratories. The company own important products of radio research now in advanced stages are Television and Facsimile.

Various broadcasting stations have already commenced experimental transmission by facsimile of news bulletins and pictorial material to a limited number of receivers in their local areas. The television problems of facsimile have been solved and RCA is now building facsimile transmitters and several hundred receivers which have been ordered by independent broadcasting stations.

While the technical and economic problems of television are far from being complicated, definite progress is being made toward their solution. Television pictures are larger, sharper and more brilliant than ever before due to marked improvements in both transmitting and receiving apparatus. The industry must now decide upon the acceptance of definite technical standards before any public television service can be made practicable.

COMMUNICATIONS

The direct contact which RCA Communications facilities and subsidiaries with foreign countries is an important factor in our international relationships. In time of war these facilities would be indispensable as an important arm of our national defense and in times of peace they are of vital importance in helping to guarantee not only the unhampered communication between our government and foreign countries but also to keep these same avenues of communication open for our importers, financial institutions, business enterprises and our people in general.

Further, the daily short-wave programs of the National Broadcasting Company to foreign countries, operating continuously 18 hours a day, broadcast in 6 different languages, serve as an ambassador of goodwill every day in the year. Through both its national and international services day by day assistance is rendered to many branches of the government including the Departments of State, War, Navy, Interior, Commerce, etc.

These facts, however, tell only a small part of the story of how this tremendous radio organization serves the “public interest, convenience and necessity.”

Radio is the greatest gift of education, culture and entertainment ever presented to more than 160,000,000 people. Radio has broken down age-long barriers of distance and isolation and to this tremendous radio organization the Radio Corporation of America, rightfully goes a huge share of the credit.

"WHEN YOU CAN MEASURE"

Under this title General Electric Co. has just recently come out with a radio manual which may obtain application on their business letterhead.

"CONTINUOUS-FILM TELEVISION"

Under this title readers of August Radio-Craft (newstand, July 1) will find a description of P. T. Barnum’s latest contribution to the art of television.

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RADIO-CRAFT—complete in everything radio men need, gained popularity and leadership in a few years. Never once has RADIO-CRAFT shortened its stride of editorial progress. Broader in news scope—excellence in illustrations—continued improvement in editorial technique—accuracy in wiring diagrams and schematics—these are the basic ideals upon which RADIO-CRAFT success has been achieved.

The publishers of RADIO-CRAFT make you a very liberal subscriber offer. You earn, every monthly issue—they want you to get the benefits of the news of the trade, and they have arranged a special offer with an attractive premium—and they have made a special price for you.

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SERVICING

A complete guide is devoted to radio servicing.'ll find in this section, given to a number of the most essential in-formation—why a complete listing of equipment and many other classifications.

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Please Say That You Saw It in RADIO-CRAFT

MAP STICK CHAMPION OF THE AIR

Dr. Irving Langmuir Explodes the Story of the Fly that is Faster than Sound

DIGRESSING for the moment from the usual pure-scientific investigations where heordinarily occupy his time, an industrial research scientist has exploded—with proofs aplenty in different ways—a fantastic yarn about an insect that flies so fast it arrives before you hear it—leaves a speed of 818 miles an hour (one travels only 200 miles an hour).

The scientist is Dr. Irving Langmuir, associate general director of General Electric’s research laboratories and Nobel laureate. For his scientific reputation he has smashed the deer fly, which repeatedly in recent years—and more and more—has been used up as something which has far outstripped man’s piny efforts to become flight-speed champion of the living world. Man’s planes hurl themselves through the heavens at a mere rate of hardly more than 400 m.p.h.

Particularly in recent months there have been cartoons and news items referring to the speed of deer-fly or again simply to the deer-fly.

New Dr. Langmuir, writing in the March 11 issue of Science, has shown:

(1) The non-streamlined—and really flat-headed—fly at such a speed would encounter a wind pressure against the head of about 8 pounds per-square-inch, probably enough to crush the fly.

(2) Power consumption for maintaining a velocity of 818 miles-per-hour would be about one-half horsepower which, for a fly, would be a good deal.

(3) If the fly equals man in efficiency—and it does not—then as though the wind were 818 miles-per-hour more effi- cient than man who himself has a high thermodynamic efficiency—he fly must consume 1.5 times his own weight per square inch of his wing area to deliver the 570 watts, or nearly half-horsepower of energy, such speed requires.

(4) A piece of solder of roughly the dimensions of the fly can be seen only as a blur if, in a brightness-lighted, white room, it is at- tached to a silk thread and swung so that its speed is 13 miles-per-hour; that at 26 miles-per-hour it is barely visible; that at 40 miles-per-hour it appears as a faint line and that its direction of flight cannot be told; and that at 54 miles-per-hour the ordinary fly is invisible.

(5) Laboratory light intensity measurements and calculations also prove an inordinate increase in the size of the deer fly is invisible at speeds of 64 miles-per-hour and above.

(6) A fly striking a person at such a speed would exert a force of 310 pounds, or about 4 tons per-square-inch, and would penetrate deeply into human flesh—and the first such instance is yet to be reported; and finally—

(7) Dr. Langmuir concludes a speed of 25 miles-per-hour is a reasonable one for the deer-fly, while 800 miles-per-hour is utterly impossible.

In conclusion, then, do not have to hang their heads in shame because they can hardly attain 100 miles-per-hour with today’s airplanes. Nor will they ever have to move over in our courses to give the right-of-way to deer fly speedsters.

Incidentally, Dr. Langmuir is a licensed airplane pilot. In September, 1936, in the Journal of the Aeronautical Sciences, he also digressed from such subjects as monatomic gaseous, disso- ciation, and such G.E. research laboratory sub- jects as tell, in an article edited by the late Vil- lier Forbes of the Harvard Medical School, about “Airplane Tracks in the Surface of Stratus Clouds.”

In that article he told how he had closely observed such clouds, had cut through them with his airplane, and had found that the scientists had examined the clouds and the changes wrought by the whirring propellers and the cut of the wings had been observed by them. Still other instances of non-molecular reports of this scientist could be mentioned. For instance, in Science for February 11, 1938, Dr. Langmuir wrote on “Surface Motion of Water Induced by Wind,” basing his report on observations made a transatlantic line.
LOOKING AHEAD TO TELEVISION OCCUPATIONS

Modern science and invention constantly are creating new occupational opportunities in a rapidly moving world. In the accompanying article a prominent New York City consulting industrial engineer gives a fascinating overview of what may be expected occupationally with the coming development of television. The information is most valuable to counselors of youth who might well heed the warning to proceed with caution!

DR. ALFRED N. GOLDSMITH

A STUDY of occupational possibilities in the television field on the assumption that interesting art has made its commercial début is possibly premature and certainly hazardous. It saves slightly of planning the Panama Canal shortly before the discovery of America. At best, any vocational analysis of the television of the future must be read with several proviso in mind.

In the first place, a normal engineering development has assumed, that is, is taken for granted that technical knowledge of television will increase apace, enabling the practical solution of the remaining engineering problems of television within a reasonable time. It is also assumed, although it should not prevent the engineers from designing equipment meeting the reasonable needs and desires of the future, that during this time, they might upset all calculations. We are all familiar with acts where normal progress has been retarded by disturbances which the engineers have not as yet been able to overcome. There is a slight but nevertheless existent chance that some of these will put off the commercial advent and general acceptance of television for some time.

In the second place, a normal economic development of television must be regarded as probable in any analysis of its occupational possibilities. Television transmitting and receiving equipment is elaborate and relatively costly. Television program construction will be more complex and expensive than radio program construction of today. The television art is a combination of many phases, in which an art which can hardly be introduced rapidly on a large scale in times of marked economic depression might be expected to win public favor in less favorable circumstances.

The television programs will be paid for, under our present system of broadcasting operation, by advertising sponsors in the main. The sponsors will pay for a portion of the program chasing power and general good will of the looking and listening public. But the size of the audience, its purchasing power, and its mood will all influence the extent to which the advertiser can justifiably support television broadcasting. Accordingly, there is an action and reaction between economic conditions and television success. If times are bad, the programs must be restricted which, in turn, affects the public response that justifies the broadcasting of the programs. Only in reasonably good times can this circle of effects be broken advantageously. Accordingly, those contemplating television as a career will watch closely for times of general economic recovery since it is in such times that acts like television can be expected to flourish and to afford opportunities for a multitude of new workers.

Assuming that television comes into its own in due time, it probably would be best to outline the various occupational opportunities which it will offer, and the requirements of each position where the activities of the field in some detail (with the various prospective openings italicized).

OUTLOOKS IN MANUFACTURING

Let us start at the factory where the necessary equipment for television transmission and reception originates.

Here are the typical apparatus engineers who are capable of doing research, development, and design work in this very field. These men must be technically trained and well-qualified along conventional radio lines in order to meet the more difficult problems of television. These radio engineers are, in fact, electrical engineers with specialized training in the particular field of communications. In the factory there are also needed tube engineers who will handle the similar problems of vacuum-tube and cathode-ray-tube production that is in the remaining part of the television transmitters and receivers. Some of these men may be untrained technicians, but most should be technically qualified. But more commercial fields of tube research and design work will be required for television equipment construction, including test men, supervisors, production and manufacturing engineers, and the like.

The qualifications here are similar to those for positions of the same type in other fields except that the manufacturing and test problems are probably more difficult and more rapidly changing than in most other fields, thus demanding a flexible, responsive, and original mind as well as great native energy and determination.

TRANSMITTING STATION JOBS

Once the television transmitter has been built and shipped, it must be installed in the television transmitting station and then either maintained. At this point, an entirely new series of openings will exist. Television station engineers will include field-survey engineers who will determine the best location for the station and its antenna system and who will study the strength and acceptability of the signals throughout the service range of the station. These men will also furnish the data which will satisfy the governmental authorities that the station is covering its territory with an adequate service in the physical sense. The equipment must be maintained in good condition at all times, and emergencies must be met and handled by the maintenance staff of the station. Men of great reliability and prompt resourcefulness are required for this type of work.

The television-station studios will require a staff of their own of considerable size and of wide diversity of tasks. Considering the technical men only for the moment, there will be lighting experts who will arrange and control the powerful illumination which floods the sets (scenery) in the studio, and the actors. These men must be skilled electricians capable of handling, shifting, and controlling illumination in any desired fashion. There will be the microphone or sound men in the studio who will place and control the microphone supports or booms which hold the microphone close enough to the actors to pick up speech or music, while still keeping the microphone outside of the view of the camera. Here men with steady hands, quick responses, and a cool way of working effectively will be required (particularly in the stress of high-speed operations such as the studio performance). In the control rooms of the studio, there will be sound-control men and picture-control men who will handle respectively the quality of the sound and the picture which is being transmitted. These men will be technically trained, probably as junior engineers, and must have quick reactions, sound judgment, and manual skill in getting the picture and sound results which will best please the audience.

Sometimes, the television transmissions will be from sound-motion-picture film which has been previously made. For example, a film news reel may be transmitted. This requires that these

(Continued on following page)

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ANNOUNCEMENT WHICH APPEARS ON PAGE 4

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Be sure to read the Announcement which appears on Page 60 of this Issue.

RADIO-CRAFT for JULY, 1938

LOOKING AHEAD TO TELEVISION OCCUPATIONS

(Continued from preceding page)

shall be projectionists who will handle and project the film on the television receiver to which they are bound to the audience. Here too there will be unprecedented numbers of amateur and professional control men who will carefully monitor the transmissions.

CAMERA MEN

The television-camera men will constitute a brand new profession and those engaged in the television pick-up or "camera" which is trained on the action and carefully and continuously focuses the image on the television transmission must be instantaneous, they must work with perfect coordination in groups where several cameras may be employed to cover a scene simultaneously and they must be resourceful and artistic in their pictorial sense. It will be essential, and the television broadcast cannot be altered after it is transmitted. The first transmission to the audience is the last transmission, in general, and there is no opportunity to rectify errors or limitations by a succession of "take" (as is commonly done in present-day motion-picture production). Accordingly, the job of television-camera men will be exacting and important.

It is possible that some department of the television-camera men will be a part of a larger group, for it is clear that the outdoor television pick-ups (or "apart" productions) will be the responsibility of a large number of similar qualifications and perhaps as great resourcefulness and the ability to work under the most difficult and uncontrolled conditions to be encountered in the outdoor studio. The outdoor camera man will necessarily be of somewhat the same type as the present successful newsreel camera man who can meet an unusual assignment and be ready for anything.

Since a fair portion of television programs may, as was stated above, from film, it will be necessary to film television. Recording both picture and sound in the same way as now done by the motion-picture studios and new television camera men will be required. The tasks which the camera men, sound recordists, editors, cutters, and other members of the type of sound equipment designed for television cannot, in most cases, develop as rapidly as the programs develop because of the commercial ineptness of the commercial occupation.

TELEVISION SERVICE MEN

Still considering work of primarily technical nature in the television field, it is clear that the position of the television service men will be installed correctly and kept in good operating condition.

It is expected that the existence of a good-sized group of television Service Men. Such men must be familiar with the circuits of television receivers, their operation, the location of the faults and the methods of correction, and the handling of television equipment. The television service men will be the communication and engineering experts in the new field of television. Their duties enter this in the operation and maintenance, and the repair of television equipment. The public response to television will depend in some part on the number of these Service Men, particularly during what may be the more or less difficult early days of commercial exploitation of television.

RELATED ACTIVITIES

Governmental regulation of radio broadcasting, as at present, will lead to the need for a number of radio augments in the various districts of the country charged with the investigation and supervision of the operation of the station to determine whether the Federal Communications are observed and to report on matters of service to the Federal Communications Commission. Further, many of the larger of the Commercial stations will include engineering and legal experts in the new field of television. These interested in entering the commercial service and maintenance of the sort design the future.

There will necessarily be a considerable number of radio enthusiasts in the various districts of the country charged with the investigation and supervision of the operation of the stations to determine whether the Federal Communications are observed and to report on matters of service to the Federal Communications Commission. Further, many of the larger of the Commercial stations will include engineering and legal experts in the new field of television. Those interested in entering the commercial service and maintenance of the sort design the future.

"Radio Engineering", in its new 2nd Edition, is an eminently successful text, and is practically a new book; over 3/4 of the text has been completely rewritten and more than 2/3 of the illustrations are new. Besides bringing all material up to date, and adding a complete set of problems for each chapter, the author has added a considerable amount of new material which is here presented in print for the first time. In addition, many changes have been made to improve the presentation of various sections.

Each of the 18 chapters in this book is subdivided into 5 to 15 sections. The chapters are titled as follows: The Elements of a System of Radio Communication; Properties of Resonant Material; Television; Selection of Radio Tubes; Supervision of the Schools; and Classroom Use.

Dictionaries. Published by A. S. Litvinchen. (1937.) Published by Technical Encyclopedias and Specifications, Inc. (Available in U.S. from sales agents and Bookings.) Size: 7 x 10 1/4 ins., cloth covers, 560 pages. Price $4.50.


Here is a truly monumental work of interest to all who may find their self called upon to translate a radio technical term, abbreviation or symbol either from or into the English, French, German or Russian language. This so-called "preliminary" volume of radio terminology has exceptional merit in enabling the interested technical reader to make better headway. For those technicians who can use a book of this nature we highly recommend "A Dictionary of Radio Terminology in the English, French, German and Russian Languages."

Radio in the Classroom, by Margaret Harrison. (1937.) Published by Prentice-Hall, Inc. Size: 5 1/2 x 8 ins., cloth covers, 260 pages. Price $2.50.

Although this book is primarily concerned with the use of radio as a supplementary tool to education it contains a certain amount of technical information regarding radio equipment for the school that will be of interest to the progressive and service-minded teacher who wants to add a possible asset to the extensive but still limited field of school radio and sound installations.

Note however, that this book is mainly designed to aid principals, supervisors and teachers to help make use of programs broadcast throughout the world. The tenor of this book may be visualized by noting the following listings of its chapters: Educational Objectives and the School Radio; Radio Programs Available to Schools; Selection and Classroom Use of Radio Programs; Classroom Activities Related to Radio; Supervision of the School Radio; Radio Equipment for the School; Radio's Contribution to the Unit Program and the Development of the Units of Classroom Work.


This long-awaited book is right-up-to-the-minute, with more than 3,800 definitions of the technical words and terms used in all branches of radio, including aviation, navigation, and industrial control, photovoltaic, photocell applications, sound pictures, public address systems, television, telegraphy, electricity and magnetism.

Almost everyone in the radio field at one time or another will probably find this volume useful. It's a radio library "must" book.


Written in German, this beautifully-prepared volume is probably the most comprehensive cross-referenced to practical German radio technique and equipment. It is a reference and practical handbook for every radio enthusiast and technical scholar.

The section devoted to vacuum tubes contains an extensive list of technical characteristics; data and tube lists of all types. A second chapter breaks down various circuit arrangements and gives fundamental components. An exceptionally interesting chapter is one devoted to antenna coupling circuits of various sorts. This chapter is probably one of the most practical to the short-wave experimenter and will be of considerable help. Another unusually interesting chapter is devoted to antenna coupling circuits of various sorts. This chapter is probably one of the most practical to the short-wave experimenter and will be of considerable help.

This book is published at $2.50.


"Air-Cooled Transmitting Tubes," is the subtitle of this most useful new publication. The volume is devoted to a discussion of the various tubes that are manufactured and are still obtainable. It contains the chief technical information that every radio engineer or transmitter designer needs, in order to make good decisions about his equipment.


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This tube "databook" contains the chief technical data on all tube types—from the oldest to the newest. Prepared as a pocket-size book, it includes a wealth of information on tube applications and uses—maximum ratings, values of essential characteristics, and the more important characteristics in operating curves for each active tube. Much of this information has previously been obtainable only by a limited number of receiver designers and engineers—data on all tubes that have been at all widely used in the past in receivers and amplifiers that are still handled by the trade. It is estimated that about 80% of the tubes advertised up to the end of 1937. For completeness there are included the necessary data on rectifier, radio receiving, special receiving tubes, and panel lamps.

Literally a treasure on tubes, "Databook" gives definitions of the various tube characteristics and their values in these quantities may be determined from the characteristic curves; simple circuit diagrams showing the essentials of the various sections of a modern radio receiver, including the newest features, and convenient charts for determining the proper values of certain tube circuit constants and operating voltages.

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LOOKING AHEAD TO TELEVISION OCCUPATIONS

(Continued from page 62)

a corresponding television-cable staff. To the extent that radio-relay methods of syndicating network program material will develop in the television field, there will have to be established a radio-relay staff, consisting of engineers, maintenance men, and the like, to keep the connecting links in perfect operating condition.

OPPORTUNITIES FOR WRITERS

Leaving the field of technical television occupations, it is evident that there may exist a building multiplicity of opportunities for persons of the necessary originality, energy, and application.

Programs cannot be started until there are authors. Since the television lookers may be practically insatiable in their demands for program material, it will tax the inventiveness and strength of the authors to the utmost to supply the steady flow of interesting and usable material for the television programs of the future. The material prepared by the authors will, in some instances, require revision or adaptation by writers or script men who will have to be high-speed literary lights of special ability to meet the increasing and considerable demands of the program staff.

DIRECTORS, ACTORS, MUSICIANS

The casting and production of the programs will require the active interest of specialists. For instance, there will be needed a number of persons, including, of course, directors who will know how to build up, rehearse, and present television programs. These men can be drawn partly from the legitimate or "little" stage and the motion-picture studios. In part, however, they will have to be trained at dramatic schools which may be established for the purpose.

At this point there is reached what may be the most serious television demand of all, namely, the demand for original creators of new "acts" are meant as a word appearing before the television camera and microphone including music, music numbers, dramatic and comedy characters, commentators, wadeburnial actors, interviewers, and the like.

It must be borne in mind that we do not as yet know just what are the desirable qualifications for a television actor. The nature and psychology of the home audience, the limitations and opportunities of home presentation, the technical capabilities and restrictions of the television screen, and the economic problems of television will all affect the suitability of a given person as a prospective television actor. If only a minor fraction of the aspirants will please...Television public. It follows, however, that a great number of applicants will be necessary to meet the situation. However, the career of a television actor will be appealing to many and, in spite of the long odds for the individual, it is likely that there will be intense competition from a horde of applicants for these openings. Probably those who have been adequately trained and have had successful experience in somewhat similar fields will stand the best chance of successfully entering this new field.

A considerable number of studio openings will necessarily exist in the television field, for example, jobs for carpenters, scenic painters, set artists or designers, costume experts, wardrobe mistress, makeup men, historical research specialists (who will see to it that no historical inaccuracy or inaccuracy are present in the performances and the like). Such openings will increase only rather slowly in number as time goes on, since it is likely that the full development of the television field as a branch of the art of the stage will take a generation or more because of the many and novel problems which are involved.

CAUTION

One final word may be in order of the form of advice to the person who is thinking of entering the field of television. Don't rush and ram- walk: and watch where you are going. Speed in rushing into the field will not be nearly so helpful as a first knowledge where your abilities lie, cultivating those abilities by training in fields similar to television, and then everlastingly seeking to the job of perfecting your talents and their application once you have entered the television field. Remember that television success pays come rather as the result of a prolonged marathon of effort than from a brief gold-rush of enthusiasm.

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Follow the Crowd...

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