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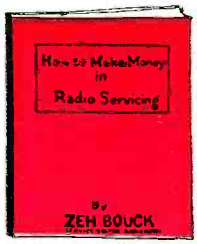

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Radio News

3410 Verified Foreign Programs

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in a Six-month Period

F. L. STITZINGER

This Erie, Penna., SCOTT owner, between January 1st and July 1st, 1932, logged and received verifications of 1588 programs from 41 stations in 22 foreign countries. Mr. Stitzinger's remarkable DX-ing feat included the reception of 387 programs from Pontoise, Paris, France; 131 programs from Barranquilla, Colombia; 101 from DJA, Berlin, Germany; and others from stations scattered all over the world map, including such remote and seldom heard places as Bandoeng, Java; Leopoldville, Belgian Congo; and a host of other interesting and thrilling air treats unknown to owners of less capable radio receivers.

A. G. LUOMA

From his Chicago, Ill., home this enthusiastic SCOTT dial-twirler reached out to listen to 1261 verified programs from 75 stations in 26 foreign lands. Paris, France, was his favorite station, too, being tuned in 277 times. Followed in frequent reception Saigon, Indo-China; Bogota, Colombia; Chelmsford, England; EQA, Madrid, Spain; and a roll-call of stations all the way from Sydney, Australia and Geneva, Switzerland to Kootwijk, Netherlands and Merida, Yucatan. He began DX-ing because of actual enjoyment of programs received instead of for the thrill of long-distance reception alone.

W. C. GANGLOFF

In six months of distance-grabbing on his SCOTT this resident of Cincinnati, Ohio, succeeded in logging and getting verifications from 42 stations, located in 22 foreign countries, of 592 programs. His favorite station overseas was Barranquilla, Colombia, which came in 112 times. Paris, France, was a close second, with 102 verified programs received. Then, stringing along to build up his impressive total came such little-heard stations as Khabarovsk, U. S. S. R. and many another ear-thriller from thousands of miles away. Mr. Gangloff insists that his performance could easily be duplicated by any Scott owner.

15,847 More Foreign Programs — from 320 Stations in 46 foreign lands — were received by more than 200 other Scott Owners to give this POSITIVE PROOF of SCOTT distance-getting ability

Such performance records speak more eloquently of this receiver's merit than bales of laboratory curves and scientific reports so highly technical as to be understood only by trained radio engineers. Not that we haven't plenty such scientific engineering proof to offer—the curves of SCOTT Receiver performance, *made by recognized independent testing laboratories*, have never been bettered. But unless you're a baker you aren't interested in the kind of plums used in the pudding . . . the proof is in the eating. Likewise, unless you are a radio engineer the technical data regarding a receiver doesn't interest you . . . the proof is in actual performance in the hands of actual owners! That a receiver able to deliver such miraculous distance-getting on the short waves is also a star performer on the broadcast band, with sensitivity, selectivity, and tone quality of richness and fidelity unequalled, is simply an added reason for your wanting a SCOTT ALL-WAVE Deluxe. Soon there will be under way a great International DX Contest sponsored by the world's leading radio publications, that will bring world-fame to its winner. We confidently hope to see this contest, too, won by a SCOTT owner. But why should you wait for that further evidence? Rather, get a SCOTT yourself and go into the contest with the *best* chance of winning!

. . . and these men are "Just Average" Radio Fans — Not Professionals!

Their mighty feats of DX-ing, and those of the more than 200 other SCOTT owners mentioned, were accomplished under ordinary home reception conditions—probably no better than those you have to contend with. The reason for their remarkable performance was primarily the true ABILITY of their receivers, plus patience and easily acquired skill at tuning that may be learned by anyone. You, and a SCOTT, can do as well, and have as great thrills!

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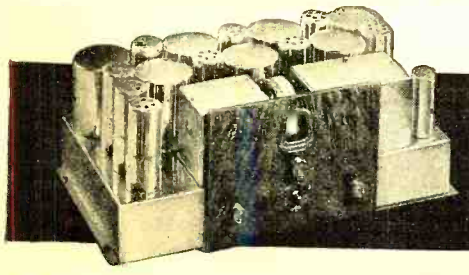

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The Editor—to You

WHO are the set builders of today? This is a question asked of members of our Editorial staff. It is often accompanied by the question: Is there *anyone* who builds a set today? These questions might possibly be best answered by an examination of the Technical Inquiries that come in to the Technical Information Service of RADIO NEWS every month. By far the greatest bulk of them deal with queries regarding the construction and operation of receivers described in the magazine from month to month. An examination of these inquiry letters shows that there are many who repeatedly write in to this service regarding a newly constructed receiver. Upon examination, we find that the ages of readers utilizing this service lie between 16 and 40. We would divide set builders into three general classes; first, those who build sets for the pleasure they get out of it, both in the actual building of the set and in its use. This group, evidently, contains persons all along the age scale. The second group comprises persons who build radio receivers primarily for the education and understanding of radio principles that they get out of it. The age of this group tends to be largely located toward the lower limits of the age scale, although there are a considerable number in this group ranging from 25 to 35 years of age. The third group comprises set builders who build receivers for resale and profit. The ages of this group are well distributed within 25 years of age and the upper limit. In this latter group there are found a large number of servicemen.

* * *

THE type of persons in Group One range all the way from boys building their first set to men in every profession. They include big business men, members of the medical profession, artists, engineers, bankers, brokers, politicians, clerks, salesmen and a great number of policemen and firemen. In the second group there are large numbers of grammar-school and high-school students as well as students in the physics and engineering departments of colleges, evidently with a trend to things mechanical and electrical, who build receivers to become acquainted with the phenomena of radio at first hand. We find there are also quite a number of older people, who have gotten into the radio industry through some business channel, knowing little of radio principles, who have taken to set-building to gain what they consider to be necessary knowledge at first hand.

In the third group we find an increasing number of set constructors who are handy with tools and who rely upon their proficiency in bolstering up their fallen incomes. They build receivers for their friends and acquaintances and in this way gain a name in the locality as a radio expert. It is from this latter group that the bulk of radio servicemen are developed. Those who show a natural aptitude and an understanding of radio principles and at the same time are equipped with some business ability, usually find they can make more money and have a higher standing in their neighborhood by going over solely to this line of work. Then, of course, there are the well-established servicemen who specialize in custom-built radio receivers for their best customers. Servicemen of this class combine engineering and business ability to a high degree. They know what should go into a receiver and they have developed their own pet design, specializing on high quality of reproduction, and they know how to sell!

* * *

IT is interesting to note here that the greatest percentage of those now in the radio industry, even some of the great executives, have been drawn to radio through the lure of set-building in youth, or in operation of radio receivers, transmitters, etc., from either a commercial or amateur standpoint. The radio industry, therefore, is one that has grown up with the radio amateur and most of the people in the industry are still experimenters and amateurs at heart.

* * *

THE industry, therefore, and the publications of this industry, will do well not to forget the experimental set-builder and amateur, if they have the best interest of the industry in mind.

* * *

IN this issue of RADIO NEWS we are centering our attention on set-building, with a number of articles on construction data that should give all kinds of set-builders, experimenters and amateurs a chance to indulge in this activity whether it be for education, profit or pleasure.

* * *

WHAT are the ultra-short waves good for? Among the newest experiments being made in the development of transmissions by ultra-short waves, we find the engineering officials of the Columbia Broadcasting System now using five-meter transmitters and receivers for interoffice communication. The photographs reproduced on this page show, above, E. K. Cohan, technical director of the system, speaking into a portable one-watt transmitter on his desk, while below, the chief division engineer, Henry Grossman, listens in on a receiver in a studio on another floor. The portability and low power requirements of these outfits, it is believed, may eventually bring about their general use in the field of remote control for regular broadcasting. These transmitters and receivers at present are operated strictly portable, with their own power supplies and carrying their own antenna as a part of the unit. This can be seen as short rods protruding from the top of the cabinets. At present the 5-meter waves are found extremely useful in directing studio adjustments when no telephone wire is available.

* * *

COMING over the Editor's desk are a number of helpful comments from readers:

"I WISH to comment on the new department in RADIO NEWS entitled 'Receiver Performance.' I believe this to be a highly commendable and much desired addition to RADIO NEWS. From 1929 to 1931 I was an engineer in the receiving laboratory of RCA Communications."—Porter H. Buckminster, Sedgwick, Me.

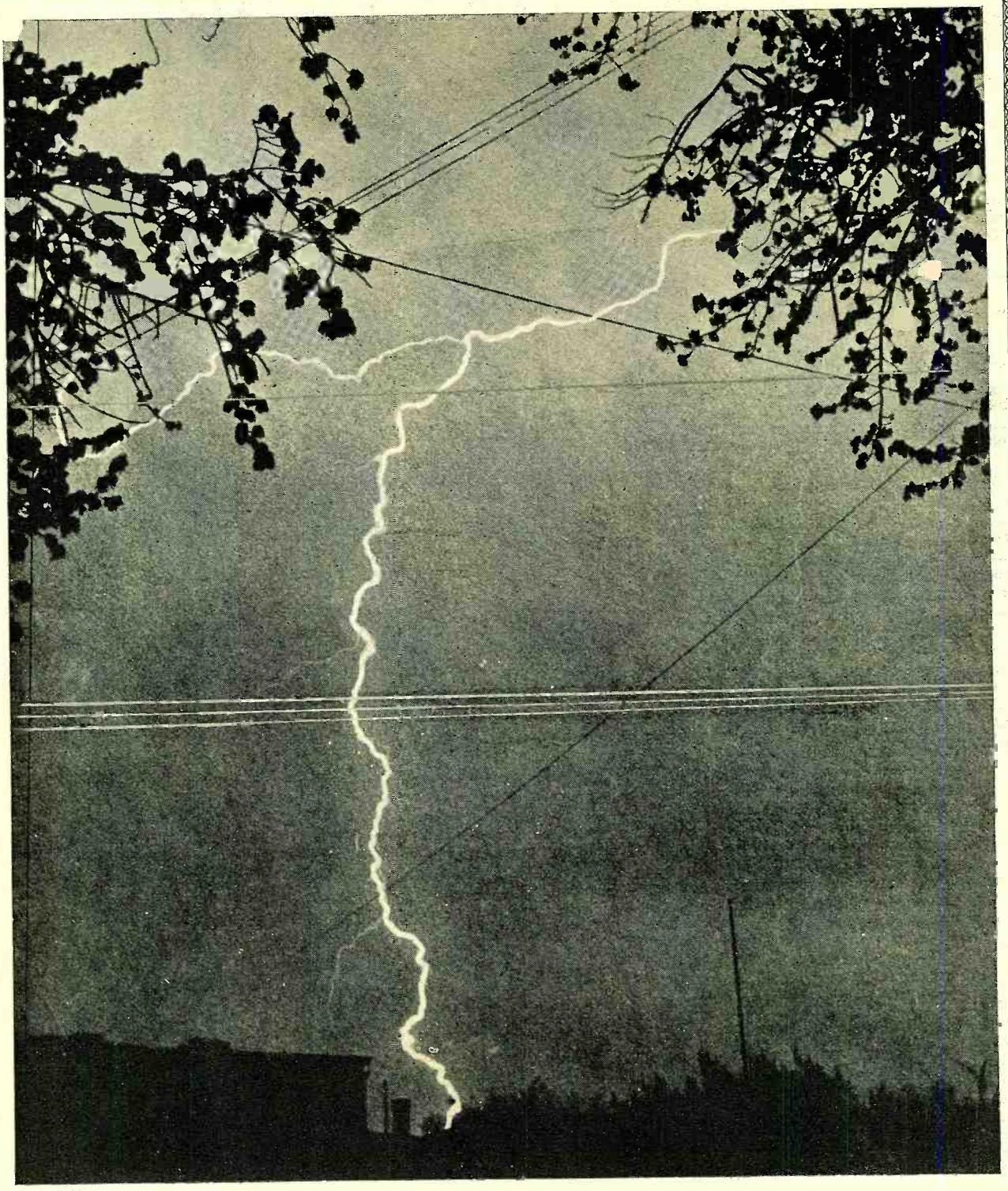
* * *

"IT IS only through the pages of RADIO NEWS that I have gleaned the knowledge of American radio receivers and servicing."—S. Lessick, Pretoria, South Africa.

* * *

"THE Free Booklet service is a splendid idea and brings readers attention to new technical matter being released by the various manufacturers. Your service was practically over night as compared to eight weeks for a similar service by another radio magazine."—John A. Hollister, Jr., Jacksonville, Fla.

Hugo Gernsback



A Factor in Creating Atmospheric Disturbances

Flashes of lightning have long been supposed to be the origin of those crashes and roars heard in radio receivers that interfere so greatly with radio reception, especially when listening to signals from a distance. Now we begin to understand why static has never been conquered. It is because it has never been thoroughly understood in either origin or nature. A large amount of it, it is now suggested, depends on discharges of electron clouds into the Heaviside layer.

Radio News

VOLUME XV August, 1933 NUMBER 2

RADIO *and* STATIC

Is there any device now developed or on the market that will eliminate natural static disturbances from radio reception? In this interesting discussion the author takes you back over thirty years of development of so-called static eliminators. Some were worked out in theory by well-known authorities, but, unfortunately, none proved of great practicability. The author also points out that, in spite of many failures, devices for this purpose continue to be the goal of many experimenters

By **J. C. Williams**

WHEN RADIO NEWS some ten years ago published an editorial in which an executive of a large radio corporation was reported to have said that his company would gladly pay $500,000 for a bona fide static eliminator, it merely added more fuel to a fire that already had been blazing for many years.[1] For the most fascinating problem in radio, and the goal for all radio engineers, before the advent of the short waves, was to overcome static, and the number of anti-static devices that have been patented would reach from here to the moon and back again. Practically none of these patented inventions ever withstood the demands of commercial practice, however, and, except on the shorter waves, static is still just as much of a problem as it ever was. The records of research work carried on by radio corporations and government laboratories would fill a library, and the more than 50,000 oscillograph pictures of static surges that have been tabulated and filed by the Radio Research Board of London is only a part of the work of studying static, on both the long and short waves, that is being carried on in all parts of the world.[2] By static, we mean the crashes and roars of atmospheric electricity, and not man-made static, or "induction," as it was known to the old-timers.

Long before there were any wireless-telegraph signals jamming up the ether, a Russian named Popoff discovered that when his galvanometer and coherer were connected to a "sky-rod," the needle of the galvanometer would at times dance about in a diabolical fashion. And when Marconi was first broadcasting messages around the English countryside, he learned that something was interfering with the receipt of these messages. These strange clicks and rumbles emanating from the heavens were given the name of "X's" or "atmospherics," and it was recognized that they were going to be a serious obstacle in the development of wireless telegraphy. Numerous circuits and devices to eliminate these atmospherics began to make their appearance, and they have continued in a steady stream down to the present day.

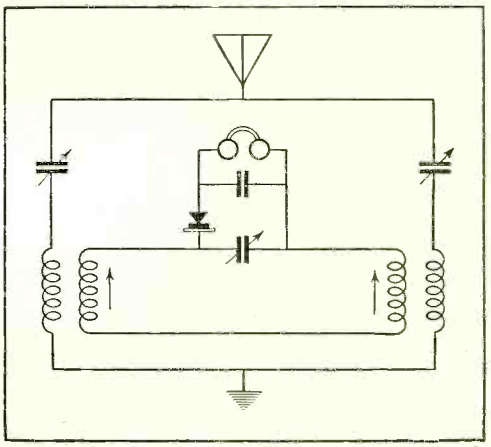
One of the earliest of the anti-static schemes was that patented by John S. Stone in 1901, in which two receiving aerials spaced a half-wavelength apart were employed, with a transmitting aerial located midway between.[3] It was primarily intended to carry on reception through the interference of the transmitter by neutralizing, or balancing out, the two equal transmitted impulses picked up by the receiving aerials, but in one of the forty-three claims it was set forth that the system could also be applied to eliminate "ether disturbances."

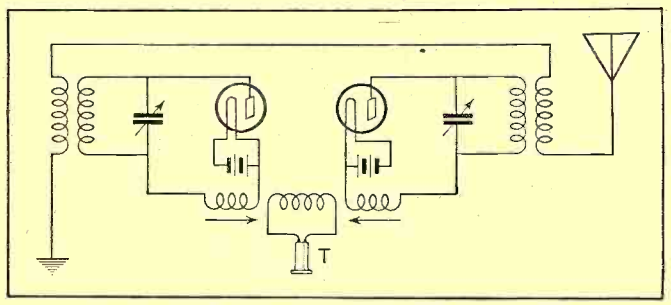
This idea of balancing out two equal impulses of static was a fascinating means of attack, and was eagerly seized upon by the inventors of the day. De Forest in 1902, Fessenden in the years between 1903 and 1907, Pickard in 1907, and Marconi in 1909, all patented systems that aimed to eliminate "atmospheric disturbances or other interference" by balancing two circuits against each other. In later years, Weagant, Taylor, Austin and Armstrong, among a host of others, all brought out circuits that used this principle to combat static. There have been shielded aerials and limiting devices, and wave coils and baffles, but no method has been so thoroughly exploited, or has looked so promising on paper, as balancing.

The principle of balancing is older than radio itself and was

FESSENDEN'S INTERFERENCE PREVENTOR

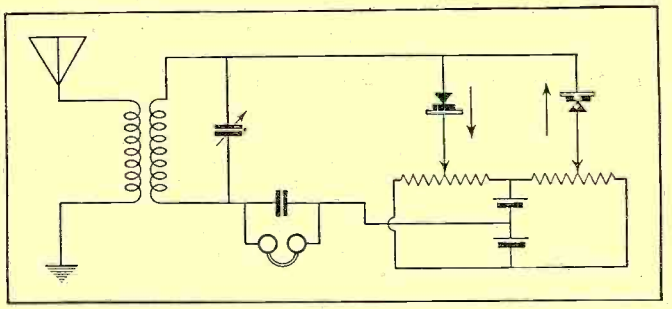
Figure 1. This basic circuit patented in 1903 has served as a pattern for hundreds of similar static eliminators





MARCONI'S BALANCED VALVE RECEIVER

Figure 2. This circuit patented in 1909 is in principle the same as that employed by Fessenden



CAPTAIN ROUND'S BALANCED CRYSTALS

Figure 3. In this circuit, once used on British vessels, the second detector is opposed to the first and is effective only for strong static

understood and used in the Wheatstone bridge nearly a century ago. The action may be simply stated by saying that if two equal currents are sent through the same wire, in opposite directions, they will cancel and no current will flow. To carry it a step further, if two similar coils have currents of the same strength flowing through them, they will set up magnetic fields of equal strength. If the two coils are placed end to end so that their lines of force flow in the same direction, the total strength of the field will be just twice that of one coil. But if one coil is reversed in position so that its lines of force oppose those of the other coil, the magnetic field will be completely destroyed and, regardless of how strong (or weak) the current, in effect it will be the same as though no current were flowing. This principle has been applied to radio from its earliest days.

Alexanderson Magnetic Balance

When properly used, the heaviest currents as well as the slightest impulses can be completely nullified by its use. The overwhelming interference of a powerful Navy spark transmitter has been effectually blocked out and reception carried on when both the transmitting and receiving aerials were erected between the same two masts and separated by only a few feet—something of a miracle in the days of spark transmitters.[4] The Alexanderson magnetic balance accomplished this, for the Naval Radio Service, by the simple expedient of coupling a small pick-up coil from the receiver to the transmitter secondary inductance and balancing the currents induced in the coil against the currents induced in the receiving aerial. Any means as effective as this for eliminating interference would appear to be an ideal method to use against static, but no one yet has ever found out how to apply it successfully in that direction.

Fessenden's Interference Preventer

Fessenden's interference preventer, brought out thirty years ago, made direct use of this principle, and because of its simplicity and the fact that no one could advance a hard and fast reason why it wouldn't work, it has been the most imitated circuit in radio.[5] Fundamentally, the circuit consists of two receiving systems, coupled either to a common aerial or to separate aerials. One receiver is tuned to the incoming signal, while the other is thrown slightly off tune and does not receive the signal. Static surges, theoretically, will be the same in each receiver. Then by differentially combining the two outputs, the static will neutralize or balance itself out, while the signal, coming from only one receiver, will not be neutralized and will be heard, free from all interference. This is the fundamental idea in back of all systems that aim to eliminate static by balancing two independently tuned circuits against each other. Though the original circuit employed a specially constructed telephone receiver in which there were two opposing sets of windings, the action was in no way different than that described above.[6]

Just why the circuit does not work is not so easy to show, for there are several contributing factors. Before balancing can take place, four conditions must be satisfied. The amplitude of the two impulses must be the same, the decrement, or wave-form, must be the same, the frequency must be the same, and the phase must be exactly opposite. These last two conditions are most important, and if they are not fulfilled to the letter, all attempts at balancing will be useless.

To illustrate the point, a carrier wave that produces a beat note of 2000 cycles in the headphones may be balanced to a minimum against a similar note of 2000 cycles, providing the phase is exactly opposite. If the tuning is changed so that the carrier waves produce a beat note of 2100 cycles, it is obvious that the matching note will likewise have to be raised to 2100 cycles. But more than this, the phase will have to be so regulated that both notes reach their peak at exactly the same instant, 180 degrees apart. When one note is at its positive peak, the other must be exactly at its negative peak. If these two notes are not timed correctly, if they are not exactly in phase, they will not balance and both of them will be heard in the phones.

Reasons for Failure

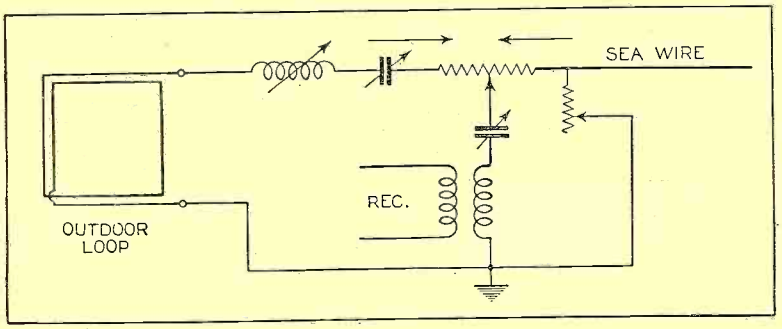
Weagant has said that when the two receivers of Fessenden's circuit are tuned to different wavelengths they pick up static at different frequencies, and when in this condition, cannot possibly be made to balance.[7] De Forest, on the contrary, has stated that good results can be obtained when the circuit is properly tuned.[8] Carl Englund has declared that single surges may be made to balance, but overlapping wave trains will not balance.[9] John Carson, in a mathematical analysis, has shown that a balance may possibly be maintained when no signal is being received, but as soon as the signal combines with static in one receiver and not with static in the other, the balance is destroyed and static from both receivers is then heard in the phones.[10] His conclusions were that no appreciable gain could be expected from balancing arrangements.

But perhaps one of the reasons why the circuit does not mitigate static is that in all the variations of it made public, no account has been taken of the possible difference in phase in the two receivers. A suitable phase regulator, such as in Alexanderson's barrage receiver, might possibly give more favorable results. Another reason for its failure, not recognized in the early days, is that a considerable part of static is oscillatory in character and may not affect even closely adjacent wavelengths in the same way.[11] All the static in the two receivers is not exactly the same, and only those surges that are identical can, theoretically, be balanced out.

But whatever the principal reason for its failure, the big moguls of radio have all worked with it and given it up as being worthless. The Bell Laboratories, over ten years ago, discarded balancing as

TAYLOR'S BALANCED ANTENNA SYSTEM

Figure 4. This circuit, developed during the war for long-wave reception from Europe, utilizes an underwater aerial balanced against an outdoor loop

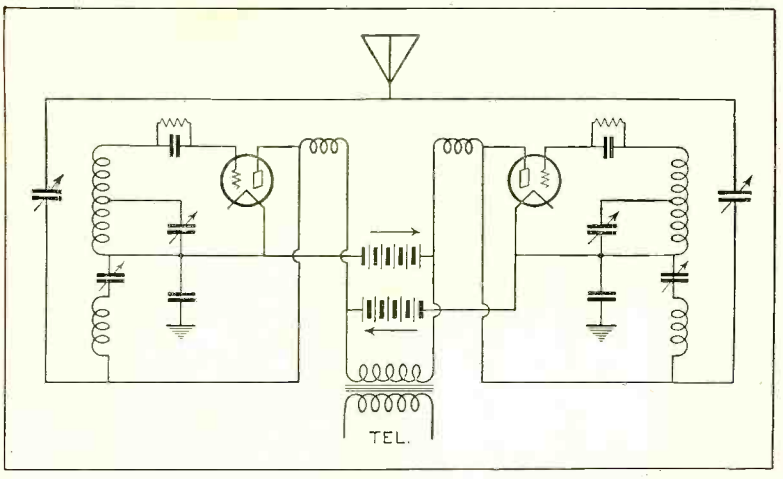


a solution to the static problem after extensive experiments along this line and declared that nothing favorable could be expected of it.[10]

Taylor's Balanced Aerials

The only cases on record where balancing has been of any use in improving reception are those where both receiving circuits are tuned to exactly the same wavelength, and advantage is taken of the difference in signal-to-static ratio between two dissimilar antenna systems. A. Hoyt Taylor developed one of these systems for European reception during the war.[12] He balanced a "sea" wire (a long length of insulated wire suspended just below the surface of the water) against an outdoor loop. When static in the sea wire was adjusted to the same intensity as static in the loop (by means of resistances), it was found that signals in the sea wire were stronger than signals in the loop. Part of the static could then be balanced out and still leave some of the signal. The aerials picked up different amounts and types of static, however, and the balance was far from perfect.

At Otter Cliffs, Maine, Pickard installed a system to receive the long waves from Europe in which he balanced an outdoor loop against a vertical aerial to get unidirectional reception such as the compass stations use.[13] He eliminated the worst of the static that arrived from the southwest and was troubled only by disturbances arriving from the direction of Europe, which, fortunately, were not strong.



REINARTZ' ELIMINATOR RECEIVER

Figure 6. This 1932 circuit, devised to eliminate man-made static, is merely an improvement over Marconi's balanced valve receiver

Weagant's System

Weagant's system, also developed during the war, should be mentioned as another case where balancing was employed between two antenna systems tuned to the same wavelength.[7] He used two outdoor loops, separated by several thousand feet, in a line with the transmitting station, with the receiver located midway between the two loops. Static surges, theoretically, affected the two loops simultaneously and could be balanced out, while the signal wave arrived at the second loop a fraction of a second later than at the first and was therefore out of phase and would not be balanced. His theory that static waves came from directly above and affected both loops simultaneously was never accepted and has since been disproved.

In each of these systems the balancing was done directly in the aerial circuit, before the waves reached any tuned circuits in the receiver, and both aerials were tuned to exactly the same wavelength. They are the only cases on record where balancing has been used commercially in this country, and their success was so limited that they have all been replaced by directive aerials in which balancing plays no part.

Armstrong's Method

Armstrong brought out a static eliminator in 1928 that is complicated in detail but still may be traced directly to Fessenden's balanced receivers.[14] It uses a single aerial and receiver, but requires a double wave to be transmitted, a telegraph wave for the dots and dashes and a compensation wave for the spaces, separated by about 50 or 100 cycles on the long waves. The two waves are required to be very close to each other in frequency so that static disturbances on both waves shall be essentially the same. The receiver feeds into two highly selective filters, as separate units, one filter passing the telegraph wave but not the compensation, and the other passing the compensation wave but rejecting the telegraph wave. The outputs are then recombined differentially, so that the static, theoretically the same in each leg, balances out, leaving only the telegraph and compensation waves. These are again separated by two more filters and finally run through two rectifier tubes so that the telegraph wave produces a positive voltage and the compensation wave produces a negative voltage. The two voltages operate a tape recorder and give twice the needle deflection of an ordinary recorder. While it is admitted that static is not entirely balanced out, it is claimed that reception is improved. Critics of the system, however, have declared that any improvement the method claims is due solely to its super-sharp tuning qualities, in the filters, and not because of any balancing effect.[9]

Other Methods

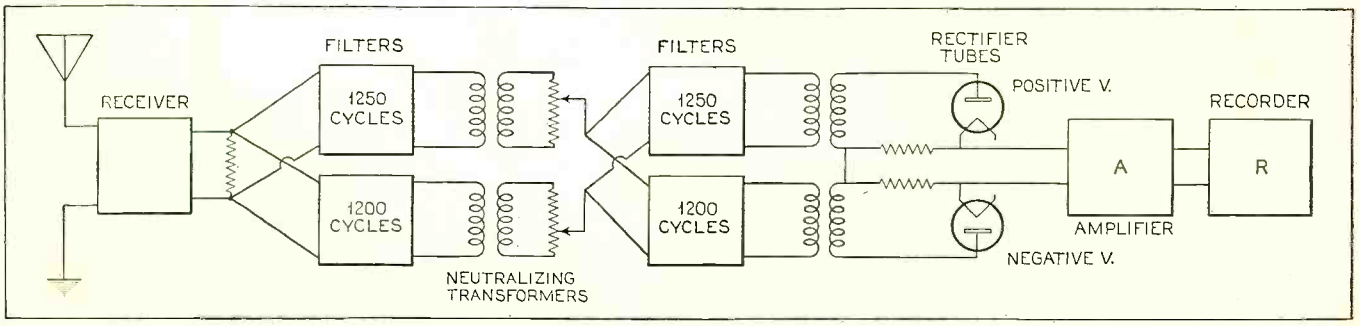
Other methods have been just as barren of results as balancing. It has long been known that loose coupling between the aerial and receiver weakens static to a greater extent than the signal.[12] It would seem, then, that a receiver employing several stages of transformer-coupled amplifiers with very loose coupling between stages would weaken the static with each transfer, and that if enough stages were employed it would eventually be eliminated. But this method only results in an extremely selective receiver, for after the first transfer of energy from aerial to receiver, the signals are weakened in the same proportion as the static, and apart from sharp tuning, which in itself weakens static, nothing is gained.

Limiting Devices

Another popular method has been to use a limiting device that would restrict the strength of the static to the strength of the signal by limiting the available plate current to a certain value. It is then hoped that the strength of the signal will remain the same while the static will be reduced, but no one yet has ever found out how to (*Continued on page* 119)

ARMSTRONG'S 1928 STATIC ELIMINATOR

Figure 5. This circuit requires the transmission of both telegraph and space wave to maintain a static balance. The filters separate the two waves and static is theoretically balanced out in the neutralizing transformers. The second set of filters again separate the waves and the rectifier tubes convert the energy into positive and negative voltages to operate the siphon recorder

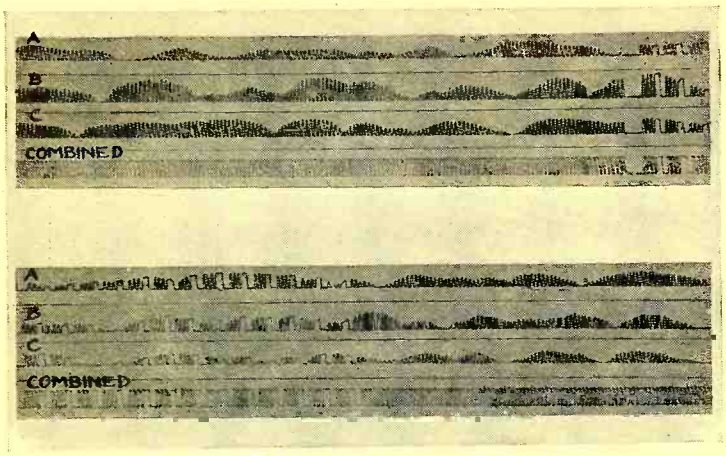


HOW AMERICAN COMMUNICATIONS ENGINEERS

Diversity

It may be that the information as an inspiration to experimenters well just what troubles fading been suggested that the same smaller way to amateur

By Murray



IRONING OUT FADING

Tapes A, B and C are the recorded outputs of each separate receiver of a diversity system. The "combined" tape is the recorded output of the tone keyer which is operated by the rectified and combined receiver outputs

WITH few exceptions, owners of short-wave receivers have probably noticed, during their past listening to short-wave radiophone and telegraph stations, how the strength of the signal varies from a high volume down to a low volume. If the receiver is equipped with automatic volume control, the reception might be clear and distinct for one instant and then smothered with noise as the automatic gain control operated to increase the sensitivity of the receiver to hold the same volume level. In the earlier days of radio broadcasting, the listener blamed the receiver when the signal faded and in many cases returned it to the dealer with remonstrances. However, now the listener is more or less reconciled to these variations and takes them as a matter of course, just as the variations in the weather.

The thought invariably occurring in the minds of the short-wave listeners is, "Wouldn't these waves be fine if we could only eliminate these effects?" Perhaps it has seldom occurred to the listener that many communication companies actually use these wavelengths as a means of conveying messages, just as the cable companies use their cables of copper wire.

Far more elaborate equipment is required, however, for the reception of these waves on a commercial basis than is available to the average short-wave listener. Highly directional receiving antennas, capable of receiving only from the direction of the sending station, are used to eliminate a major portion of the static, interference and other noises. Receivers and antennas, in triplicate, tuned to the same station, employ the "diversity" principle so that three chances of receiving the signal are present, instead of one. Each receiver employs radio and audio-frequency amplification and utilizes ingenious filtering and regulating circuits to bring the signal from the chaos of static, fading, interference and frequency variation to the cosmos of a steady, clear and distinct high-speed signal capable of conveying many messages per minute.

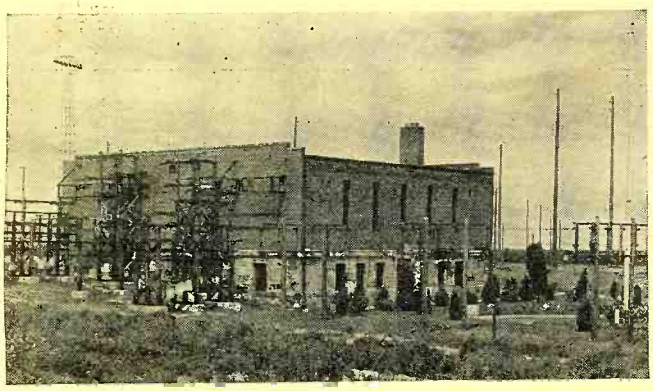
Such have been the developments of R.C.A. Communications, Inc., by its engineers at the receiving station located on the eastern end of Long Island, at Riverhead, N. Y. This station has progressed from a single building, housing a single long-wave receiver connected to a single Beverage wave antenna, to an array of ten buildings housing apparatus for the reception and measurement of waves from the longest to the shortest in use. The rapid developments in improving the transmission and reception of the short waves have forced these wavelengths to the front so that they no longer act as assistants to their older relatives, the long waves, but assume a more important rôle with the long-wave equipment acting as a stand-by.

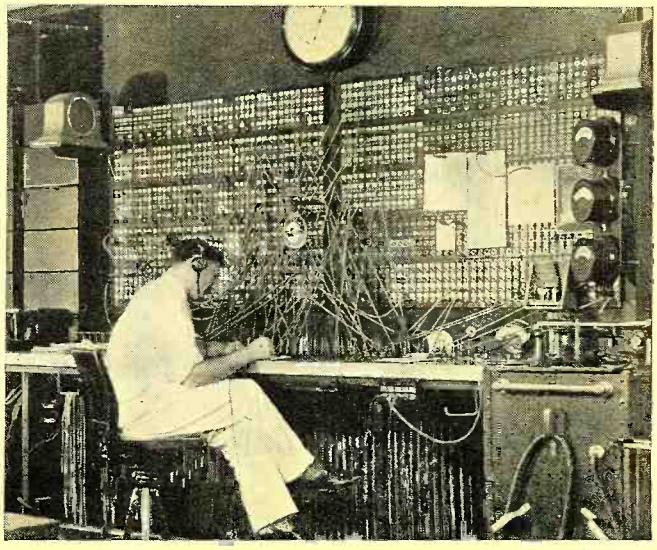
Diversity Outstanding Development

It was as early as 1923 that the inventive genius of H. H. Beverage, inventor of the Beverage wave antenna and now chief research engineer for R.C.A., and H. O. Peterson, now in charge of the R.C.A. research and development laboratories for receiving, evolved the principle of "diversity" reception. These two inventors deduced the theory that if the outputs of several spaced antennas were combined, the average value of the several would be more constant than the value obtained from a single antenna. After this deduction, experiments were performed which proved that the spaced antennas had different fading characteristics. The experiments also indicated that not only did the signals from the spaced antennas vary in different manners with respect to intensity, but also with respect to phase. Attempts to combine the radio or intermediate frequency of the signals showed that there were instances when the signals from the two antennas were of the right phase to aid each other, but that there were also instances when the phase was such that phase opposition occurred. Such

DIVERSITY RECEIVING BUILDING

Below: The receiver building at Riverhead, New York, showing the antenna structures supporting the transmission lines carrying energy from the triple directive antennas. Right: The Riverhead wire-line control board that carries messages to the central office





ARE CONQUERING FADING ON SHORT WAVES BY

Reception

contained in this article will serve and amateurs alike who know causes on the short waves. It has scheme might be applied in a transmission and reception

G. Crosby

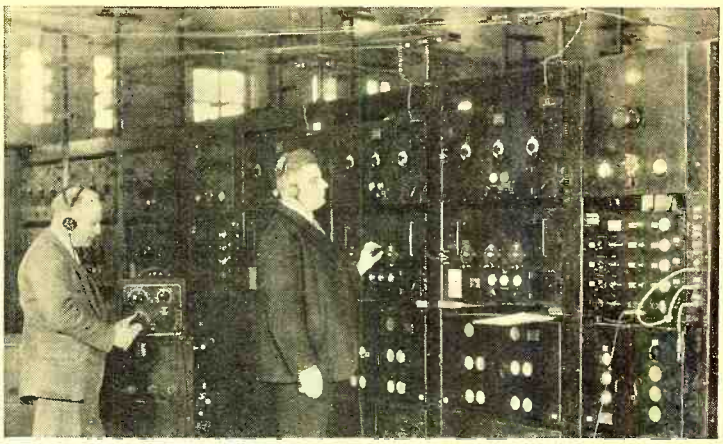
a phase variability precluded the possibility of combining the antennas directly in the manner that the long-wave antennas had been combined. Again the ingenuity of the inventors was to be applied in devising means and apparatus for combining the signals irrespective of their phases.

Many means were devised to combine the signals, irrespective of phase, but the one showing the most promise proved to be the process of rectifying the alternating current energy of the various signals from the spaced antennas and adding the resulting direct currents. The alternating voltages, as received from the individual receivers, were merely passed through vacuum-tube rectifiers so that their voltage was no longer an alternating voltage requiring proper synchronization or phasing, but direct current with constant polarity that could be added to any other direct current by the mere process of securing the proper initial polarities for combination. The process was thus converted from a problem analogous to synchronizing several alternators which varied in phase to one of connecting several batteries in series or parallel.

Other Methods of Fading Elimination Inefficient

Before the advent of the diversity principle, the only methods available for the reduction of fading were the use of repetitions and of limiting. The repetition methods included "double" and "triple" sending, where each word is sent twice or three times to insure its reception. Also, whole messages or parts of transmissions were sent many times over so that each reception could be compared to eliminate the errors.

With the advent of directive transmission and reception together with increased transmitting power, the use of "limiting" became possible. A "limiter" functions in a manner similar to an automatic volume control, by acting to "limit" the strong periods of the signal to a definite maximum value which cannot be exceeded. Such an arrangement sometimes takes the form of an overloaded amplifier having a definite maximum output; when the signal "fades in," the overload capacity of the amplifier is reached and the output cannot go above the definite maximum. Thus the signal level is maintained more constant. This type of automatic volume control would be ruinous to the quality of telephony transmission, but for telegraphy it serves a useful purpose.



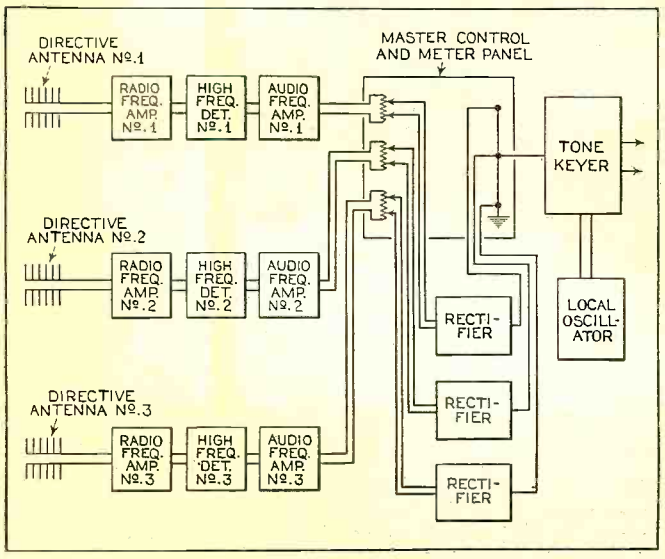
THE OLD AND THE NEW

H. H. Beverage adjusting one of the triplicate receivers on the new diversity receiver panels. At left H. O. Peterson tuning a small remodeled Radiola II which was connected in the old days to a wire hung out of the window for receiving the first short-wave commercial signals

The slowing down of transmission speed with double and triple sending, together with the message repetitions, had its apparent disadvantages. In the cases of strong signals, the limiter could be used effectively, but its effect was to hold the signal down when it came in strong. Such an effect would be analogous to an attempt to eliminate depressions by curbing prosperity; what we would, of course, rather have would be a bolstering up during the depressions. Thus, there was no device which would bring the signal up, free from noise, when it faded to one of its minimum points.

Diversity Improves the Signal While It Is Weak

The great advantage the diversity system has over the other methods of fading elimination is that in this system several spaced antennas are used, so that when the signal fades out on one antenna, another antenna lends a helping hand. Thus there might be three antennas in use, and the chance of their being a signal on any one of the three would be much greater than it would be if only one were used. The system might be likened to a fireman trying to direct his hose into three closely spaced windows instead of one. If his aim is poor, the likelihood of his getting water into the building would be far greater than if he had only one window to aim at. In the same manner, the Heaviside layer, which refracts the short waves around the curvature of the earth, sometimes (*Continued on page* 117)



SCHEMATIC DIAGRAM OF THE SYSTEM

At left a block diagram of the triplicate diversity receiving system. Below: Central offices at 66 Broad Street, New York City, where the signals received at Riverhead are recorded on paper tape and decoded by high-speed operators on the various circuits

MODERN EQUIPMENT AND TECHNIQUE FOR

SERVICING RECEIVERS

The multiplicity of new tubes and circuits calls for revised trouble-shooting methods. The author, in this and the article to follow, offers some pertinent suggestions on suitable equipment and on a revised technique

By Joseph Kaufman

Part One

A NEW TYPE SET TESTER

This set tester incorporates all of the equipment required for complete receiver analysis, following the technique suggested in this article. It includes a completely shielded, calibrated, modulated oscillator with output attenuator, 5 d.c. voltage ranges, 5 a.c. voltage ranges, 3 resistance measuring ranges covering up to 1.5 megohms, 2 d.c. current ranges and an output meter. The unit is entirely self-contained, including batteries, test prods, shielded oscillator lead and output tube adapter

THESE are hectic days, times when radical departures are being made to maintain markets or develop new ones. This applies to radio just as well as to any other industry. It is high time that you as a serviceman should consider whether your service technique, your equipment and training are going to help you make the grade. It is my sincere hope that this article will at least help you think constructively about this situation.

Radio receiver circuits (and we are talking about receivers only) have progressed from conventional to highly specialized arrangements. If you have followed the recent development in tubes, and understand the real purpose back of them, you will realize that we have not seen the end of special tubes to fit new circuits. No end is in sight.

It is claimed that the major repairs at the present time are on the older, more conventional receiver. Experience, however, has shown that servicing of a machine lags only a few months behind its appearance. If the newer products are complicated and involve tubes and circuits which make present service methods cumbersome, it is high time for the serviceman to prepare himself.

Set Analyzers

It is generally agreed that the set analyzer as a universal diagnostic device is on the way out. Analyzers are essentially voltage and current measuring instruments. The serviceman who insists on using only the analyzer in detecting circuit defects will have to develop extraordinary ability, and even then will possibly not be able to make the grade. With the introduction of the tubes of only last season, the number of suitable adapters has already grown to unwieldy proportions. The adapter situation will become worse, and the serviceman is confronted with the burden of choosing from a maze of adapters.

Looking a little further, we find that it is going to be quite a problem to develop an automatic system of testing multi-purpose tubes. How about tubes like the diode, which has no plate supply connection, or those like the muting controlled tubes used so that they are effective only when a suitable signal is fed to the input of that stage?

Point-to-Point Resistance Measurements

There is no denying that the point-to-point resistance measurement method has been a real contribution to modern servicing. As generally accepted, this consists first of checking the main power supply to assure oneself that the fundamental source is in order; second, an independent check of tubes to prove that they are in working order; and third, to check from the socket contacts to an important or common point in the radio circuit, the resistance of the component parts individually or in series as the circuit may place them.

There are definite problems in conjunction with the point-to-point resistance method which must not be overlooked.

The defect may not be traceable to a resistance or to an improper joint. There may be other troubles which do not show up as a variation in resistance.

Perhaps the most serious problem is the fact that manufacturers as a whole do not give the serviceman sufficient information for a direct, quick point-to-point resistance procedure. He should give the essential point-to-point resistances from the tube socket, with the resistance variations that are allowable, but actually we can hardly expect more than a circuit diagram, with the values of the components marked, the working voltages and special instruction when a unique system is used. The serviceman is, therefore, compelled to compute the resistance combination, a complicated task.

Even then we must not overlook the fact that a low resistance, for example, the secondary of a transformer whose resistance variation may be given to within one-half percent, may be in series with several high resistances whose acceptable variations are ten percent. The total allowable variation under those conditions will not show up a dead short across the low-resistance component.

Although the point-to-point resistance method can, and perhaps will be, developed to a high degree of perfection, it is the writer's opinion that its greatest value will be for mass production testing and the checking of several similar machines. It might effectively be developed to a point where receivers can be checked by the less experienced serviceman, but at a great waste of time. Point-to-point resistance measurement is a static testing procedure, and may not necessarily reveal the working or dynamic conditions of a receiver.

In the last twenty years and as Director of Education of the National Radio Institute, I have come in direct contact with many very capable servicemen, met many factory service managers and have had considerable personal experience in

manufacturing, servicing and teaching. I have learned that the successful always employ a system which leads directly to the source of trouble. In servicing, there is a definite trend toward this type of procedure.

The direct method is basic, fundamental and independent of tubes, circuits or the type of power supply. Properly followed, it defies most changes in the industry.

Three cardinal factors are involved in this technique. They are:

(1) A sound fundamental training in radio theory and radio design practice.

(2) Well selected, precise but simple equipment which is sufficiently basic to be adaptable to any special need.

(3) A carefully selected and closely followed service technique, fortified by experience.

The man who can qualify on all three counts will develop into a highly capable serviceman—and will be the only man who will stand the test of time.

Only a few words regarding the first requirement. You must weigh yourself carefully in your own mind and answer yourself honestly. If you can read such magazines as RADIO NEWS, know what is being said, don't have to learn things parrot fashion, and if you enjoy a grasp of the fundamental principles behind the articles you read, then you are well fortified in this respect. If your self-analysis is negative, you should give serious consideration to some sound training. There are a number of reliable home-study and residence schools which are available within the means of every one. But continue to read the professional magazines in order to keep abreast of developments—otherwise you will go stale.

Apparatus Required

Before describing the basic procedure, it will first be best to summarize the equipment required. We will assume, of course, that we are interested solely in servicing broadcast receivers.

First, a 100 to 1500-kilocycle modulated oscillator will be required. It should be stable and have an output which can be controlled from absolute zero to maximum. The oscillator and the output leads must be so well shielded that absolutely no r.f. signal gets out except through these two leads. It should be well calibrated and rugged so it will stay put.

The measuring equipment should be developed around a basic d.c. microammeter, the lower the better, but not so low as to sacrifice ruggedness. At the present time a 500-microampere meter seems to be satisfactory. Of course, there will be a need for other current ranges and these can be easily obtained by means of shunts. The suggested d.c. microammeter will provide a very sensitive voltmeter when used with suitable multipliers. As voltages as high as 1000 volts may be encountered, a tapped multiplier system should be used. Voltage change-overs may be made with plug and jack or switching arrangement.

A sensitive, rugged a.c. voltmeter is needed. The general preference today is the midget copper oxide rectifier, combined with the d.c. microammeter and multiplier. This instrument, too, should have a range of 0 to 1000 volts, with suitable intermediate ranges. Using the 500-microampere meter and a copper oxide rectifier, it is safe to assume that a sensitivity of about 1500 ohms per volt may be obtained on a.c. measurements.

The very fact that we have an a.c. voltmeter means that we also have a suitable output-indicating device when connected in series with a 1 to 2-microfarad condenser. The voltmeter may be placed across a real or reflected load and the output thus measured. When shunted across a known resistance, actual power may be computed. With any output device a simple but effective output adapter is required, and one that is independent of the number of tube prongs or their arrangement.

Without question, an ohmmeter capable of measuring from 0 to 1 megohm will be needed for circuit checking. The resistance-measuring system should be divided so that precise readings may be obtained within any single range. Of course, the ohmmeter must not drift, once it is adjusted to the zero point, and the calibration must be such that it may be quickly read.

With the apparatus listed so far, practically every type of servicing test can be accomplished. Moreover, innumerable testing set-ups can be made; for example, special L, C, R bridge measuring circuits, direct-reading capacity meters, leakage measurements, circuits which will measure the inductance of coils having a d.c. component, vacuum-tube voltmeters, oscillator circuits for grid-dip indications, and, with a therocouple, an r.f. ammeter and voltmeter—in fact, the list is almost inexhaustible.

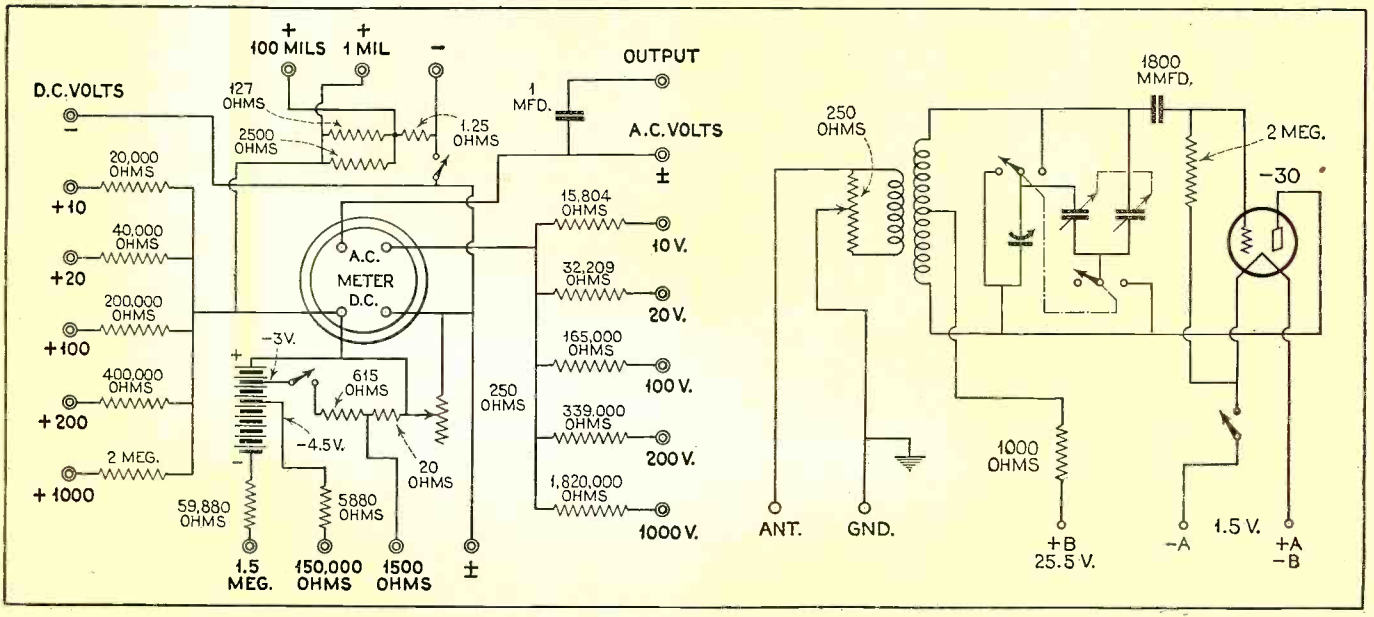
There will be occasions where a break in to a socket to measure current will be necessary. There may be a need for measuring voltages from the top of a chassis. For this purpose it is probable there will be available four, five, six, seven and eight-prong special wafer type adapters which will permit such special measurements.

The servicemen who have some of the recent set analyzers which have built into them copper oxide rectifier a.c. voltmeters, sensitive d.c. voltmeters, milliammeters and multirange ohmmeters, may use their equipment with the addition of a well-calibrated, well-shielded modulated oscillator. In no sense is it necessary for the man who is already properly equipped to make any radical purchases. Rather it is necessary to adapt himself to a technique which will place him in a stronger position to cope with modern receiver problems.

The serviceman whose equipment is obsolete should consider buying new equipment. The National Radio Institute and the Philco Radio & Television Company have introduced a special N. R. I.-Philco and a Philco (*Continued on page* 123)

THE CIRCUIT OF A MODERN SET TESTER

Figure 1. Circuit of the tester shown in the accompanying photograph. At the left is the universal meter with its shunts, multipliers, etc. At the right is the modulated oscillator circuit, which is completely shielded



THE "Discoverer Five"

TUNED R. F. SHORT-WAVE SET

By
Clifford E. Denton

IN designing a short-wave set as much skill is required in rejecting impractical, unworthy ideas as in selecting and including desirable features. This alone is enough to differentiate the correctly engineered set from the 57 other varieties.

Here are a few of the special features which contribute to the effectiveness of "The Discoverer." The newest and most efficient tubes are employed. Plug-in coils of special design add to the effectiveness of the circuit. Four pairs of coils are used to cover the short-wave band from 10 to 200 meters. High-gain coupling is employed between the r.f. stage and the detector. The set is adequately and completely shielded. The chassis strongly built of steel with cadmium finish. A handsome gun-metal finished cabinet improves the appearance and aids shielding. Single-dial control gives easy tuning. Finally, the set is easy to assemble and wire, and a complete kit is available so that it is not necessary to waste time shopping around for the specified parts.

Basically, the circuit of the Discoverer consists of a tuned r.f. stage, a tuned "grid-leak-condenser" detector stage with regeneration, a resistance-coupled first audio stage, and a resistance-coupled output stage. The r.f. stage uses a variable-mu −58 tube. A −58 tube is also employed as the detector. Regeneration is obtained by connecting the cathode of the detector tube to a tapped point in the secondary of the r.f. transformer L2. The tap is made at ⅓ the number of turns, counting from the ground end.

This type of regeneration gives smooth regenerative action, with full, even control. It also has a very important advantage that changing the position of the regeneration control does not detune the set. The variable resistor R5 controls regeneration by changing the detector screen-grid voltage.

Condenser C9 and resistor R8 act as a resistance-capacity filter for reducing hum in the detector stage. The r.f. choke L3, by-passed by condenser C8, keeps the r.f. currents out of the audio circuit. The result is humless operation, even when earphones are inserted at the jack J1.

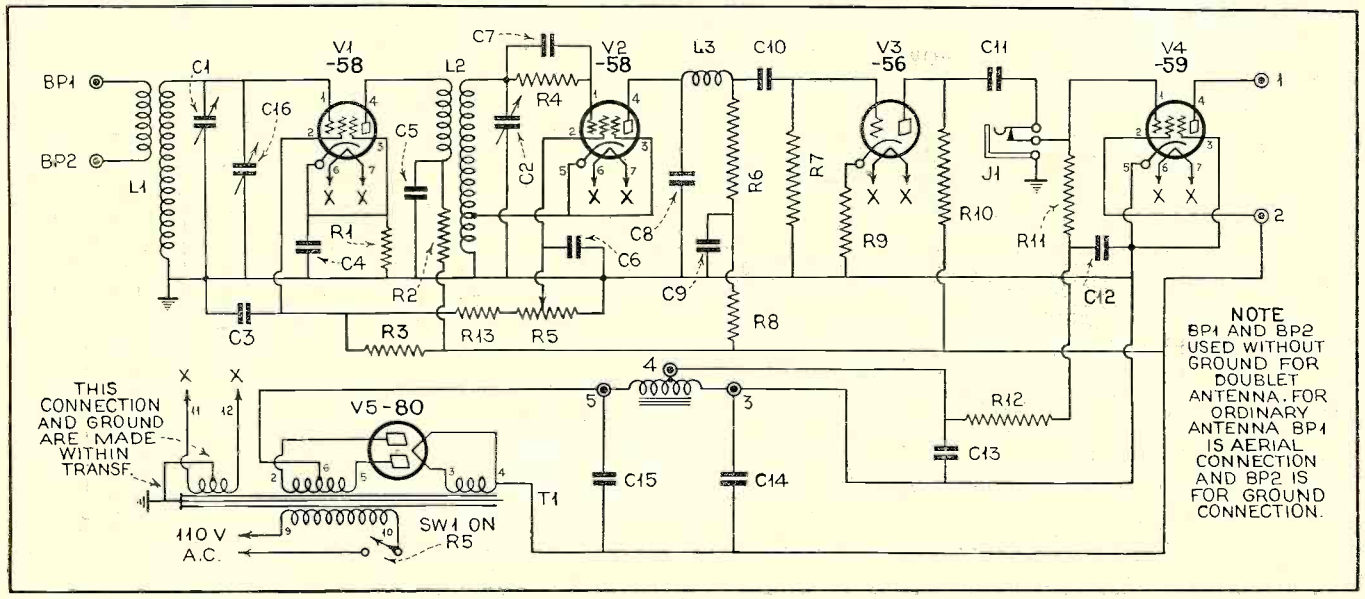
The first audio stage employs a general-purpose −56 tube, which feeds into the −59 power output tube. This latter tube, being a pentode of the indirect heater type, gives low hum output. Furthermore, it has greater power sensitivity.

The phone jack, J1, is connected so that the grid bias on the −59 is not disturbed when using the phones. In other words, the grid circuit is always closed. No direct current flows in the jack terminals, so that there is no chance of getting a shock at this point.

The power supply is more or less conventional, using an −80 rectifier tube. The speaker field serves the dual purpose of filter choke and bias resistor for the −59 tube. The 1800-ohm field is tapped at 300 ohms and the voltage drop across this smaller section gives the correct negative bias voltage. The two 8 mfd. electrolytic filter condensers, C14 and C15, are combined in a single can.

The metal chassis is available bent to shape and with wafer sockets V3, V4, V5, speaker connection socket and binding-post strip riveted in place. The balance of the assembly is left to the builder. The four Isolantite sockets V1, L1, V2, L2, are fastened into position. The tube shield bases for V1

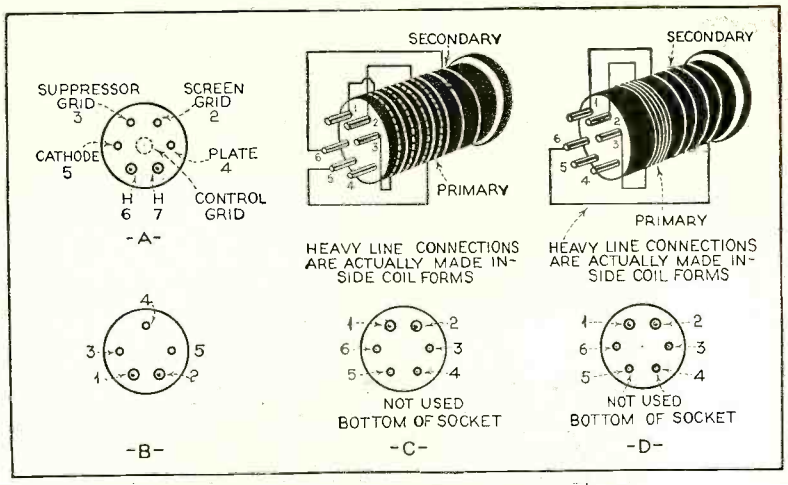
FIGURE 1. THE SCHEMATIC CIRCUIT DIAGRAM



and V2 are put into place at the same time. The dual variable tuning condenser C1, C2 is equipped with stay bolts, so that the bolts can be slipped into the holes provided for them in the chassis and fastened securely. The condenser is mounted and then the dial. A single bolt on the front chassis wall holds the dial in place.

The small variable condenser C16 is mounted at the right of the front chassis wall. The regeneration control R5 is at the left. The phone jack J1 is mounted on the rear chassis wall, as shown.

The power transformer T1 is mounted next, being placed in a position such that the 110-volt lugs are towards the rear of the chassis. A small bakelite terminal strip is mounted beneath the chassis ¾ inch from the underside, near the outlet hole provided for the 110-volt supply cable, and the latter is firmly anchored to this strip. The dual electrolytic condenser C14, C15 is mounted next.



CONNECTIONS TO SOCKETS

Figure 2. The numbers correspond with the numbered terminals in Figure 1. (a) Type -58 and -59 tubes, V1, V2 and V4. (b) Speaker socket. (c) Coil L2 and coil socket. (d) Coil L1 and its coil socket

Assembly and Wiring

The long metal shield plate "C" is fastened to the top of the chassis as indicated, and the two smaller shield strips are then fastened at right angles to this and to the chassis.

Fixed resistor R4 is soldered to the terminals of mica condenser C7 and the latter is then fastened to the side of shield plate "A" as shown.

The r.f. choke L3 is fastened underneath the chassis, using a 2¼-inch bolt, which also serves to fasten the socket of V2. All other parts are soldered in position during wiring.

Flexible solid hook-up wire is recommended. The usual order of procedure should be followed. Filament circuit first, then grid circuit, plates, cathodes, by-pass condensers and negative returns, filter system and power supply. Special care should be taken to make connections to socket terminals exactly as shown in the sketches.

The "Discoverer Five" uses a simple tuned r.f. circuit, where the only extra adjustment required is that of the antenna trimming condenser C16. After the preliminary testing has been accomplished, the set can be placed in the metal cabinet furnished with the kit, the antenna and ground connected and tubes and coils inserted in the proper sockets. The speaker should be plugged into the 5-prong wafer socket mounted on the rear of the chassis before the power supply is turned on.

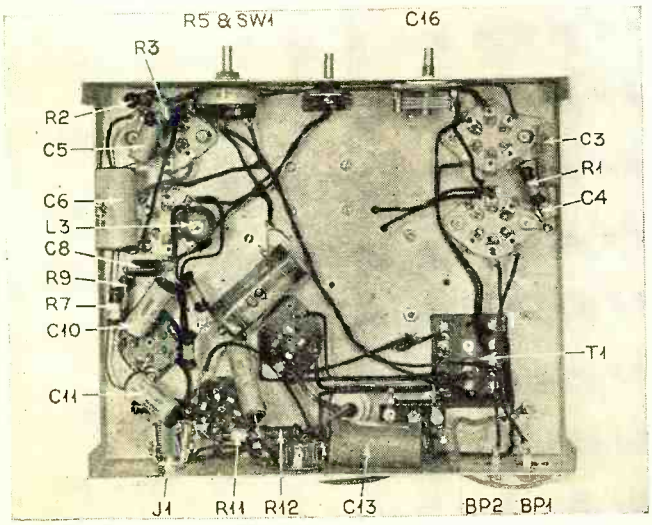
The regeneration control knob should be turned slightly to the right, closing the a.c. power switch. Time should then be allowed for the tubes to heat up. The regeneration control should then be advanced about one-quarter the way until a squeal is heard in the loud speaker. If the squeal is not perceptible, slowly rotate the small antenna trimming condenser until the two main tuning circuits are in exact resonance. This will produce a rushing sound in the speaker. As the small trimming condenser is turned and the antenna circuit is brought into resonance with the detector tuning circuit, it should be necessary to turn the regeneration control to the left, due to the excess of oscillation or regenerative action. If the regeneration control is advanced too far, it becomes impossible to obtain the regenerative action, and as this condition varies with the different bands, it is necessary to have a regeneration control which is capable of covering all of the variations due to the difference in coil characteristics for the various bands.

The antenna trimming condenser C16 should be constantly adjusted to exact resonance when tuning for weak or distant signals. The operator will note that the smoothest control of regeneration will occur when the antenna and detector circuits are tuned to exact resonance and the regeneration control is backed off a trifle from the point of maximum regeneration.

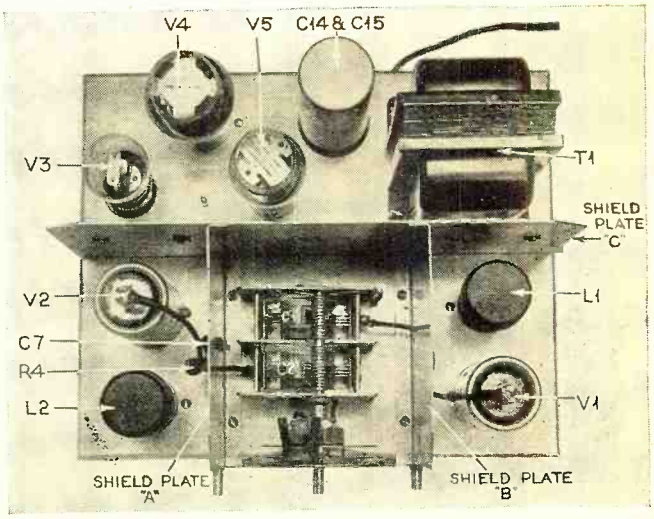
In practice, this receiver works in a slightly different way than that ordinarily ascribed to regenerative circuits. In its essence the action can be described as follows: The detector tube is constantly oscillating, and is pulled out of oscillation by means of the regenerative control. There are two factors which govern this action; one is the power absorbed from the detector circuit by the preceding stage. This power is considerable, due to the fact that the plate coupling coil in the r.f. stage has a turns ratio of 66% of the total winding and is very closely coupled. Further, the reduction of the applied voltage to the screen grid of the detector tube will tend to pull the tube out of oscillation.

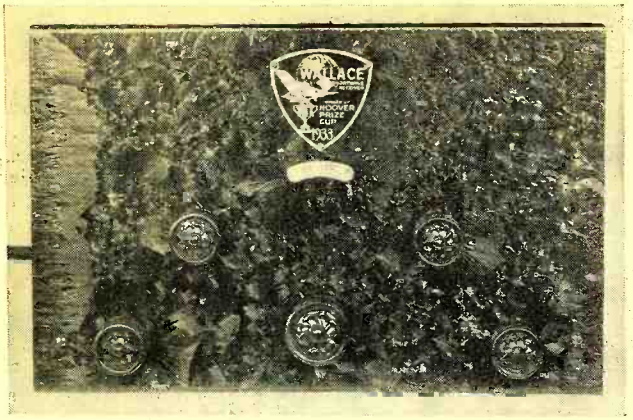
In the ordinary regenerative receiver the tube is pushed into oscillation by means of energy fed back from the plate circuit to the grid circuit or some other similar means. The fundamental action is that of a stable tube and the tube is actually forced into oscillation by means of any one of these commonly known methods. In the (*Continued on page* 118)

UNDERSIDE VIEW, SHOWING WIRING



TOP VIEW OF THE RECEIVER





Don Wallace's Two-Tube S. W. Set

By Bernard J. Montyn

IT is possible to build a small, two-tube receiver which will enable the operator to receive as many stations as with a larger set, although not as loudly. For such results, however, great care must be taken not to lose any of the signal strength picked from the air. In other words, all parts and circuits must be as efficient as possible and both aerial and secondary circuits should be tuned. This has been successfully accomplished in the receiver here described. This set was designed by Don C. Wallace, well-known amateur owner and operator of W6AM at Long Beach, California. Mr. Wallace's receiving system distinguishes itself from others mainly in the aerial circuit employed. The diagram shows this; a dipole antenna is used and the double lead-in is transposed. This has proved one of the most effective aerial systems. To take the great advantage of the signal, the aerial should be tuned, and while tuning it, the symmetry should not be destroyed. This condition was met admirably by cutting the antenna coupler in the middle and inserting a 43-plate midget variable condenser.

Coil Construction

The cutting of the primary results in a coil with eight terminals. The illustration indicates how this is done. The coil mounting has four prongs on the bottom and also a four-prong, wafer socket at the top. The plug fitting in this socket carries two twisted pairs of leads. One pair connects to the two aerial posts, the other pair to the antenna tuning condensers. No ground is employed, but the chassis itself may be grounded.

Special coils have been made for this receiver. The secondaries of these consist of a silver ribbon wound on a ribbed form. This insures high efficiency. Moreover, an Isolantite socket is employed.

The next point of interest is the main tuning condenser. It consists of two sections on a single shaft—one section of two plates and one of nine plates. The switch S2 enables connection of the condensers in parallel or to have only the smaller section connected. It is obvious that with only the small section in use, a band-spread effect is obtained and the band is located at the lower limits of the coil. For instance, a coil which tunes from 75-150 meters with both condensers may spread the amateur 'phone band all over the dial with the small condenser. If, however, a band-spread effect is desired at another point, a special coil will have to be wound for it. The experimenter can prepare such coils himself by the cut-and-try method, adding or subtracting one turn at a time on the secondary.

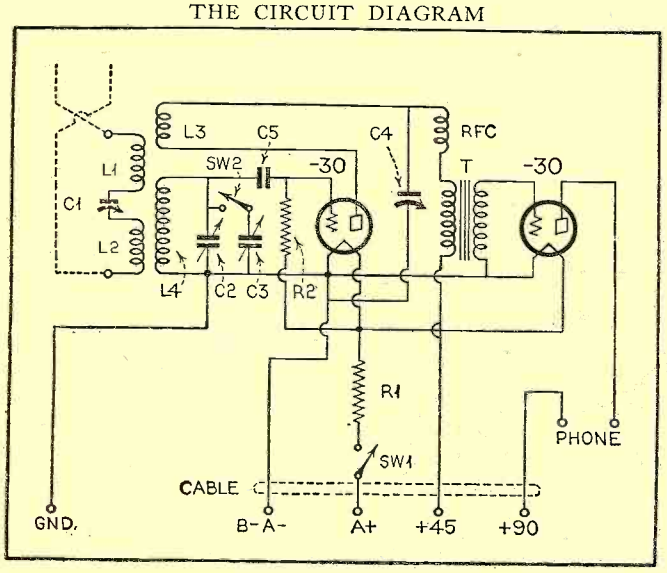
The set, shown in the illustration, employs two 2-volt tubes. Their filaments can be wired in parallel and two dry cells, with about 8 ohms in series with them, will light the filaments. It is also possible to employ a 4½-volt C battery for the A supply. In that case, the filaments are wired in series and a fixed resistor of 8 ohms is connected in the circuit.

Operating the set is simple enough. The filament switch (bottom, left) is turned "on" and the regeneration control is adjusted till a hiss is heard in the 'phones. By slowly rotating the main tuning dial you will hear a whistle when a station is passed. If the regeneration control is now turned lower, the program will come in. So far, this is the procedure for any regenerative receiver. The antenna tuning condenser should then be set to approximately the right place before looking for stations with the main tuning condenser. After some practice, the reader will find where this should be. After a signal has been tuned in, it can be made considerably louder by turning the antenna condenser to the correct position. The regeneration condenser will then probably have to be readjusted slightly.

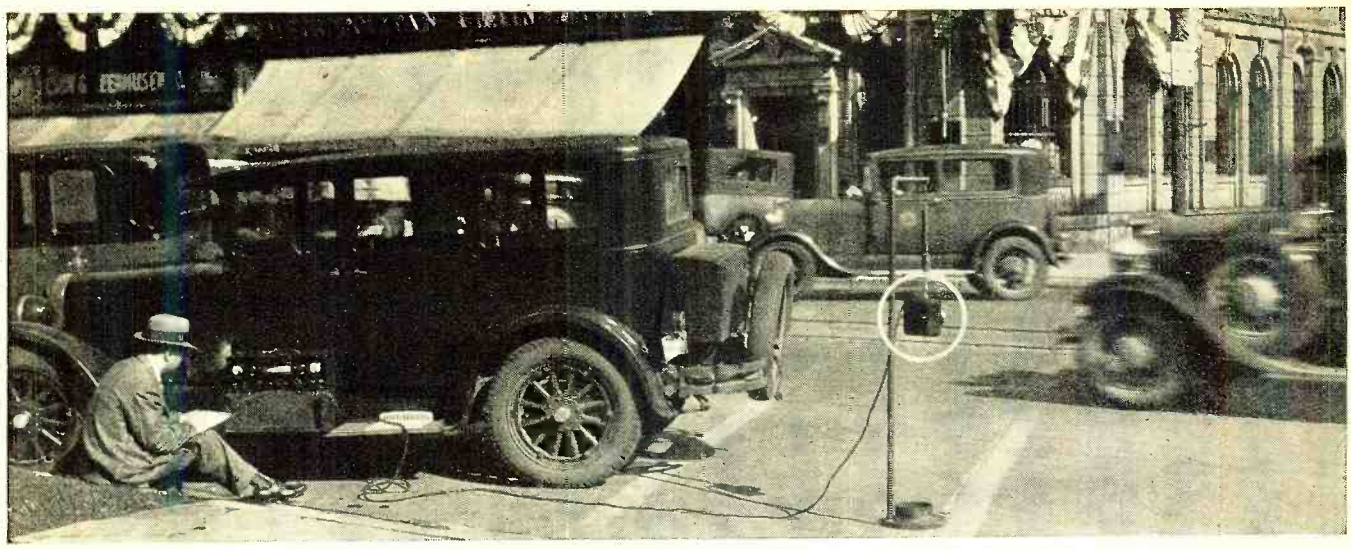
Parts List

C1—Hammarlund 43-plate midget condenser, 325 mmfd.*
C2, C3—Hammarlund special "Wallace" band-spread condensers, 75 mmfd. total*
C4—Hammarlund 34-plate midget condenser, 250 mmfd.*
C5—Fixed condenser, .00025 mfd.
L1, L2, L3, L4—Bruno No. 1A short-wave coil*
R1—Special filament resistor, 8 ohms
R2—10-megohm grid leak (*Continued on page* 124)

THE CIRCUIT DIAGRAM



REAR VIEW OF THE SET



MEASURING THE INTENSITIES OF SOUNDS ON A BUSY STREET

Figure 4. Here we see an engineer sitting on the curb with a noise-measuring unit and a microphone hanging on a vibrationless support. It is with equipment of this type that noise surveys of cities are made

RADIO *and* ACOUSTICS

The importance of radio principles in measuring sound, reducing noises, the design of auditoriums, studios and office buildings is now recognized. This article outlines some of the methods used by the engineers for coming to a solution of the many problems involved

By Irving J. Saxl, Ph.D.

Part Two

THIS modern age and a century of industrialization have brought with them an enormous increase of noise. The roaring of machines and the rattling of high speed tools have taken the place of slow and more quiet labor. New problems have arisen for our nervous systems, now continuously exposed to the dangers of noise, and new chances are being given to those scientific organizations who are able to measure and eliminate noise successfully, for indeed silence is golden when it applies to machines in action. Everywhere in industry noise-measuring devices are now used to help perfect quiet running machines, for the less noisy the machine or apparatus, the better it sells. This is a viewpoint that is coming to be widely accepted, and it will provide work for the radio, electronic and acoustical engineers in practically every acoustic field of enterprise.

Noise is a rather indefinite word. For characterizing it to a better extent, we have to distinguish between the intensity of noise, the frequency characteristics and the specific susceptibility of the human ear. If we want to know more about noise, so as to be able to fight it successfully, we must concern ourselves with these three facts:

1. The measurement of the intensity of noise;
2. The determination of the frequency distribution of noise, and
3. The relation of both these characteristics to human physiology and psychology.

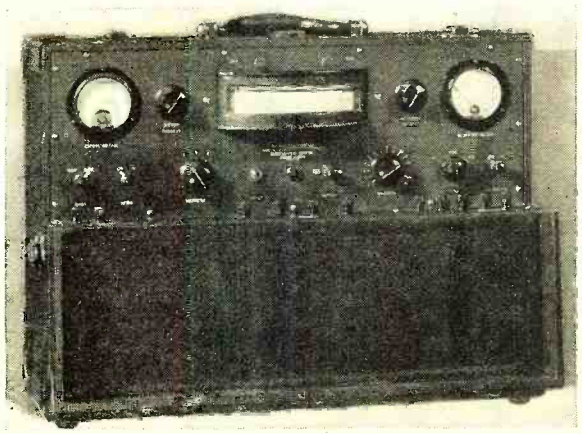
The latter point becomes clear if we consider the fact that a sound of short duration appears louder than a number of equal intensity sounds continuing at the same level over a longer period. We adjust ourselves to continual noise, exactly as we adjust ourselves to sunlight and twilight.

Professor Morgan and Dr. Laird have shown experimentally that noise produces mental and physical fatigue, retards the speed of work and interferes with its quality. These experiments were carried out with commercial typists who had worked alternately in noisy and quiet rooms. The silencing of the modern typewriter has increased the efficiency of the office worker considerably; similar results have been achieved by the silencing of other machines, apparatus and procedures.

The great differences in sound intensities are shown graphically in the noise thermometer shown in Figure 1.* We see that the levels of noise pass between an intensity of about 110 decibels, the sound of an airplane engine or a thunder crash, and go down to a sound intensity of less than ten decibels, obtainable in sound-proofed rooms.

CLOSE-UP OF AN ACOUSTIMETER

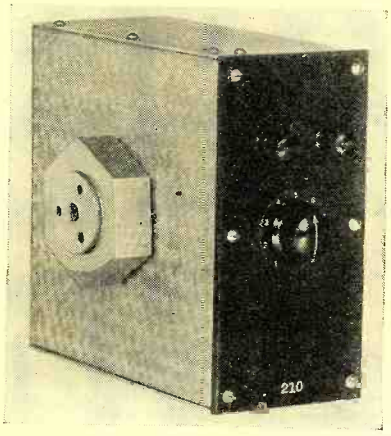
Figure 2. This illustration shows a view of the operating panel of the sound intensity meter shown in use at the head of this article



For making exact measurements of the total noise emitted by devices or the specific sound absorption of certain materials respectively, special chambers have been developed which are practically a room within a room—of such construction that outside sounds and even building rumbles cannot enter. Within the room are conducted experiments to determine the amount and type of noise produced by motors, fans and many other kinds of equipment and the specific absorptive properties of various materials. Of course it is not always possible to transport machines into a closed room and to measure every random noise. Moreover, when the question of noise localization and elimination comes up, the clear identification of a

NOISE IN THE OFFICE

Figure 5. The scene depicted shows a sound intensity measuring instrument regarding the general noise level from typewriters, telephones, adding machines and general conversation. Figure 6, at right, pictures a vibration pick-up for special noise-measuring use



small, limited area is of importance. How is this done?

Figure 2 shows a close-up of a noise-measuring device. In Figure 3 is shown the circuit diagram for this device and a list of parts.

As a pick-up, the receptive characteristics of which are reasonably constant, microphones of the condenser or dynamic type are often used. The newly developed crystal microphone may also find here a field for application. If the measurements to be made refer mostly to vibrations, a construction which is practically an inverted magnetic loudspeaker, serves this purpose beautifully. This vibration pick-up is shown in Figure 6. The moving "head" of the latter is attached to the vibrating object by means of a metal rod. The relatively heavy armature, connected to the outer case, remains stationary while the rod, connected to the moving apparatus, vibrates, thus producing an e.m.f. which is led to the two binding posts on the panel.

The sound and vibration-measuring apparatus mentioned above are matched according to the value of their internal impedances to the corresponding input side of the matching transformer T1. (See wiring diagram, Figure 3.) The input tube and also the following tubes are of the –30 type. The last stages of the amplifier are transformer coupled. The last one couples to the thermocouple TC, the rectified output of which activates a microammeter, reading from 0 to 200.

For calibrating the set to a standard sound, a standard signal is impressed upon the circuit through the calibration jack CP. The intensity of this calibrating signal must be kept constant by reading a constant value on the meter M1. By moving the jack switch S1 to the other side, the system is then ready for action.

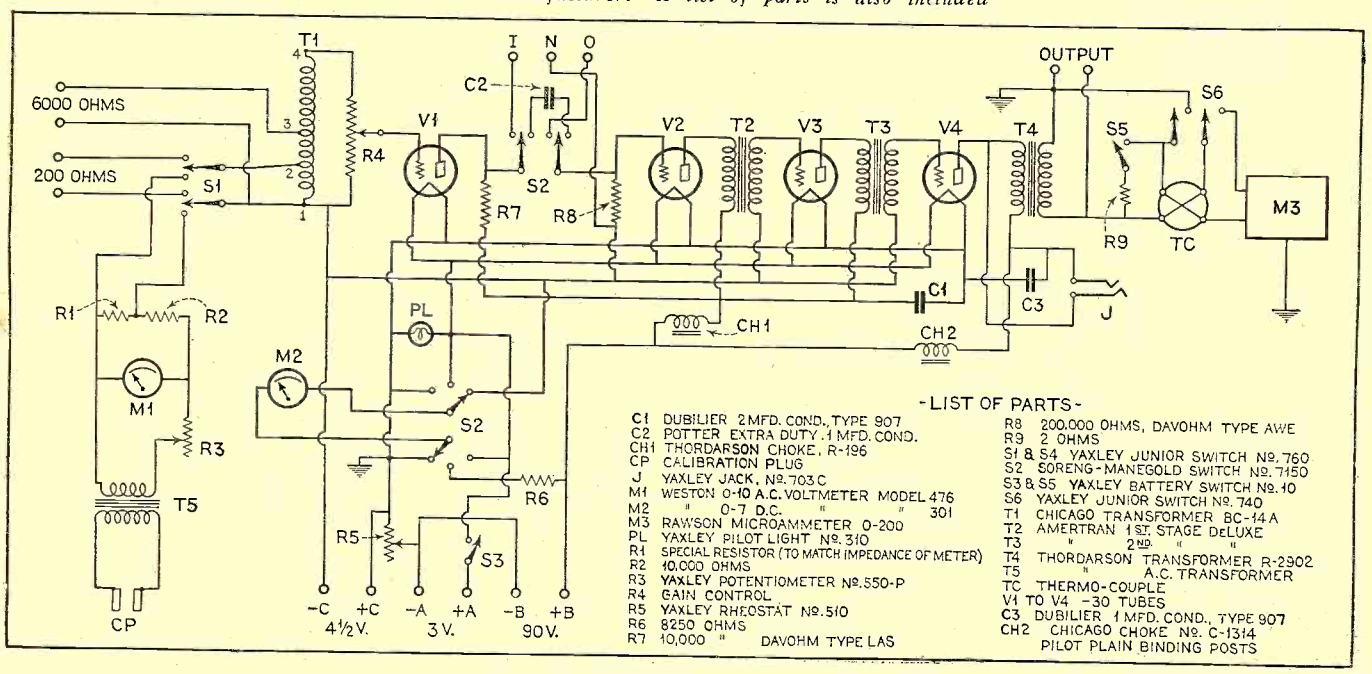
Any acoustical impressions received by the pick-up will then be converted by it into electrical impulses. These impulses, after having passed the 4-stage amplifier, are rectified and activate the microammeter. The reading of this indicating instrument therefore will be proportionate to the original sound energy which fell upon the detecting unit, the microphone.

Noises and sounds, however, vary considerably in their intensity. For making the noise-measuring device, sometimes referred to as an acoustimeter, adaptable to the widest possible range of sound levels, it is necessary therefore to include an attenuator, or weighting network. This makes it possible to vary the total gain of the amplifier system by changing the voltage impressed upon the grid of the first tube, V1, by taking off this voltage on various points of the resistor R4.

Figure 7 shows, indirectly, to what extent the silencing of the modern car has been accomplished by systematic use of acoustic equipment. A standard of quietness may be definitely established and maintaind for motors, transmissions, axles, bearings, etc. The result is extreme quietness in the operation of the completed car. It is an interesting fact that in a modern car running at considerable speed, the highest noise is made by the *tires*. Small as this remaining amount of noise is, successful attempts have been made to reduce it with the aid of the acoustimeter.

THE CIRCUITS AND APPARATUS EMPLOYED IN AN ACOUSTIMETER

Figure 3. This drawing is a schematic wiring diagram of a model B, type B183, acoustimeter made by a well-known American manufacturer. A list of parts is also included



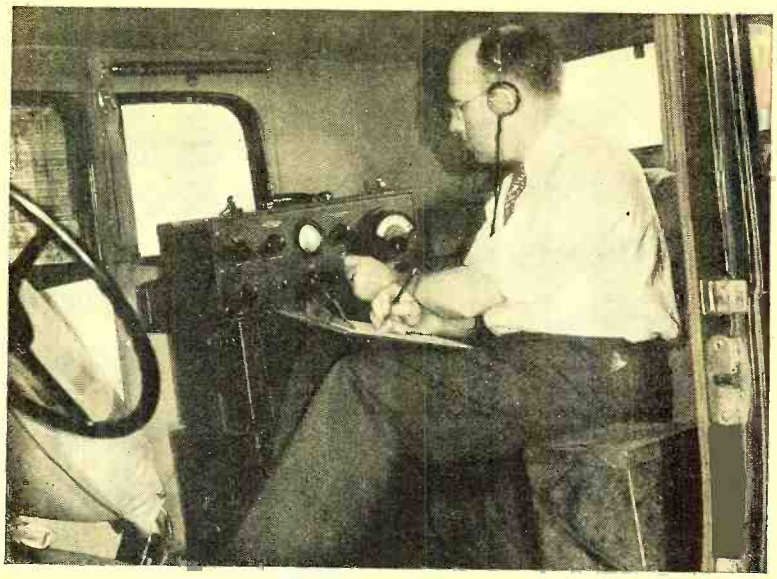
-LIST OF PARTS-

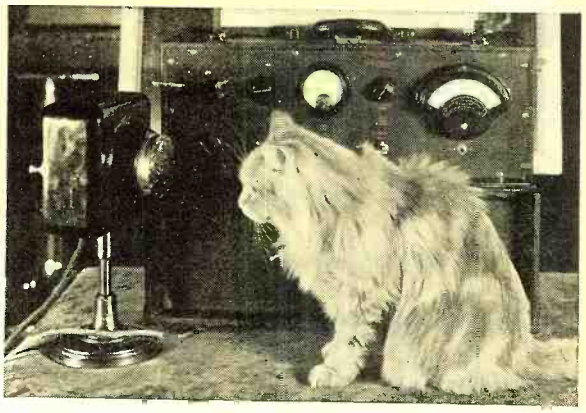
C1 DUBILIER 2 MFD. COND., TYPE 907
C2 POTTER EXTRA DUTY .1 MFD. COND.
CH1 THORDARSON CHOKE, R-196
CP CALIBRATION PLUG
J YAXLEY JACK, Nº. 703 C
M1 WESTON 0-10 A.C. VOLTMETER MODEL 476
M2 " 0-7 D.C. " " 301
M3 RAWSON MICROAMMETER 0-200
PL YAXLEY PILOT LIGHT Nº. 310
R1 SPECIAL RESISTOR (TO MATCH IMPEDANCE OF METER)
R2 10,000 OHMS
R3 YAXLEY POTENTIOMETER Nº. 550-P
R4 GAIN CONTROL
R5 YAXLEY RHEOSTAT Nº. 510
R6 8250 OHMS
R7 10,000 " DAVOHM TYPE LAS
R8 200,000 OHMS, DAVOHM TYPE AWE
R9 2 OHMS
S1 & S4 YAXLEY JUNIOR SWITCH Nº. 760
S2 SORENG-MANEGOLD SWITCH Nº. 7150
S3 & S5 YAXLEY BATTERY SWITCH Nº. 10
S6 YAXLEY JUNIOR SWITCH Nº. 740
T1 CHICAGO TRANSFORMER BC-14 A
T2 AMERTRAN 1ST. STAGE DeLUXE
T3 " 2ND. " "
T4 THORDARSON TRANSFORMER R-2902
T5 " A.C. TRANSFORMER
TC THERMO-COUPLE
V1 TO V4 -30 TUBES
C3 DUBILIER 1 MFD. COND., TYPE 907
CH2 CHICAGO CHOKE Nº. C-1314
PILOT PLAIN BINDING POSTS

The B. F. Goodrich Company of Akron, Ohio, have run tests for the noise reduction of their tires with this type of equipment. Figure 8 shows this arrangement for measuring the noise of tires. In this particular installation it is of course not advisable to have the microphone directly near the tires. The sound is therefore conducted to a microphone through the tube inserted through the floor of the car and fitting over the diaphragm of the microphone. It was found that certain treads make more noise than others. A special tread development was developed, therefore, with the effect that it was quieter than any other make in comparison.

Who would have thought a short time ago that electronic devices would be used for silencing tires, measuring street noises, knocking noise of motors, etc.? Indeed, this age, by producing machinery that makes noise, finally has produced equipment with which it is possible to measure noise and thus to eliminate it.

Other applications include the use of the acoustimeter for detonation measurement, a study of which has been carried on by the Armour Institute of Technology in Chicago. Another company measures the noise of their cream separators with the aid of an acoustimeter. Still others use the acoustimeter in reducing noise of refrigerators, cameras, typewriters, airplanes, oil burners, belt drives, electric motors, gear boxes and other apparatus.





NOISE OF TIRES

Figure 8. A set-up for measuring tire noise used in the Goodrich company. Sound is conducted to the meter from a microphone inserted through the floor of the car. Figure 7, left, the Packard company has used a sound-intensity meter for developing the car that will run as quietly as the purring of a cat

An interesting type of design for the automatic recording of sound intensities over a period of time is shown in Figure 9. In this device the electric output of the sound meter is impressed upon a special recording unit as shown schematically in Figure 10.

This automatic level recorder is used where a continuous permanent record of the sound intensity levels is required. It is particularly useful for determining trends of noise or other sounds over a comparatively long period of time.

The recording instrument consists of a condenser microphone, attenuator, amplifier and rectifier with a polarized relay controlling a motor actuating the attenuator. The movement of the attenuator is recorded by a pen on a continuous chart driven by a telechron motor.

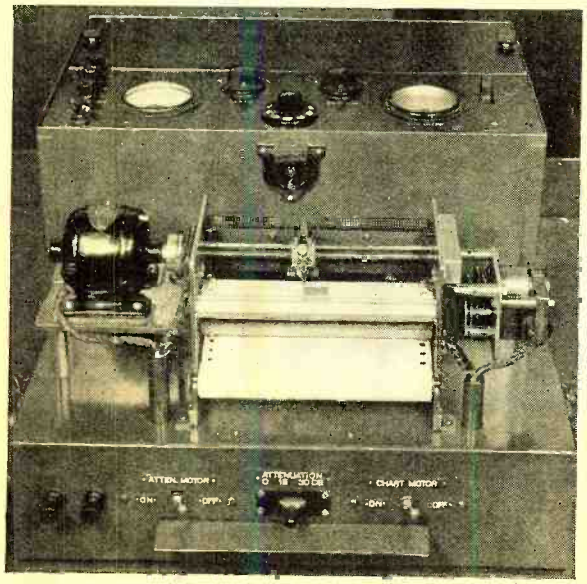
Any change of noise level causes variation in the rectified current supplied to the polarized relay. The variation in current about the balance point of the relay causes it to operate a reversible motor, driving the attenuator control of the amplifier. The action of the device is to maintain a constant output to the polarized relay by varying the amplifier gain to correspond with the variation in noise level.

Referring to Figure 9, at the extreme right side is a little synchronous motor which, as it remains permanently in step with the network, pulls a recording paper, at constant speed, over a gear transmission. The field of this motor can be reversed. The movement of the recording pen comes to a standstill if a potentiometer in back of the recording roll balances the output of the sound amplifier.

These and other acoustical devices, such as a meter designed to measure the relative intensity of sound frequencies given off by a machine, are becoming extremely (*Continued on page* 125)

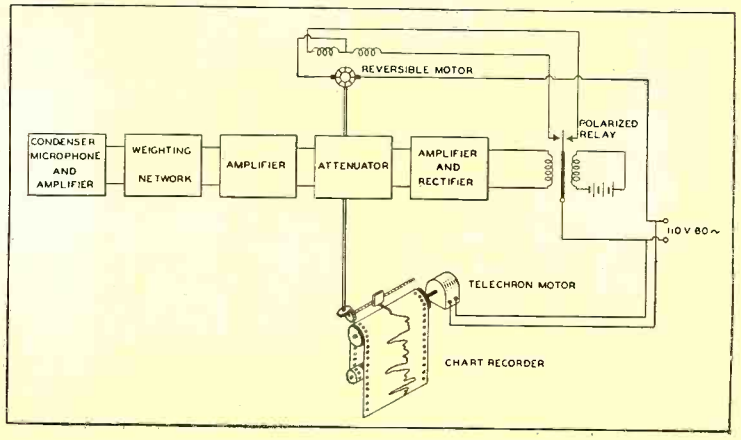
AN AUTOMATIC RECORDER

Figure 9. Here is shown another type of recording instrument that draws a graph of noise intensities on a slowly moving roll of paper



BLOCK DIAGRAM OF RECORDER

Figure 10. In this schematic we see the arrangement of the apparatus which is motivated by the reversible meter and the small telechron meter working through a polarized relay



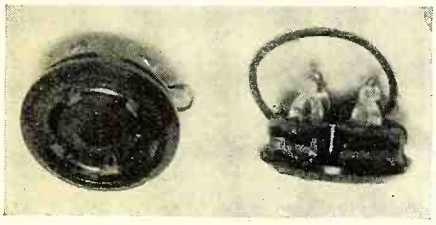
What's New in Radio

A department devoted to the description of the latest developments in radio equipment. Radio servicemen, experimenters, dealers and set builders will find these items of service in conducting their work

By The Technical Staff

A New Radio Socket

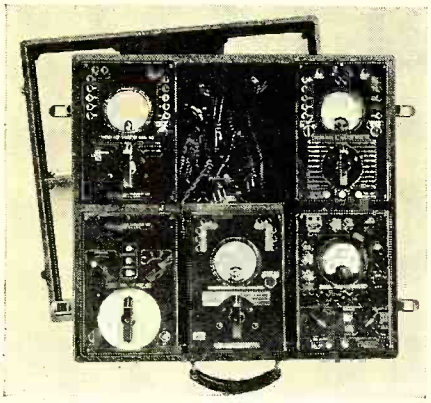
Description—The American Phenolic multi-position vacuum-tube socket is neat in appearance, uses no rivets in its assembly and should prove popular with both the set manufacturer and the amateur constructor. A single locating lug allows the socket to be positioned at various angles which makes possible short connecting leads and also makes possible the interchange of various type sockets in the same mounting holes. This type of socket design permits tube shields to be mounted underneath the socket without employing chassis fasteners or rivets. These sockets are available in different models to take all the vacuum tubes now in active use.



Maker—American Phenolic Corp., 549 W. Randolph St., Chicago, Ill.

Service Equipment

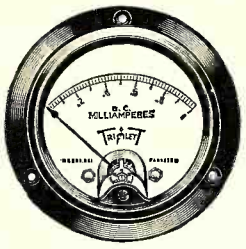
Description—The five Weston standardized service units enclosed in this carrying case include the model 660 radio set analyzer, model 661 tube checker, model 662 test oscillator, model 663 volt-ohmmeter, and the model 664 capacity meter. This combination of service equipment provides a desirable portable laboratory with facilities for a wide range of tests. All five units are identical in size. If desired, single units can be supplied, mounted in individual leatherette-covered carrying cases. The model 660 set tester is a single-meter a.c.-d.c. instrument designed to provide complete voltage and current readings at the tube sockets in all makes of receivers. The tube checker, model 661, tests 4, 5, 6 and both the large and small-size 7-prong type tubes. It operates from 100 to 130 volts, 60-cycle a.c. line supply. The i.f. and r.f. test oscillator, model 662, is a self-modulated instrument with frequency ranges from 100 to 3000 kilocycles. The No. 663 volt-ohmmeter will indicate readings below 10 ohms to as low as 0.1 ohm. The high range permits testing of grid leaks up to 10 megohms. The capacity meter, model 664, is designed for a wide range of capacity and a.c. voltage measurements. Its ranges are: microfarads; 10-200, 1-20, 0.01-0.2, 0.0001-0.02; volts, 4-8-40-200-400-800 a.c., 1000 ohms per volt.



Maker—Weston Electrical Inst. Corp., 615 Frelinghuysen Ave., Newark, N. J.

Meters

Description—The illustration below of an 0-1 d.c. milliammeter is representative of the new Triplett line of the D'Arsonval moving-coil instruments. The flush type meter Model 321 shown in the illustration has a 3½-inch case with a 2⅜-inch scale. This same size meter is also available for front-of-board mounting. Model 223 is a narrow-rim instrument with a 1¾-inch scale. These new moving-coil instruments include d.c. ammeters and voltmeters in various single and dual measurement ranges.



Maker—The Triplett Electrical Instrument Co., Bluffton, O.

Adjustable Pyrohm Resistors

Description—Announcement is made of the new Aerovox No. 958 adjustable pyrohm resistor, especially designed for use as a transmitting grid leak. This new resistor is also adapted to power units or wherever a heavy-duty adjustable resistor is required. The resistance wire is wound on a porcelain tube and is covered with a vitreous enamel, protecting the wire windings against accidental injury, oxidation and moisture. A strip of the winding is exposed along the entire length of the resistor so that contact may be made by means of the adjustable slider to obtain the desired resistance value. These resistors are available in values from 5000 to 100,000 ohms and in power ratings up to 200 watts. The dimensions of the resistor are, 8½ inches long by 1 1/16 inches in diameter.

Maker—Aerovox Corp., 70 Washington St., Brooklyn, N. Y.

Name Plates

Description—These new Blan aluminum-processed name plates have an electro-plated black finish that cannot mar or scratch off. The plates are stamped to order as illustrated by the group in the photograph. The letters are raised and show a clear aluminum white against the black background. The plates are ⅜ inch in width and can be had in any length. These name plates can be applied to many useful purposes, such as attachment to transmitting equipment, personal radio sets, laboratory apparatus, etc.

Maker—Blan the Radio Man, 177 Greenwich St., New York City.

A Handy Testing Kit

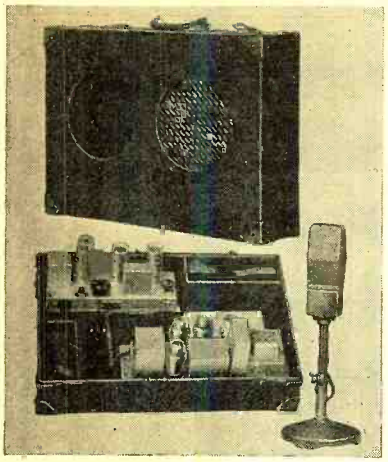
Description—This kit of interchangeable test parts should prove popular with the serviceman and radio experimenter. The kit comprises two No. 134 long and two No. 135 short type insulated test prod handles, two No. 131 plug-in prongs, two No. 136 plug-in prong jacks, two No. 133 interchangeable insulated tapered type lugs, two No. 132 insulated needle-point phone tips and two No. 130 insulated alligator clips. The various parts are finished in red for positive identification and in black for negative identification. This is a very convenient testing kit in laboratory work for making quick and positive connections to meters and other testing instruments.

Maker—American Radio Hardware Co., 135 Grand Street, New York City.

Portable Public Address System

Description—A single carrying case measuring 25 inches long by 18½ inches high by 11 inches deep housing a complete portable sound reproducing system to cover an audience up to 2500 persons. The equipment comprises a seven-tube Class B amplifying system, dual loud speakers and a "velocity" ribbon type microphone. Heretofore, the ribbon type microphone has only been employed for discriminating sound work. This latest type microphone provides favorable directional characteristics, high sensitivity and faithfulness of response. The five stage Class B amplifier is designed to deliver 20

watts output and the following type tubes are used: one –57, two –56, three –59 and one –83 type rectifier. The amplifier is mounted on two separate chassis in order to reduce hum to a minimum. The equipment has a tone control and a voice-music com-

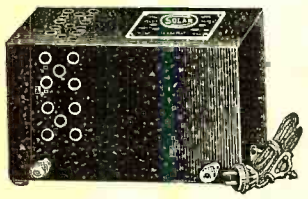


pensation switch. Provisions have been made to supply polarizing voltages for a carbon type microphone. Single or double phonograph turntable units mounted in individual carrying cases are available as auxiliary equipment to this sound reproducing system. Sound engineers, radio dealers and servicemen should find more than ordinary interest in this public address system as a profitable item for rental or sale, for installation in auditoriums, dance halls, etc.

Maker—RCA Victor Co., Inc., Camden, N. J.

Compact A.C.-D.C. Inverter

Description—The new Solar inverter produces 110 volts alternating current from direct-current supply. There are five different models, designed to operate off 110, 220 or 32-volt direct-current lighting lines. The 110 and 220 volt units have power watt ratings of 100 and 150 watts, respectively. The 32-volt unit has a 75-watt rating. The inverter is compactly designed, measuring only 11 inches long by 6¼ inches wide by 7 inches high and the shipping weight is 20 pounds. Special inverters are available on order to meet power requirements up to 200 watts. This power supply is equipped with a protective fuse and a filter system to elimi-



nate r.f. interference. The magnetic unit employed by this device to change the direct current to alternating current is the only moving part. The manufacturer states that this magnetic unit is a time-proven device which in average use will require replacement only after a long period of service. The inverter is especially adapted for use in d.c. districts where it is desired to operate a.c. radio receivers or other a.c. electrical apparatus from direct-current supply.

Maker—Solar Mfg. Corp., 599 Broadway, New York City.

Buttonhole Microphone

Description—A new 100 ohm lapel type, single button, carbon microphone, measuring only 1½ inches in diameter. The important advantage in using the lapel or buttonhole microphone, is the complete freedom it allows the speaker in moving around the platform and addressing his audience in a natural manner. It is also useful to drivers of sound trucks, as it en-

ables them to make announcements while driving. The microphone is said to have a good frequency response. It is finished in metallic black and comes complete with convenient attaching clip.

Maker—American Microphone Co., Ind. Ltd., 251 W. 59th St., Los Angeles, Cal.

Ribbon Antenna

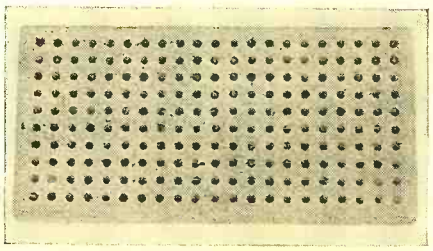
Description—Announcement is made by this company of the new "Cello" ribbon antenna. This is a thin flat ribbon type aerial made from aluminum foil covered with Cellophane. This antenna ribbon measures ⅜ of an inch across and it is said, because of this large surface area, to improve reception results. The advantage of the Cellophane treatment is the insulation factor and also its decorative quality. This

Cellophane covering may be had in a variety of colors, harmoniously adapting the antenna to the decorative color scheme at hand. This new type of ribbon antenna is flexible and can be fastened around mouldings or baseboards without difficulty. It comes in standard lengths of 50 feet and may be had in different lengths, to order.

Maker—Freydberg Bros., 11 W. 19th St., New York City.

Sound-Absorbing Material

Description—The photograph illustrates a single tile of Acousti-Celotex sound-absorbing material, a Celotex product made up in a form which greatly improves the sound-absorption characteristic over that of plain Celotex. This improvement is brought about through the perforations extending part way through the tile, the walls of the perforations adding to the total sound-absorbing surface area. Acousti-Celotex tile are utilized for surfacing walls and ceilings of



theatres, sound studios, etc., to reduce reverberation and thus improve the acoustic properties of such interiors. They also find extensive use in offices, banks, etc., where they are found effective in reducing noise. Considerable success has been met with in applying these tiles to the interior walls of radio cabinets to reduce cabinet resonance. Acousti-Celotex is available in three types, C, B and BB. These types differ in their thicknesses, which are ⅝ inch, 13/16 inch and 1¼ inches respectively and show sound-absorption coefficients of .30, .47 and .70. The tile sizes are 6 by 12 inches, 12 by 12 inches and 12 by 24 inches.

Maker—The Celotex Co., 919 N. Michigan Ave., Chicago, Ill.

Midget Receiver

Description—The new Autocrat mantle type set illustrated here is a six-tube super-

heterodyne circuit featuring automatic volume control, tone control, dynamic type speaker and an image suppressor circuit. This receiver takes advantage of the new type tubes which include: one –58 type, one –57 type, one –56 type, one –55 type, one –2A5 type pentode power output tube and an –80 type rectifier. The receiver chassis and the reproducer are housed in a walnut two-tone cabinet measuring 14 inches high by 12 inches wide by 9 inches deep.

Maker—Autocrat Radio Co., 3855 N. Hamilton Ave., Chicago, Ill.

Balanced Antenna System

Description—The new "Staticlear" balanced antenna system is designed to eliminate man-made radio interference. It is said that the transmission line may be as long as 1000 feet without affecting signal strength or causing pick-up of interference. The kit consists of 75 feet of two-wire transposed trans-

mission line, two radio-frequency transformers to match the antenna and receiver input impedances to the balanced transmission line, and complete mounting hardware. This system is designed for use with either broadcast or short-wave antennas.

Maker—Clough-Brengle Co., 1134 W. Austin Ave., Chicago, Ill.

New Receivers

Description—The consolette and table type receivers illustrated here are a part of the

(*Continued on page* 118)

AN INTRODUCTION TO THE VARIOUS PHYSICAL

Phenomena Underlying Radio

In preceding sections the elements of the structure of matter, the electron theory and the mechanics of heat production have been given in enough detail so that we may now turn to the examination of the electrical results of mechanical and thermal action

By **E. B. Kirk**

Part Five

IF one material be moved over the surface of another, a mechanical resistance is met with which is called "friction." The magnitude of this resistance depends on the materials in contact, the condition of the surfaces and on the force pressing the surfaces together. The larger irregularities of the surfaces can be reduced by smoothing and polishing, but if solid matter be as loosely put together as the atomic theory pictures, a surface can never be a definite plane, but must be thought of as the mean level of the outer particles. Since the forces which constitute friction arise from the irregularities of the surfaces, they are reducible (in the final analysis) to atomic and electronic attraction and repulsion. If this be so it follows that, aside from the passage of radiant energy, at least two kinds of interchange can take place between and through the surfaces. First: energy can be transfered from one body to the other by the collisions of their particles. Second: molecules and electrons may actually pass from one body to the other. Ordinarily the number of these atoms or molecules which succeed in migrating through the surfaces in contact is relatively insignificant and we can dismiss this type of exchange by saying that in general such action takes place under three sets of circumstances. If the temperature is sufficiently high to make one or both of the bodies sublime, melt or become plastic, conditions of diffusion similar to those in liquids or gases are brought about. If a chemical reaction is started; this action takes place if the attraction between the unlike atoms of the two bodies is greater than the mutual attraction between the like atoms of each body, in which case the unlike atoms combine to form compound molecules. Or if an electric potential be applied and maintained between the bodies, a migration of the atoms themselves may take place thus producing electrolysis. Since we are not interested in chemical reactions, our attention will be directed only toward the interchange of energy and of electrons.

A transfer of energy in general will be in the form of increased kinetic activity and will manifest itself as a flow of heat. A transfer of electrons, since electrons are negative charges and are identical no matter from what material they are liberated, results in the electrical condition of the bodies being changed. If the bodies in contact are non-conductors, electric charges may collect. If the bodies are conductors, electric current (under certain conditions) may be set up.

Innumerable combinations of substances and conditions presupposes the exploration of a vast and complex field of phenomena. For a systematic consideration of the more important cases it is necessary that we resort to some such arbitrary division of the various possibilities as the following.

Division 1—Similar Material, Similar Conditions

Under this heading may be placed the action of two pieces of the same material, both being in the same physical condition. Physical condition is described as solid, liquid or gaseous, with a further description of temperature, internal and external strain, magnetic, optical condition and so forth. Examples of this class would be two pieces of copper or two amounts of water in contact. Obviously two pieces or amounts of the same substance under these restrictions are identical with a single piece or amount of the material with an imaginary surface separating it into two parts.

Division 2—Similar Material, Unlike Conditions

The two bodies in contact are the same material but differ one from the other in their physical condition. Each piece, however, must be uniform throughout. In some cases this would be the same as having a single piece in a non-uniform condition as a bar of iron with one end heated or compressed or with unequal strains within it. Other examples would be ice in contact with water or mercury with its vapor. The Thomson effect, the Electrostrictive, and the Piezo- and the Pyro-electric effects come under this heading.

Division 3—Unlike Material, Like or Unlike Conditions

The two bodies of this division differ one from the other in chemical constitution. Both may or may not be in the same physical state or condition. Copper in contact with zinc is an illustration. Or neon gas in contact with an electrode, a liquid with a solid (as an electrolyte with a metal plate). Each substance, however, is supposed to be in a homogeneous condition. Since this class is practically endless, we shall be able to consider only typical examples. Electrolytic action and thermo-electric effects, such as the Peltier and the Seebeck effects will be considered.

The above arbitrary (but practical) division covers what is termed interface phenomena, an interface being a separating surface through which forces act or action takes place. In each of the above divisions, with the exception of the first, there is supposed to be a transfer of energy through the interface which is greater in one direction than in the other. In order that this be so, work must be supplied in some form. We now pass to typical examples of the above three divisions which we shall consider in order.

Examples of Division 1

Simple contact of two pieces or amounts of the same substance in exactly the same physical condition will not give rise to any detectable action either thermal or electrical, since the atoms of the two are the same and have on the average the same amounts and distribution of kinetic energy. Therefore, on the average, the same number of molecules, atoms, and electrons will pass in one direction through the interface as in the other. If, however, one piece be moved over the surface of the other, the work expended ordinarily appears in the form of heat due to the increased agitation of the particles of the surfaces. This local production of heat sets up a non-homogeneous condition within the bodies, falling within the actions taken up under our *second* division.

As distinguished from what may be thought of as surface disturbances or local differences of condition, there are phenomena associated with a general or uniform change of condition throughout the mass of a body. We know that the resistance of a wire, for example, depends on its temperature among other things; the higher the temperature, the higher the resistance (holds for most substances). Evidently any change of motion resulting from thermal agitation affects the migration of the electrons. This has been touched on, previously, under the section dealing with the kinetic theory of electrons. All of the facts of conduction, however, are not so easily explained as might be assumed from a first survey of the triumphs of the electron explanation; carbon and certain alloys, for instance, have a negative thermal co-efficient of resistance, for as the temperature is increased, the resistance decreases. This must be explained by supposing a tendency toward an internal rearrangement of the atoms or molecules with an increase of temperature allowing, in spite of the increase of the random movements and collisions, freer passage of the electrons (resembling possibly the regular disposition of molecules in a crystal or space lattice). Laboratory measure-

ments have shown that with decreasing temperature the conductivity becomes better and better and there has been no contradiction to the assumption that at absolute zero (some −273° C) conduction would become perfect, that is, a current once started in a circuit would continue indefinitely. The internal rearrangement at the extremely low temperature apparently opens up avenues or lanes through which the current electrons pass, practically unimpeded by direct collisions (that is, the electron mean-free-path approaches infinity).

This phenomena of super-conductivity was first observed some twenty years ago by a Dutch physicist, Heik Kamerlingh Onnes and his co-workers at Leyden. Since that time much research has been devoted to the study of low-temperature phenomena but super-conductivity has never been observed in any substance above −263° C (usually given as 10° K., K or Kelvin being the absolute scale of temperature) which seems to indicate that at or about this temperature there occurs a radical rearrangement of the internal structure of all substances exhibiting this action.

By means of liquid Helium, temperatures within 1.5° C of absolute zero have been attained recently; even at some 5.° Kelvin a current started in a lead ring has persisted for over thirteen hours. Study of conduction at these levels of temperature are of utmost importance to theory but they promise little for commercial application, directly.

What has been said above does not come strictly within the scope of the *first* division since the maintenance of an electric current requires the application of an external field or source of potential difference if the conductor was itself originally in a homogeneous condition. The flow of current is in itself a non-uniform condition requiring a non-uniform field of force to cause the movement of the electrons. We must not confuse a uniform or homogeneous condition with a uniform rate of change or gradient of a field of force or energy. A completely uniform condition is, of course, realizable only in theory.

A moment's thought on the foregoing may bring to mind a contradiction of terms, namely, if heat is motion, then the electric current even at absolute zero *is* heat. And so it is, in terms of the kinetic theory of heat when extended to include the electrons in the mechanism of heat transfer; an electric current even at absolute zero, if such be possible, is actually a very special flow of heat having no component of its motion escaping at right angles to the stream (therefore undetectable); all components of motion at right angles having been immediately removed by absorption by the refrigerating substance (liquid helium). If this state of affairs bothers us as inconsistent, we are free to change our definition of absolute zero to one requiring the absence of all motion, molecular, atomic, and electronic. This would be in keeping with a mathematical and a more strictly thermo-dynamical point of view.

Pressure Effects

An application of pressure to a body results, of necessity, in an internal rearrangement of the particles. The distances between the molecules are decreased, and the mean-free-path of the particles is decreased accordingly. This results in more collisions per unit of time, giving a rise of temperature in the compressed area. The increase of energy density (the original kinetic energy of the material being compressed into a smaller volume) is immediately distributed to the surrounding regions and, if given a sufficient time, will re-establish a condition of equilibrium and uniform temperature. But since the arrangement of the fields of force has been changed, the electrical, magnetic, thermal, optical, and all other properties of the material have been affected.

It is natural to suppose that an increase of pressure would, by crowding the particles closer together, allow the electrons less space through which to move and thereby increase the resistance. But for most metals (pure hard metals at least) the resistance falls with increasing pressure. This can be predicted, however, if we assume that pressure acts as does extremely low temperatures in-so-far as causing the molecules to assume a more orderly arrangement within the substance. Since there are frequent exceptions to the foregoing it is necessary to assume that in all cases of increase in the orderly internal arrangement with increased pressure, direct open traffic lanes are not produced. For example: if a box be filled in an orderly way with large marbles fitted as closely together as possible and a small shot be dropped between the marbles of the upper layer it could not fall directly to the bottom but would be forced to change its direction at each layer.

Applications of Pressure Phenomena

Although there seem to be no pure examples of the application of pressure phenomena to the radio art, there have been numerous applications in combination with other actions. Lepel in 1906 patented a detector known as the compressed dielectric detector. It consisted of two electrodes, one flat, the other spherical, separated by india rubber, collodion, or celluloid. The electrodes when forced together by a pressure of some 300 pounds allowed a current to pass. Apparently this arrangement acted as a rectifier.

The action of certain crystal detectors is no doubt complicated by pressure action. Although a relatively light contact pressure may be used, the pressure per square cm. may reach surprising values since the entire pressure may be transmitted through an extremely minute area of the crystal (similar to the ordinary phonograph needle exerting at times a pressure of over 50 tons to the square inch). The consideration of the rectifying properties of crystals falls properly under the *third* division, dissimilar material in contact. The rectifying action of coherers also is complicated by the pressure action but, apparently, their action depends more heavily on thermo-electric or thermionic phenomena. Microphonic contact evidently depends, in part at least, on pressure actions taking place within the particles or materials in contact.

Optical and magnetic pressure characteristics are important enough to receive special attention in later sections.

We may add, before passing to examples of the *second* division, that the hardening or heat treatment of a metal alters its internal arrangement by a change of the space lattice or of the crystalline structure. The result may be an irregular intertwining of similar minute crystals as in a pure metal, in the complex association of unlike crystals as is the case in some alloys, or the mixture of crystalline and non-crystalline material. The two latter possibilities may be treated as dissimilar materials in contact.

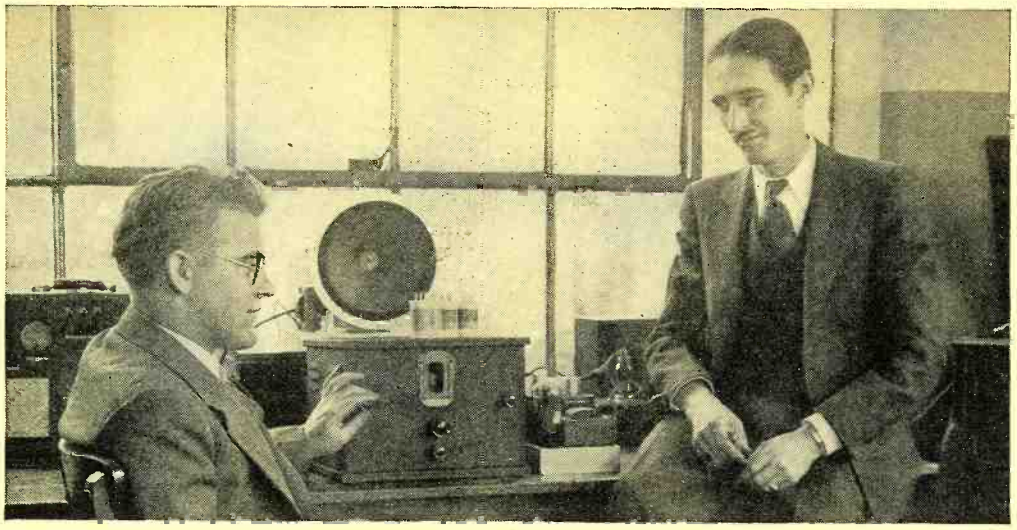
Examples of Division 2

This section gives more interesting actions for discussion. The two bodies in contact are supposed to be the same chemically, that is, they are both composed of the same kind of molecules or atoms, but one body differing from the other in physical condition.

Volta some hundred years ago discovered that when two pieces of different metals were placed in contact and then separated they acquired electric charges. If the two pieces are placed in an electrolyte and joined through an outside circuit a current will be set up. The nature of the electromotive force thus established received no adequate explanation until O. W. Richardson and P. Debije, through their researches, pointed out that contact electromotive is an intrinsic property of metal and is dependent on the rate at which the electrons in the metals "evaporate". Although the metals exhibit this action in its highest degree, any two materials will in general give rise to a contact difference of potential which is accounted for by the difference of the electron pressures in the two. Contact potential difference may amount to several volts; it is an important factor in vacuum-tube theory and practice, for example, thorium oxide is used in filaments to reduce the contact potential, thereby allowing the electrons to escape with the expenditure of less work (lower filament heat or lower plate voltage) from a pure metal filament.

The importance of contact potential will be better appreciated when we reach the *third* division and the section dealing with thermionic phenomena. For the present a brief explanation will be sufficient for the conditions of the *second* division under which it arises.

A contact potential represents the amount of work required to take a unit charge out of the substance in question against the attractions within the surface. The greater the contact potential, the greater the energy which has to be supplied to the electron to drive it out. The work necessary to move an electron across an interface, between two different substances (in this case between the same substance in different physical condition) depends therefore on the difference of the contact potentials of the individual substances, that is, on the rate at which the electrons evaporate from the two substances. For example, in a mercury-vapor lamp, when the mercury is first heated, molecules and electrons evaporate; this tends to create a difference of potential, (*Continued on page 122*)



THE "Short Wave Master 6"

A 14-115 METER T. R. F. RECEIVER

There are many s.w. fans who maintain that tuned r.f. receivers are the most desirable type for short-wave reception—and for them this receiver offers a good example of modern design

By
Hubert L. Short
and
Frank Lester

ONE of the outstanding phenomena of 1933 radio history has been the startlingly revived interest in home set building, brought about mainly by the growth of the short-wave "game." People everywhere are buying parts, studying hook-ups and neglecting their business, their friends and their families in their search for elusive foreign low-wave phone stations. The old DX fever of eight and ten years ago is again rampant and has afflicted many former radio fans and constructors who have not touched a soldering iron in years, as well as newcomers who are just discovering radio to be the ideal hobby it has always been for countless "hams."

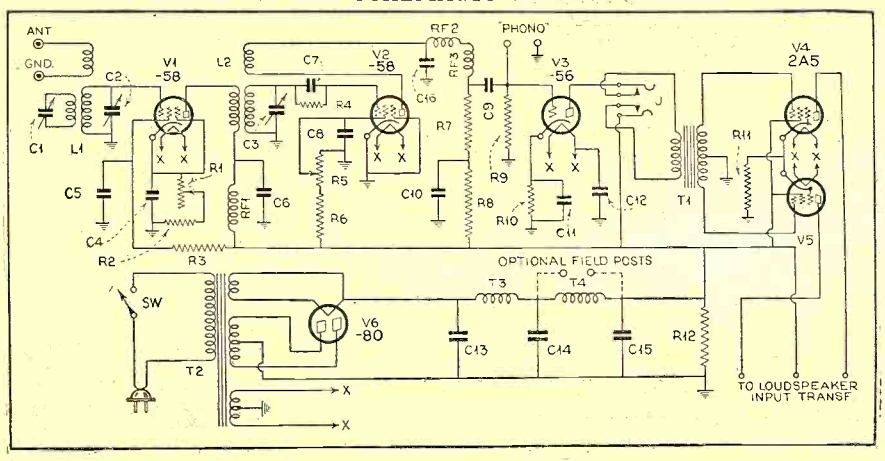
The vagaries of short-wave transmission, the uncertainty of broadcasting schedules and the generally unsettled nature of high-frequency technique, are just what are making the short waves so interesting. Logging certain foreign stations is very much a sporting proposition, akin to making a hole in one, and that is what maintains a radio fan's curiosity and attention at fever pitch, not only for weeks, but for months and years.

The people entering the short-wave game at the present time are particularly fortunate in that they have a wide choice of parts, circuits and accessories. There is little of the confusion and blind groping that marked the early days of the broadcast business, and the constructor now really gets a fair return for his investment in equipment. The short-wave field in particular has benefited by the recent avalanche of new tubes, which otherwise has distressed the broadcast set business. It is now possible to build stable, fairly simple short-wave receivers that are highly sensitive and selective and that operate a loudspeaker with a comfortable margin of reserve power.

A representative receiver of the new crop is the new Short-Wave Master 6, described herewith for the first time. This is a thoughtfully designed kit job brought out to meet the special requirements of the many people who want to enjoy the fun and thrill of building their own short-wave set, but who are not capable of or do not have the facilities for performing a great deal of tedious machine work on metal shields and chassis. The day of the wooden baseboard set is definitely over, and the practice today is to use metal construction, for reasons of both electrical necessity and physical appearance.

The Short-Wave Master 6 is a little different from other kit sets in that the cabinet is supplied as a completely finished unit, with all shield partitions welded in place. Accurate mechanical fitting of all the parts is thus assured. Both top and bottom are quickly removable, leaving the inside fully accessible for all the assembly and wiring operations. Measuring 12½ inches wide, 8¾ inches deep and 8½ inches high, the cabinet is finished in mark-proof black crackled enamel and presents a professional, factory-built appear-

FIGURE 1. THE SCHEMATIC CIRCUIT DIAGRAM



ance of which the builder will be proud. The top, of course, is hinged to permit quick changing of plug-in coils.

The power pack is built as a separate little unit measuring 9¼ inches long, 6¾ inches wide and 5½ inches high overall. Connection between the receiver and the pack is made by a convenient plug-and-cable system. The pack was made separate from the tuner because a separation of several feet between the units contributed noticeably to the quietness, stability and general flexibility of the outfit. Furthermore, the absence of the extremely heavy power transformer, filter chokes and filter from the receiver chassi makes the latter easier to handle.

Electrically, the receiver comprises one stage of tuned radio-frequency amplification, employing a type –58 tube, V1. (See the complete schematic diagram, Figure 1, for parts markings.) This tube, the antenna plug-in coil L1, the tuning condenser C2 and the trimmer C1, occupy the left-hand compartment of the cabinet. The r.f. tube works into a regenerative detector V2, another type –58. This tube, the detector plug-in coil L2, the tuning condenser C3 and the regeneration control potentiometer R5, occupy the right-hand compartment. The detector is resistance-capacity coupled to a type –56 first audio stage, V3, which in turn feeds into a push-pull Class A output stage using two type 2A5's, V4, V5. The power pack is of orthodox construction and uses the reliable type –80 rectifier, V6, in a full-wave circuit, with plenty of filter action supplied by the chokes T3 and T4 and the filter condensers C13, C14, C15. Resistor R12 is merely a 12,000-ohm bleeder put there to protect the electrolytic filter condensers while the tubes are warming up.

The audio components of the set are arranged along the back of the cabinet and are isolated from the sensitive r.f. and detector section by a solid shield that extends the full length of the box.

In addition to the detector regeneration control R5, there is a separate r.f. gain control in the form of R1, which is a 50,000-ohm variable resistor that determines the control grid bias of the r.f. tube, V1. This control is combined with a 110-volt switch, which is snapped to "off" when the knob is turned to the zero or minimum volume setting. Two individual leads for the switch are provided in the flexible cable that connects the set to the power pack, so the latter may be mounted out of sight and need neither be seen nor touched.

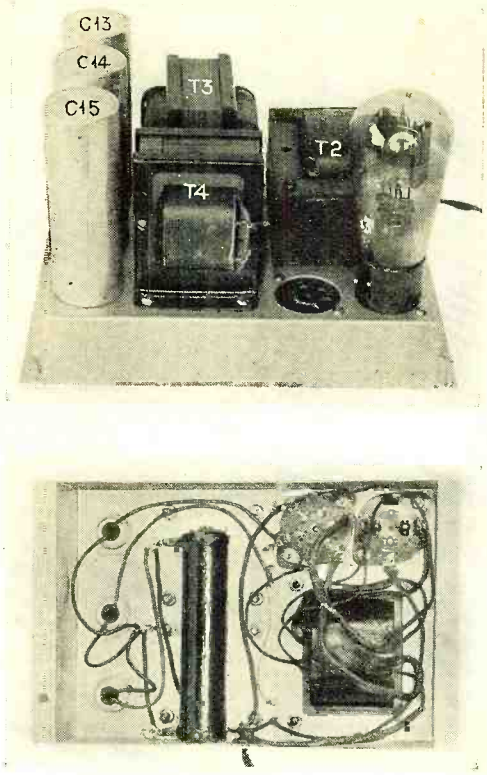
For the sake of simplicity, the schematic wiring diagram does not show the cable, which contains eight wires: two pairs in parallel for filament supply (to avoid voltage loss through the wires), two for the control switch and one each for "B" plus and "B" minus.

Four pairs of plug-in coils, using Isolantite six-prong forms, give the Master Short-Wave 6 a wavelength range of 14 to 115 meters. Extra coils to reach the broadcast band are also available separately. It is an interesting fact that the two coils of each pair are identical, obviating the care usually required in seeing that the r.f. coil is plugged into the r.f. socket, etc. The four pairs of coils supplied with the set tune as follows with the 90 mmfd. variable condensers C2 and C3: red dot coils, 14-24 meters; blue, 23-41 meters; black, 38-70 meters; yellow, 65-115 meters. *A check in the* RADIO NEWS *Laboratory showed plenty of allowance for overlap, the exact coil ranges being 13.8-25.2, 22.5-42.0, 36.2-69.1 and 61.3-117.5 meters.*— THE EDITORS.

Each coil contains a secondary of heavy wire, an interwound primary and a tickler in a slot at the lower end. With the coil L1 in the antenna position, the secondary functions as such, but the small "tickler" winding is employed as the primary, while the interwound "primary" is shunted by a 35 mmfd. midget condenser C1 to form a sort of absorption tuning loop for "trimming" purposes. The setting of this condenser is not critical; the correct position for each pair of tuning coils is quickly determined by ear.

The primary winding of L1 is brought out to two separate binding posts, so that a doublet antenna with transposed feeder lead-in may be used if desired. With an ordinary antenna, the lower end of the winding is simply grounded by a jumper to an adjacent post that makes contact with the cabinet.

(*Continued on page* 122)

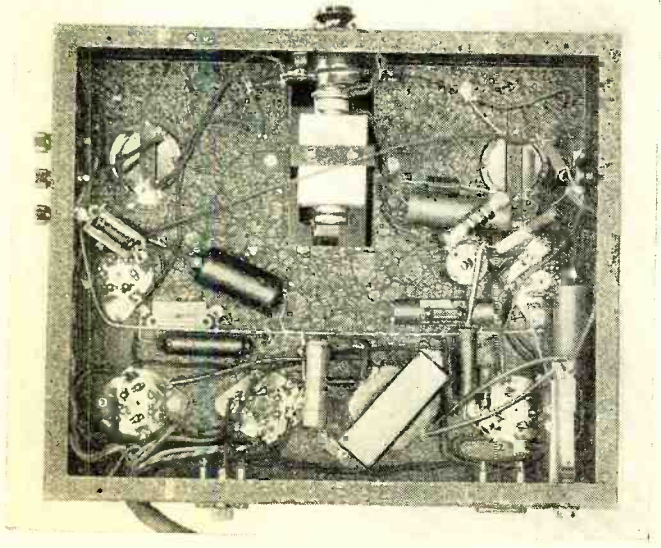


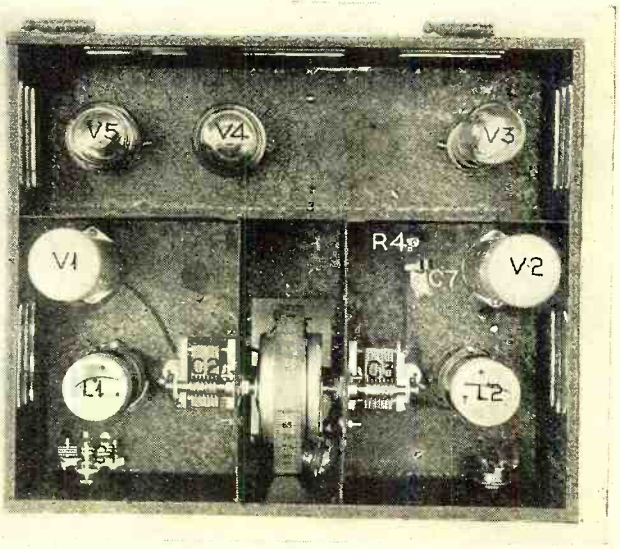
THE POWER PACK

These views provide the complete layout plan for the power supply unit. All connections to receiver are made by one cable plug and the socket next to the rectifier tube

UNDERSIDE AND TOP VIEWS OF THE RECEIVER

Here the hinged top cover and the base plate have been removed to show the location of parts. The simplicity of assembly is especially noteworthy





ELIMINATING CHARTS AND TABLES IN READING

Multi-Purpose Meters

In this article the author gives further suggestions for extending the applications of meters, illustrating the use of a new universal scale which permits direct readings in numerous ranges without calculations. An earlier article appeared in the June issue

By H. G. Cisin

Part Two

THE present article is a continuation of the one on "Eliminating Charts and Tables in Reading Multi-Purpose Meters," which appeared in the June, 1933, issue of RADIO NEWS. That article described and illustrated the new Taussig Masterdial and also explained its uses in connection with multi-range voltmeter and milliammeter circuits commonly employed.

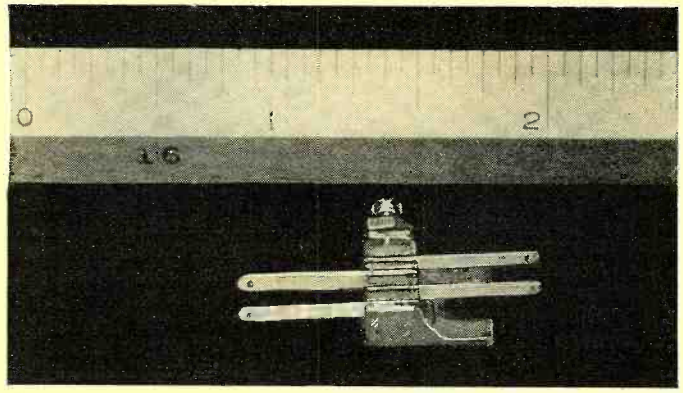
Several letters have been received from readers who were under the impression that the application of the Masterdial is limited to the two uses explained in the first article. Other readers seemed to think that the utilization of the Masterdial involved the necessity of making intricate mathematical calculations.

Before proceeding further, it should be understood definitely, first, that the Masterdial is practically unlimited in its application and, second, that no calculations whatsoever are necessary in order to apply this convenient device.

Referring to Figure 1, it will be noted that the Masterdial is calibrated to read 5 a.c. voltage ranges, when used with an 0-to-1 ma. d.c. meter and a Taurex rectifier. (This rectifier is shown in photo.) Figure 2 illustrates an arrangement whereby the same d.c. milliammeter may be employed for reading four ranges of a.c. voltages and four ranges of d.c. voltages. When the triple-pole, double-throw switch SW2 is thrown to the down position, the Taurex rectifier is connected in the circuit, thus converting the meter into an efficient a.c. meter. When the switch is in the up position, the meter reverts to its normal use as a direct-current meter. Additional voltage ranges may be obtained by increasing the number of contacts at switch SW1 (Figure 2) and providing suitable multiplying resistances. However, the same resistors are used both for a.c. and d.c., thus saving the cost of a complete set of precision resistors and more than offsetting the cost of the Masterdial.

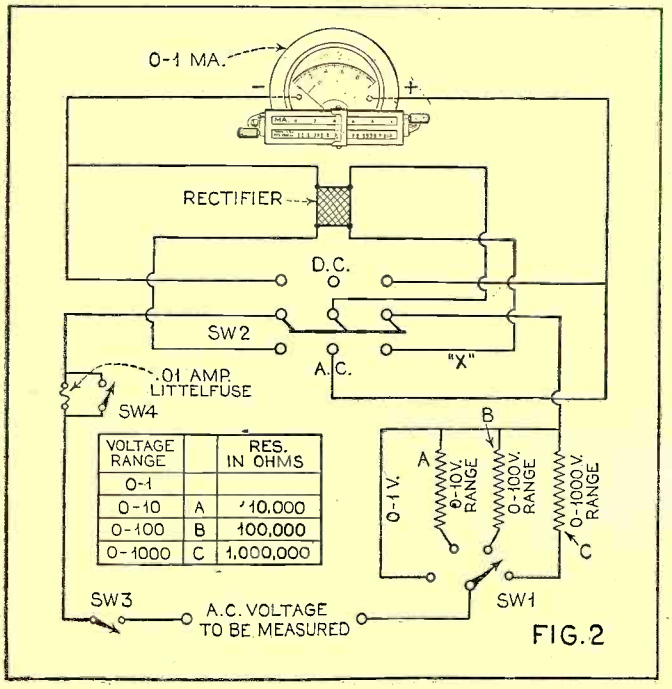
A TINY RECTIFIER

An 0-1 milliammeter may be converted to use as a universal meter by adding this rectifier and the necessary multipliers and shunts for the ranges desired, as shown in the accompanying circuits



0-1 MILLIAMMETER CONVERSION

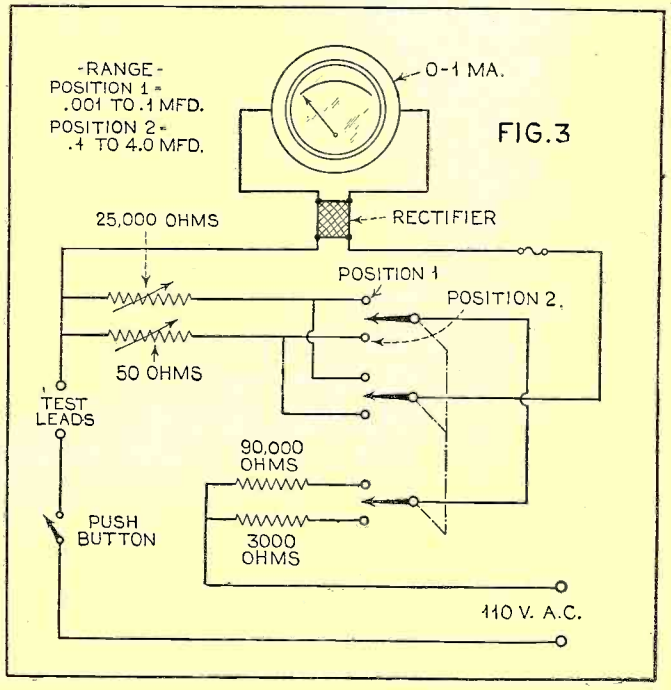
Figure 2. Circuit for converting the 0-1 milliammeter to various a.c. and d.c. voltmeter applications through the use of a meter rectifier and multiplier resistors



VOLTAGE RANGE		RES. IN OHMS
0-1		
0-10	A	10,000
0-100	B	100,000
0-1000	C	1,000,000

CIRCUIT FOR CAPACITY MEASUREMENTS

Figure 3. An inexpensive but accurate capacity meter may be constructed using an 0-1 milliammeter, a meter rectifier and suitable resistors and switches, as shown in this circuit



This type of a.c. meter indicates the average value instead of the r.m.s. value, and as a result, the range of the meter is a little larger than that of a d.c. meter with the same multiplier. The resistance of the rectifier varies slightly with the current flowing through it. (This is true of every rectifier-type a.c. meter.) For this reason, the scale is necessarily non-uniform.

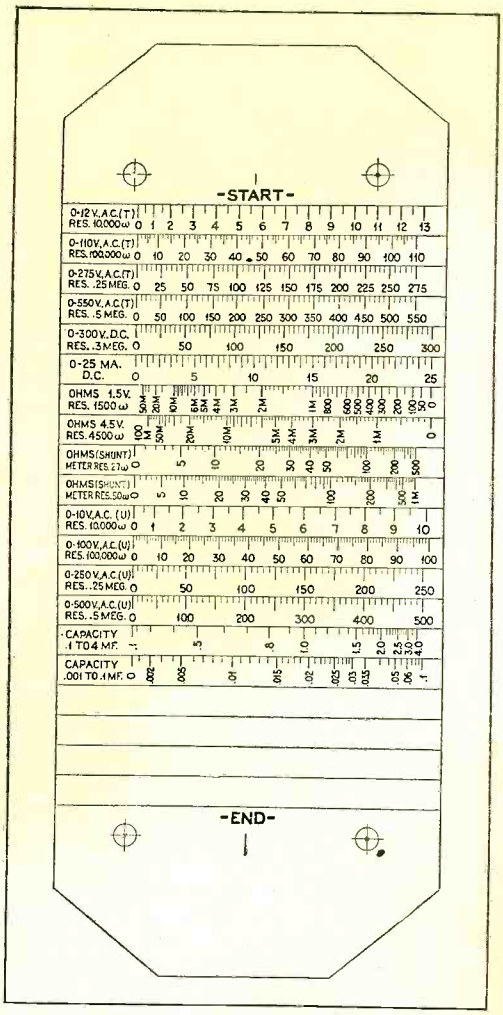
On the universal type meter, the maximum range of the d.c. milliammeter is made somewhat smaller than 1 ma., thus making the maximum a.c. range just right. On d.c., an external shunt makes this range exactly 1 ma.

The Calibration

The universal meter comes calibrated for an a.c. voltage range of 5 volts. It has been found that when the 10-volt range is employed, the readings will not be accurate if multiplied by two. Therefore the serviceman will be especially interested in the calibrations plotted by Mr. Taussig and incorporated in his Masterdial. These cover 0 to 10, 0 to 100, 0 to 250 and 0 to 500. It will be noted that all scale readings calibrated for the universal meter are marked on the Masterdial scale with a (U), while all scales calibrated for a meter using the Taussig rectifier (Taurex) are marked with a (T).

When the meter is being used with the Taurex rectifier for a.c. measurements it will be necessary to insert an additional resistance at the point marked "X" so that the calibrations on the Masterdial will read correctly. If so, the value of the required resistance will be found on the card mount to which the Taurex rectifier is secured. An .01 amp. fuse is shown in the circuit. This is provided merely for the protection of the meter and the rectifier. Switch SW4 should be closed to short out the fuse when highly accurate readings are being taken, otherwise the resistance of the fuse would introduce a factor of error on the lower ranges.

Figure 3 shows how easy it is to use an O-1 d.c. meter as a capacity meter. The only requirements are a few resistors, a Taurex rectifier, a double-pole, double-throw switch and, of course, a Masterdial. A 110-volt a.c. power source is used. When switch SW1 is in the No. 1 position, the meter will indicate capacities from .0001 mfd. to .1 mfd.; when in the No. 2 position, the meter reads capacity values of from .2 mfd. to 4 mfds. Referring to Figure 1, it will be seen that both these capacity ranges are provided for in the Masterdial. In starting to use the meter as a capacity meter, the variable resistors should be adjusted to the lowest resistance value and the test terminals should be shorted. The resistance should then be increased gradually until the meter shows full-scale reading.



THE CALIBRATED SCALE OF THE MASTER DIAL

Figure 1. This is the roller scale removed from the universal meter scale, which attachment was illustrated in the June issue. It provides direct calibrations for 16 possible applications of an 0-1 milliammeter or a universal meter

The Masterdial is supplied with two series type resistance range calibrations. The type of circuit employed is shown in Figure 4. Here a variable resistance is connected in series with a milliammeter and a dry cell. The first calibration provides a means of measuring resistances from 0 to 50,000 ohms. In this case, a 1.5-volt dry cell is used at "V" and a 1500-ohm resistance at 'R." The resistance is made adjustable to compensate for voltage variations.

The second calibration permits measurement of resistances up to 100,000 ohms. In this instance, a 4.5-volt battery is used at "V" and a 4500-ohm resistance at "R."

If additional ohmmeter range are desired, these may be obtained quite readily by increasing the potential at "V" and the resistance at "R." Thus, the voltage may be increased from 1.5 to 15 volts and the resistance from 1500 ohms to 15,000 ohms. This extends the resistance range tenfold. Similarly, the 4.5-volt battery may be increased to 45 volts and the 4500-ohm resistance to 45,000 ohms.

Reading Low Values

For reading very low resistances, the shunt circuit shown in Figure 5 is employed. The Masterdial is provided with two calibrated scales for low-resistance readings, one to take care of a meter having an internal resistance of 27 ohms and the other for the standard 50-ohm meter such as the Universal. Resistances from 1000 ohms down to 1 ohm are measured using this type of circuit.

Four blank spaces are provided for individual calibrations. These may be inserted readily by using the edge of the celluloid as a ruler.

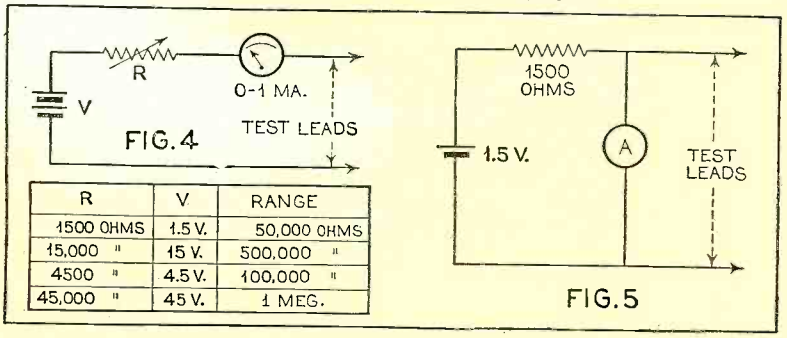
From the above, it is evident that any radio serviceman can save money and have more accurate test equipment through the utilization of the Masterdial. If he needs a portable ohmmeter, he can readily construct one merely by following the circuits shown in Figures 4 and 5. Both may be incorporated in a single instrument. An ohmmeter of this kind could be made up in a very compact case, with battery connected either internally or externally to the binding posts BP1 and BP2.

If separate multirange voltmeters, milliammeters or capacity meters are desired, these are readily available by means of the Masterdial. Combination instruments may also be constructed with equal facility. For example, a compact a.c.-d.c. volt-ohm-milliammeter may be desired. Here again, the essential requirements are a good d.c. milliammeter, a Taurex rectifier and a Masterdial. Other standard parts,

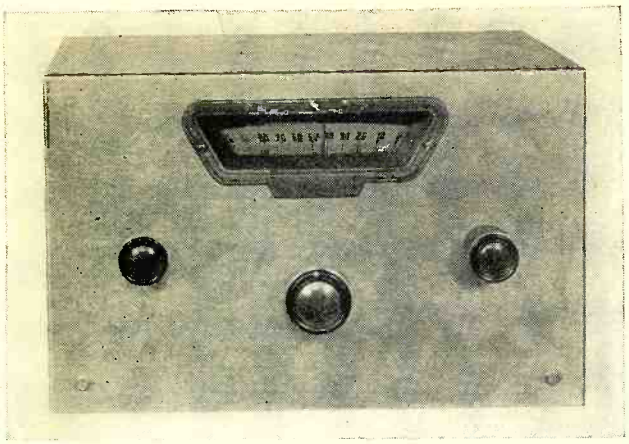
(*Cont'd on page* 125)

RESISTANCE-MEASURING CIRCUITS

Figure 4. This is the so-called series circuit used in measuring high values of resistances. Values for V and R for different resistor ranges are given in the table. Figure 5. A shunt circuit is used for measuring low resistance. The values given in Figure 5 provide a resistance range of 0-1000 ohms when employed with a meter having an internal resistance of 50 ohms (Weston Universal), or a range of 0-500 ohms when a meter (Weston type 301, 0-1 milliammeter) having 27 ohms internal resistance is employed



R	V	RANGE
1500 OHMS	1.5 V.	50,000 OHMS
15,000 "	15 V.	500,000 "
4500 "	4.5 V.	100,000 "
45,000 "	45 V.	1 MEG.



An A. C.-D. C. Universal

Three-Tube S. W. Set

By William C. Dorf

THE past six months have proven beyond any doubt the popularity of the universal type of broadcast receiver. The same principle of universal receiver design employing the new type vacuum tubes is now being applied with equally successful results to the short-wave receiver. The "Prizewinner" a.c.-d.c. three-tube short-wave receiver described in this article is truly a universal short-wave set. It is designed for operation on either 110-volt direct or alternating current (50-60 cycle) or, by the use of a battery cable which connects to the points as indicated in the schematic wiring diagram, Figure 1, it can convert the circuit for battery operation.

The universal application of this receiver and the excellent sensitivity and volume (for a small set) that it is capable of providing is made possible by the employment of the new tubes, comprising the –25Z5 full-wave type rectifier, the new –77 bias detector and the –43 type power-amplifier tube. There is nothing complicated in the construction of the receiver and the cost of the parts is under $10.00. The receiver incorporates its own power supply, and an idea of its compact size may be had by noting the cabinet dimensions (11 inches long by 6½ inches deep by 7 inches high).

Loudspeaker Reception

While the receiver is intended primarily for headphone reception, it is capable of operating a magnetic type speaker or a dynamic type reproducer on local stations. The set functions well when connected to a 10-inch size dynamic type speaker. In this case, the speaker incorporates its own rectifying system, operating from 110-volt, 60-cycle line supply. However, a dynamic type reproducer with a field winding of approximately 4000 ohms can obtain the necessary exciting current for its operation, direct from the receiver power supply. The field winding is simply connected across the cathode to ground circuit of the –25Z5 rectifier, as shown in the schematic wiring diagram, Figure 1.

Where the set operates on direct or alternating current, the heaters of the tubes are connected in series. This offers no complication, as all three tubes operate at 0.3 ampere current. A wire-wound resistor of 175 ohms, connected in series with the heater circuits of the tubes, is used to absorb the excess voltage. To light the pilot lamp, this resistor is tapped 30 ohms from one end and the pilot light is connected across this tapped resistance.

The circuit consists of a standard regenerative detector, with a conventional grid leak arrangement, employing the –77 type tube. The antenna is capacitively coupled to the detector circuit. The impedance-coupled audio-amplifier stage uses the –43 pentode type power tube. An effective two-section, power-filter system is used with high-capacity filter condensers and well-designed chokes.

There are four plug-in coils to cover the entire short-wave band from 14 to 195 meters. The coil data appears in Figure 3. A word here, in reference to the construction of the coils, will not be out of place. The position of the tickler coil should be kept as far away from the grid coil as possible, without the circuits dropping out of oscillation. The distance as outlined in the coil data will be correct for most of the inductances.

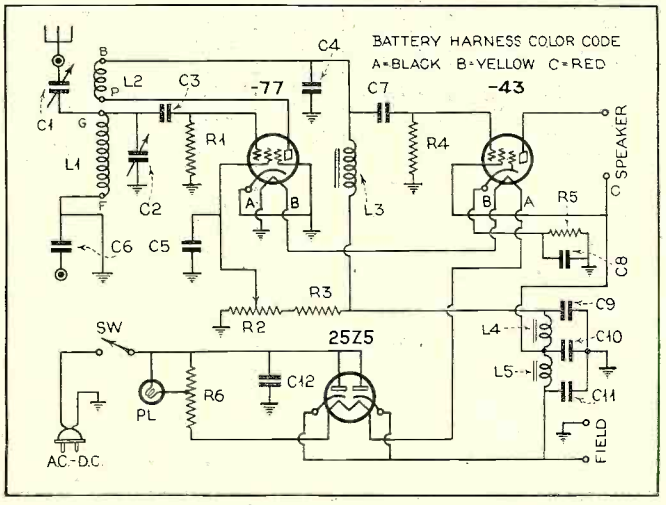
In reference to the physical construction of the "Prizewinner," the reader can refer to the schematic wiring diagram, Figure 1, and the top view of the set, Figure 2, which shows the proper placement of most of the parts.

Operation

When the receiver is operated on direct-current supply, it is necessary to observe "polarity." If the set does not produce a signal after a minute or so, reverse the line plug and the receiver should work immediately. If the set is to be operated from batteries, a special harness cable is connected to the points indicated in the schematic wiring diagram, Figure 1. Then the –25Z5 rectifier tube is removed, as it is not employed. The –41 type power tube is substituted for the –43 type tube. The battery cable is connected according to the color code on the drawing. This cable connects the two tubes in parallel so the heaters can be operated on 6 volts. The B supply should be approximately 135 volts.

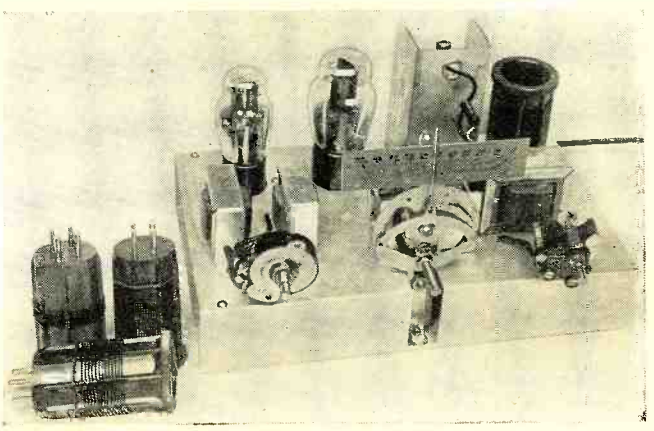
To prevent any danger of a short-circuit in the line, a condenser of .01 mfd. is connected between the ground binding post and the receiver chassis. The ground lead *should never be connected direct to the chassis.* (*Cont'd on page* 124)

FIGURE 1. THE CIRCUIT DIAGRAM



VIEW FROM ABOVE

Figure 2. The layout is very simple. The position of the tubes reading from left to right are: –25Z5, –43 and the –77 types. At the left are the plug-in coils



Radio Call Book Section

World Short-Wave Station List

(All time given is Eastern Standard Time)

By Wavelength, Frequency, Call, Location and Time

Meters	kc.	Call	Location	Service and Schedule
5.00	59,964	PK4PA	Palembang, Sumatra	Exp.
5.80	51,724	RW61	Moscow, U. S. S. R.	Broadcast
7.05	42,530	.....	Berlin, Germany	Exp.
9.68	31,000	W8XI	Pittsburgh, Penna.	Exp.
9.80	30,593	IAG	Golfo Aranci, Sardinia	Exp.
10.06	29,803	IAF	Fiumicino, Italy	Exp.
10.79	27,800	W6XD	Palo Alto, Calif.	Exp.
11.55	25,960	G5SW	Chelmsford, England	Exp.
11.67	25,700	W2XBC	New Brunswick, N. J.	Exp.
12.31	24,380	VE9GW	Bowmanville, Ont.	Broadcast
12.48	24,000	W6XQ	San Mateo, Calif.	Exp.
13.45	22,291	GBU	Rugby, England	Phone
13.92	21,540	W8XK	Saxonburg, Penna.	Exp. 7 A.M.—2 P.M.
13.97	21,470	GSH	Daventry, England	Broadcast
14.01	21,420	W2XDJ	Deal, N. J.	Exp.
14.01	21,420	WKK	Lawrenceville, N. J.	Phone to LSN; 8 A.M., 4 P.M.
14.01	21,420	WLO	Lawrence, N. J.	Transatlantic phone
14.17	21,215	LSL	Buenos Aires, Argentina	Phone to GAA
14.19	21,130	LSM	Buenos Aires, Argentina	Phone to Europe
14.25	21,060	WKA	Lawrenceville, N. J.	Phone to England; 8 A.M.—4 P.M.
14.27	21,020	LSN	Buenos Aires, Argentina	Phone to WLO; 8 A.M., 4 P.M
14.28	21,000	OKI	Podebrady, Czechoslovakia	Phone
14.47	20,730	LSY	Buenos Aires, Argentina	Phone
14.50	20,680	LSX	Buenos Aires, Argentina	Phone to U. S.
14.50	20,680	LSN	Buenos Aires, Argentina	Phone to Europe, after 10.30 P.M.
14.50	20,680	FSR	Saigon, Indo-China	Phone to Paris
14.54	20,620	PMB	Bandoeng, Java	Phone to PCK
14.62	20,500	W9XF	Chicago, Ill.	Exp.
14.72	20,380	GBA	Rugby, England	Phone to ships and LSN
14.88	20,140	DWG	Nauen, Germany	Phone to LSG; tests at 10 A.M. and 3 P.M.
14.96	20,040	OPL	Leopoldville, Belgian Congo	Phone to ORG
14.97	20,028	DHO	Nauen, Germany	Phone
15.03	19,947	DIH	Nauen, Germany	Phone
15.08	19,906	LSG	Buenos Aires, Argentina	Phone to FTM
15.10	19,850	WMI	Deal, N. J.	Phone
15.12	19,830	FTD	Ste Assise, France	Phone
15.14	19,820	WKN	Lawrenceville, N. J.	Phone to England; 8 A.M.—4 P.M.
15.21	19,720	EAQ	Madrid, Spain	Phone to S. America
15.24	19,680	CEC	Santiago, Chili	Phone
15.45	19,400	FRO, FRE	Ste. Assise, France	Phone
15.55	19,300	FTM	Ste. Assise, France	Phone 10 A.M.—noon
15.57	19,260	PPU	Rio de Janeiro, Brazil	Phone to FTM
15.58	19,240	DFA	Nauen, Germany*	Phone to XDA
15.60	19,220	WNC	Deal, N. J.	Transatlantic phone
15.60	19,220	WKF	Lawrenceville, N. J.	Phone to England; 8 A.M.—4 P.M.
15.62	19,200	ORG	Brussels, Belgium	Phone
15.77	19,020	WKW-W2XBJ	Rocky Point, L. I.	Tests
15.82	18,960	LSR	Buenos Aires, Argentina	Phone
15.87	18,892	WDS	Rocky Point, L. I.	Phone
15.90	18,890	ZSS	Klipheuvel, S. Africa	Phone to England
15.94	18,820	PLE	Bandoeng, Java	Phone to Holland; 8.40—10.40 A.M.
16.06	18,680	OCI	Lima, Peru	Tests
16.10	18,620	GBJ	Bodmin, England	Phone to Montreal
16.11	18,610	GBU	Rugby, England	Phone to New York
16.12	18,600	PDM	Kootwijk, Holland	Phone
16.27	18,440	HJY	Bogota, Colombia	Phone to CEC and LSR
16.29	18,400	PCK	Kootwijk, Holland	Phone
16.32	18,382	FZA	Saigon, Indo-China	Phone to Paris
16.33	18,370	PMC	Bandoeng, Java	Phone
16.35	18,350	ZLW	Wellington, N. Z.	Phone to VK2ME
16.35	18,350	WND	Deal Beach, N. J.	Phone
16.36	18,340	WLA	Lawrenceville, N. J.	Transatlantic phone
16.38	18,310	FZS	Saigon, Indo-China	Phone to Paris
16.38	18,310	GBS	Rugby, England	Phone to New York
16.39	18,295	YVQ	Maracay, Venezuela	Phone
16.44	18,240	FRO-FRE	Ste. Assise, France	Phone
16.44	18,240	FTE	Ste. Assise, France	Phone
16.48	18,193	GAW	Rugby, England	Phone
16.49	18,180	CGA	Drummondville, Que.	Phone to England
16.52	18,145	PMC	Bandoeng, Java	Phone to PCV 3.10—9.20 A.M.
16.56	18,105	W9XAA	Chicago, Ill	Exp.
16.56	18,100	GBK	Bodmin, England	Phone
16.65	18,020	KQJ	Bolinas, Calif.	Transpacific phone
16.80	17,850	PLF	"Radio Malabar," Bandoeng, Java	Phone
16.80	17,850	W2XAO	New Brunswick, N. J.	Exp.
16.82	17,830	PCV	Kootwijk, Holland	Phone to Java
16.87	17,780	W8XK	Saxonburg, Penna.	Broadcast, relays KDKA
16.87	17,780	W3XAL	Bound Brook, N. J.	Exp., relays WJZ
16.88	17,770	GSG	Daventry, England	Broadcast
16.88	17,770	PHI	Huizen, Holland	Exp., irregular
16.88	17,760	DJE	Koenigswusterhausen, Ger.	Phone
16.92	17,719	HSP	Bangkok, Siam	Phone
17.00	17,640	GFWV	S. S. Majestic	Phone
		GLSQ	S. S. Olympic	Phone
		GDLJ	S. S. Homeric	Phone
		GMJQ	S. S. Belgenland	Phone
		GTSD	S. S. Monarch of Bermuda	Phone
		GKFY	S. S. Minnetonka	Phone
		GMBJ	S. S. Empress of Britain	Phone
17.12	17,512	DFB	Nauen, Germany	Phone
17.24	17,400	J1AA	Tokio, Japan	Phone to Australia
17.34	17,300	W8XL	Dayton, Ohio	Exp.
17.34	17,300	W6XAJ	Oakland, Calif.	Exp.
17.34	17,300	W2XCU	Ampere, N. J.	Exp.
17.34	17,300	VE9BY	London, Ont.	Exp., irregular
17.37	17,260	DAF	Norddeich, Germany	Phone
17.51	17,122	HAS	Szekesfehervar, Hungary	Phone
17.52	17,120	WOO	Deal, N. J.	Phone
17.52	17,120	W2XDO	Ocean Gate, N. J.	Exp.
17.55	17,080	GBC	Rugby, England	Phone
18.00	16,665	DAN	Norddeich, Germany	Tests with ships
18.40	16,305	PCL	Kootwijk, Holland	Phone to Bandoeng, from 7 A.M
18.40	16,270	WLO	Lawrence, N. J.	Phone to England
18.50	16,200	FZR	Saigon, Indo-China	Phone to Paris
18.55	16,162	PSA	Rio de Janeiro, Brazil	Phone
18.56	16,150	GBX	Rugby, England	Phone
18.68	16,060	NAA	Arlington, Va.	Time; 11.57—noon
18.71	16,030	KKP	Kauhuku, Hawaii	Phone to KWO
18.80	15,950	PLG	Bandoeng, Java	Phone, afternoons
18.90	15,860	FTK	Ste. Assise, France	Phone to Saigon
19.36	15,490	J1AA	Tokio, Japan	Exp.
19.46	15,410	KWO	Dixon, Calif.	Phones Hawaii, 2—7 P.M.
19.54	15,344	KWU	Dixon, Calif.	Phone to Hawaii, 2—7 P.M.
19.56	15,330	W2XAD	Schenectady, N. Y.	Broadcast; Mo., We., Fri., 3—4 P.M., Sunday 2—4 P.M.
19.58	15,300	OXY	Lyngby, Denmark	Exp.
19.65	15,270	W2XE	Wayne, N. J.	Broadcast, relays WABC
19.68	15,243	FYA	Pontoise, France	Broadcast; 5—8 A.M.
19.72	15,210	W8XK	Saxonburg, Penna.	Broadcast, relays KDKA
19.73	15,200	DJB	Zeesen, Germany	Broadcast
19.76	15,190	VE9BA	Montreal, Que.	Exp.
19.81	15,140	GSF	Daventry, England	Broadcast
19.81	15,130	VE9DN	Montreal, Que.	Exp.
19.83	15,120	J1AA	Tokio, Japan	Broadcast, irregular, mornings
19.83	15,120	HVJ	Vatican City, Italy	Broadcast; 5.00—5.15 A.M. daily
19.85	15,104	RAU	Tashkent, U.S.S.R.	Broadcast
19.90	15,075	TI4NRH	Heredia, Costa Rica	Broadcast
19.92	15,051	.....	Hialeah, Florida	Phone to Panama and S. America
19.99	15,000	CM6XJ	Central Tuinucu, Cuba	Broadcast, irregular
20.08	14,930	HJB	Bogota, Colombia	Phone
20.23	14,706	WKU-W2XBJ	Rocky Point, L. I.	Tests; daytime
20.42	14,690	PSS	Rio de Janeiro, Brazil	Phone
20.50	14,620	XDA	Mexico City	Phone
20.60	14,550	HBJ	Geneva, Switzerland	Testing
20.65	14,530	WMN	Lawrenceville, N. J.	Phone to England
20.65	14,530	LSA	Buenos Aires, Argentina	Phone to England
20.69	14,545	RXC	Panama City	Phone to Florida
20.70	14,480	LSN	Buenos Aires, Argentina	Phone
20.70	14,480	GBW	Rugby, England	Phone to New York
20.73	14,460	WMF	Lawrenceville, N. J.	Transatlantic phone
20.80	14,420	VPD	Suva, Fiji Islands	Phone
20.95	14,310	G2NM	Sonning-on-Thames	Broadcast
21.17	14,150	KKZ	Bolinas, Calif.	Phone
21.52	13,950	YO1	Bucharest, Rumania	Broadcast
21.53	13,925	WIK	Rocky Point, L. I.	Phone
21.63	13,860	WIY-W2XBJ	Rocky Point, N. J.	Tests
21.72	13,811	SUZ	Abu Zabal, Egypt	Phone to England
21.77	13,780	KKW	Bolinas, Calif.	Phone
21.82	13,740	CGA	Drummondville, Que.	Phone
21.90	13,690	KKZ	Bolinas, Calif.	Tests, irregular
21.93	13,671	HAS	Szekesfehervar, Hungary	Phone
22.06	13,591	GBC	Rugby, England	Phone to Canada and ships
22.26	13,480	WAJ	Rocky Point, N. Y.	Tests
22.38	13,400	WND	Deal Beach, N. J.	Transatlantic phone
22.40	13,380	WMA	Lawrenceville, N. J.	Phone
22.58	13,285	CGA	Drummondville, Que.	Phone to England
22.68	13,220	GFWV	S. S. Majestic	Phone
		GLSQ	S. S. Olympic	Phone
		GMJQ	S. S. Belgenland	Phone
		GDLJ	S. S. Homeric	Phone
		VTSX	S. S. Monarch of Bermuda	Phone
		GKFY	S. S. Minnetonka	Phone
		GMBJ	S. S. Empress of Britain	Phone
22.93	13,074	J1AA	Kemikawa-Cho, Japan	Phone
23.00	13,040	DDAC	S. S. Europa	
		DDAS	S. S. Bremen	
		DDBR	S. S. Berlin	
		DDCB	S. S. Columbus	
		DDCG	S. S. Resolute	
		DDCP	S. S. Cap Polonio	
		DDDT	S. S. Deutschland	
		DDDX	S. S. Hamburg	
		DDEA	S. S. Cap Arcona	
		DDED	S. S. New York	
		DDFF	S. S. Reliance	
		DDFT	S. S. Oceana	
		DDNY	S. S. Albert Ballin	
23.38	12,830	.....	Rabat, Morocco	Broadcast; 7.30—9 A.M., Sundays
23.45	12,795	IAC	Coltana, Italy	Tests
23.46	12,780	GBC	Rugby, England	Phone
24.19	12,394	DAF	Norddeich, Germany	Phone to ships
24.40	12,290	ZLW	Wellington, N. Z.	Phone
24.40	12,290	PLM	Bandoeng, Java	Phone
24.40	12,290	GBU	Rubgy, England	Phone to New York
24.46	12,250	FTN	Ste. Assise, France	Phone
24.46	12,250	GBS	Rugby, England	Phone
24.46	12,250	PLM	Bandoeng, Java	Phone to Holland
24.60	12,150	GBS	Rugby, England	Transatlantic phone
24.68	12,150	FQO, FQE	Ste. Assise, France	Phone
24.89	12,045	NAA	Arlington, Va.	Time signals; 11.57—noon
24.89	12,045	NSS	Annapolis, Md.	Time signals; 9.57—10 P.M.
24.99	12,000	FZG	Saigon, Indo-China	Time signals; 2—2.05 P.M.

(*Continued Next Month*)

RADIO PROGRAM FEATURES

AN OFFICIAL PROGRAM SERVICE

THE radio receiver is worth only what it receives. One of the main difficulties in broadcast listening is to determine just when the more popular programs are on the air. Most listeners miss as much as 50 per cent of the worth-while programs for this reason. RADIO NEWS is therefore presenting this third instalment of a monthly broadcast schedule, listing day by day what is felt to be the most noteworthy programs on the air in the evenings, on Saturday afternoons and all day Sunday. The programs have been chosen by a committee of art, music and educational critics, as well as representative listeners. The programs listed are for the period of July 10th-August 10th inclusive. The listings include the name of the program, the time the program is on the air, the type of program, the name of the sponsor, the chain and the national stations through which it is transmitted. To use the lists one should refer to the day of the week and then run down the hours, marking off those programs you wish to listen to. If you want to find the time for a given program, the name of the program is shown bold face and is easily picked out. The list is correct up to the day of going to press. All time is Eastern Daylight Saving Time. Deduct one hour for Eastern Standard Time, two hours for Central Standard Time, three hours for Mountain Standard Time and four hours for Pacific Standard Time. All programs are sustaining, unless otherwise noted. All time is p. m. unless otherwise noted.

Compiled by

Samuel Kaufman

MONDAYS

5:45—LITTLE ORPHAN ANNIE. Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, WJR, KDKA, WHAM, WGAR, WLW, CKGW, WRVA, WWNC, WIS, WJAX, CFCF. **Also, 6:45**—WENR, KWCR, WREN, KOIL, WKY, KTBS, WEBC, WDAY, KFYR, WFAA, KPRC, WOAI.

6:45—COUNTESS OLGA ALBANI. Songs. NBC. WEAF, WTAG, WRC, WJAR, WBEN, WMAQ, WOC, WHO, WIS, WSM, WSB, WMC, WSAI, WWNC, WWFI, WTAM, WCKY.

6:45—JUST PLAIN BILL. Sponsor: Kolynos Sales Co. CBS. WABC, WCAO, WAAB, WKBW, WHK, WCAU, WJSV, CKOK.

6:45—LOWELL THOMAS, News. Sponsor: Sun Oil Co. NBC. WJZ, WGAR, WLW, CKGW, WBAL, WBZ, KDKA, WHAM, WJR, WSYR, WBZA.

7:00—AMOS 'N' ANDY. Drama. Sponsor: Pepsodent Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WLW, WMAL, CKGW, WRVA, WPTF, WIOD, WFLA. **Also,** 11:00 — WMAQ, WENR, KWK, WREN, KOIL, WTMJ, KSTP, WSM, WMC, WSB, WSMB, KTHS, KDYL, WKY, WOAI, KOA, KGO, KFI, KGW, KOMO, KHQ, KPRC, WDAF, WHAM, WJR, WFAA.

7:15—EVERETT MARSHALL. Songs and Orchestra. Sponsor: Westinghouse Electric & Manufacturing Co. NBC. WJZ, WBAL, WMAL, WBZ, WBZA, WSYR, KDKA, WCKY, WJR. **Also,** 11:15—KYW, KWK, KWCR, KSO, KOIL, WREN, WTMJ, WIBA, KSTP, WEBC, WDAY, KFYR, WMC, WDJX, WSB, WSMB, WKY, WBAP, KPRC, KTHS, WOAI, KOA, KDYL, KGO, KFI, KGW, KOMO, KHQ.

7:15—BUCK ROGERS IN THE YEAR 2433. Drama. Sponsor: Kellogg Co. CBS. WABC, WNAC, WGR, WFBM, WHK, WHAS, WCAU, KMOX, CKOK, WCCO.

7:30 — DOLPH MARTIN'S ORCHESTRA AND TRAVELERS' QUARTER. Sponsor: Tide Water Oil Co. CBS. WABC, WOKO, WCAO, WNAC, WGR, WDRC, WCAU, WJAS, WEAN, WFBL, WJSV, WLBZ, WHP, WFEA, WHEC, WORC.

7:45—THE GOLDBERGS. Drama. Sponsor: Pepsodent Co. NBC. WEAF, WEEI, WSAI, WENR, WOW, WTAG, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WDAF.

7:45—BOAKE CARTER. News. Sponsor: Philco Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, CKOK, WCAU, WJAS, WBT, WJSV.

8:00—SOCONYLAND SKETCHES. Drama. Sponsor: Standard Oil Co. of N. Y. NBC. WEAF, WTIC, WTAG, WEEI, WJAR WCSH, WGY, WBEN.

8:00—CLICQUOT CLUB ESKIMOS. Harry Reser's Orchestra. Sponsor: Clicquot Club Co. NBC. WJZ, WBZ, WBZA, WBAL, WHAM, KDKA, WGAR, WLS, KWK, KWCR, KOIL, WREN, KSO, WCKY, WMAL.

8:00—SINGIN' SAM. Sponsor: The Barbasol Company. CBS. WABC, WOKO, WCAO, WNAC, WGR, WGN, WKRC, WHK, WDRC, WFBM, KMBC, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WCKY, WCCO, WADC.

8:30—KATE SMITH LA PALINA PROGRAM. Sponsor: Congress Cigar Co. CBS. WABC, WADC, WOKO, WCAO, WGR, WGN, WKRC, WHK, WOWO, WFBM, KMBC, WHAS, WCAU, WJAS, KMOX, WFBL, WSPD, WJSV, CKOK WISN, WCCO, WHEC, WMT, WKBN.

8:45—ABE LYMAN'S ORCHESTRA AND IRVING KAUFMAN. Sponsor: Sterling Products, Inc. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WGN, WKRC, WHK, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, CKOK, WCCO.

8:45—FERDE GROFE'S ORCHESTRA WITH CONRAD THIBAULT. Sponsor: Philip Morris & Co. NBC. WEAF, WEEI, WTIC, WJAR, WCSH, WLIT, WRC, WGY, WBEN, WCAE, WWJ, WMAQ, WDAF.

8:45—PHIL COOK AND INGRAM SHAVERS. Sponsor: Bristol-Myers Co., NBC. WJZ, WBZ, WBZA, WJR, WBAL, KDKA, WGAR, WCKY, WMAL, WLS, WSYR, KWK, KWCR, WREN, KSO, KOIL.

9:00—A. & P. GYPSIES. Sponsor: Great Atlantic & Pacific Tea Co. NBC. WEAF, WIIC, WTAG, WEEI, WJAR, WCSH, WLIT, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WMAQ, KSD, WOC, WHO, WOW, WDAF.

9:00—SINCLAIR GREATER MINSTRELS. Sponsor: Sinclair Refining Co. NBC. WJZ, WBZ, WBZA, WHAM, KDKA, WGAR, WSB, WLS, KWK, WREN, WTMJ, WBAL, KSTP, WEBC, WDAY, KFYR, WRVA, WWNC, WIS, WJAX, WIOD, WMC, WJR, WFLA, WSM, WSMB, WJDX, KVOO, KPRC, WOAI, KTBS, WKY, KOIL, KWCR, WFAA, WLW, KSO, WIBA.

9:30—AN EVENING IN PARIS. Sponsor: Bourjois, Inc. CBS. WABC, WCAO, WNAC, WGN, WHK, CKOK, KMBC, WCAU, WJAS, WEAN, KMOX, WJSV, KERN, KMJ, KHJ, KOIN, KFBK, KGB, KFRC, KDB, KOL, KFPY, KWG, KVI, WGST, KLZ, WCCO, WDSU, KOMA, KSL.

9:30—JACK FROST MELODY MOMENTS, Sponsor: National Sugar Refining Co. NBC. WJZ, WBAL, WHAM, KDKA, WGAR, WLW, WJR, WENR.

10:00—CONTENTED PROGRAM. Sponsor: Carnation Milk Co. NBC. WEAF, WGY, WBEN, WCAE, WTAM, WWJ, KSD, WENR, CKGW, CFCF, WOAI, WOC, WHO, WDAF, KSTP, KPRC, WTMJ, WEBC, KFYR, WSM, WMC, WSB, WKY, WFAA, WLW.

10:00—RICHFIELD COUNTRY CLUB. Alex, Morrison, Golf Lessons. Sponsor: Richfield Oil Co. of N. Y. CBS. WABC, WOKO, WCAO, WAAB, WKBW, WDRC, WCAU, WJAS, WEAN, WFBL, WJSV, WPG, WICC, WLBW, WHP, WHEC, WMAS.

10:30—EDWIN C. HILL—"Human Side of the News." CBS. WABC, WOKO, WCAO, WAAB, WKBW, WHK, CKOK, WDRC, WFBM, KMBC, WJAS, WFBL, WSPD, WQAM, WDBO, WGST, WPG, WLBZ, WBRC, WICC, WDOD, KVOR, KLZ, WLBW, WHP, WKBH, WFEA, WREC, WCCO, WODX, WLAC, WDSU, WTAR, WMBG, WDBJ, WHEC, KSL, KTSA, WTOC, WIBW, CFRB, WMT, KFH, WSJS, WORC, WNAX, WNOX.

10:45—HOWARD BARLOW'S SYMPHONY ORCHESTRA. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, CKOK, WDRC, WFBM, KMBC, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WLBW, KTRH, KFAB, KLRA, WFEA, WREC, WCCO, WODX, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KSL, WMT, KFH, WSJS, WORC, WIP.

TUESDAYS

5:45—LITTLE ORPHAN ANNIE. Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WJR, WHAM, WGAR, WLW, CKGW, WRVA, WWNC, WIS, WJAX, CFCF. **Also 6:45**—WENR, KWCR, WREN, KOIL, WFAA, KSTP, WEBC, WDAY, KFYR, WKY, WOAI, KTBS, KPRC.

6:00—MME. FRANCES ALDA. Songs. NBC. WEAF, WDAF, WCKY, KSD (WSB, WSM, CKGW, WDAY, KPRC, WAPI, WRC, WKY, WSAI, off 6:15) (WBEN, WJAR, WJAX, WOC, WHO, WFAA, WTAM on 6:15) WIOD, WWNC, WCAE, WIS, WIBA, KOA, KPO, KFYR, WSMB, WOAI, KTBS, WTAG, KDYL, WMAQ, WFLA, WWJ, WRVA.

6:45—JUST PLAIN BILL. Drama. Sponsor: Kolynos Sales Co. CBS. WABC, WCAO, WAAB, WKBW, WHK, CKOK, WCAU, WJSV.

6:45—LOWELL THOMAS. News. Sponsor: Sun Oil Co. NBC. WJZ, WBZ, WBZA, CKGW, WJR, WBAL, KDKA, WGAR, WHAM, WLW, WSYR.

7:00—AMOS 'N' ANDY. Drama. Sponsor: Pepsodent Co., NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WLW, WMAL, CKGW, WIOD, WFLA, WRVA, WPTF, WGAR. **Also, 11:00** — WMAQ, KDYL, WDAF, KOIL, WTMJ, KSTP, WSM, WMC, WSB, WSMB, KTHS, WCKY, KPRC, WOAI, WKY, KOA, KGO, KFI, WHAM, KGW, KOMO, KHQ, WENR, KWK, WJR, WREN, WBAP.

7:15—BUCK ROGERS IN THE YEAR 2433. Drama. Sponsor: Kellogg Co. CBS. WABC, WNAC, WGR, WBBM, WHK, WHAS, WCAU, KMOX, CKOK, WCCO.

7:30 — JACK DEMPSEY'S GYMNASIUM. Drama. Sponsor: Wyeth Chemical Co. CBS. WABC, WCAO, WKBW, WKRC, WHK, WCAU, CFRB.

7:45—THE GOLDBERGS. Drama. Sponsor: Pepsodent Co. NBC. WEAF, WTAG, WEEI, WJAR, WFI, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WCSH, WFBR, WSAI, WENR, WOW, WDAF.

7:45—BOAKE CARTER. News. Sponsor: Philco Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, CKOK, WCAU, WJAS, WJSV, WBT.

8:00—BLACKSTONE PLANTATION. JULIA SANDERSON AND FRANK CRUMIT. Sponsor: Waitt & Bond Co., NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WFI, WRC, WGY, WBEN, WCAE, WTAM, WWJ.

8:00—ENO CRIME CLUES. Drama. Sponsor: Harold F. Ritchie & Co. NBC. WJZ, WBZ, WBZA, KDKA, WHAM, WGAR, WBAL, WMAQ, KWK, WREN, WLW, WMAL, WJR.

8:15—THE MAGIC VOICE. Drama. Sponsor: Ex-Lax Co. CBS. WABC, WHAS, WJSV, WADC, WKRC, WCAU, WOKO, WHK, WCAO, CKOK, WNAC, WJAS, WBT, WEAN, WDRC, KMOX, WGR, WFBM, WFBL, WGN, KMBC, WSPD, KRLD.

8:30—WAYNE KING'S ORCHESTRA. Sponsor: Lady Esther. NBC. WEAF, WTAG, WCAE, WTMJ, WEEI, WBEN, WJAR, WFI, WRC, WGY, WTAM, WCSH, WWJ, WSAI, KSD, WOC, WHO, WOW, KSTP, WMAQ, WDAF.

8:30—KATE SMITH LA PALINA PROGRAM. Sponsor: Congress Cigar Co.

CBS. WABC, WHAS, WJSV, WADC, WKRC, WCAU, WHEC, WMT, WOKO, WHK, WCAO, CKOK, WOWO, WJAS, WISN, KMOX, WGR, WFBM, WFBL, WCCO, WKBN, WGN, KMBC, WSPD.

8:45—ABE LYMAN'S ORCHESTRA AND IRVING KAUFMAN. Sponsor: Sterling Products, Inc. CBS. WABC, WHAS, WJSV, WADC, WKRC, WCAU, WOKO, WHK, WCAO, CKOK, WJAS, WEAN, WDRC, KMOX, WGR, WFBM, WFBL, WCCO, WGN, KMBC, WSPD, WNAC.

9:00—BEN BERNIE'S BLUE RIBBON ORCHESTRA. Sponsor: Premier Pabst Sales Co., NBC. WEAF, WRVA, WBAP, WTAG, WEEI, WJAR, WCSH, KOA, KSD, WRC, WFBR, WFI, WGY, WBEN, WTAM, WCAE, WLS, WSAI, WWJ, WOC, WHO, WOW, KSTP, WDAY, KFYR, WCKY, WSM, WMC, WSMB, WKY, WOAI, KPRC, WTMJ.

9:15—THREADS OF HAPPINESS ORCHESTRA. Sponsor: Spool Cotton Co. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WGN, WKRC, WHK, CKOK, WOWO, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WBRC, WBT, KRLD, KTRH, KLRA, WREC, WCCO, WLAC, WDSU, WTAR, KOMA, WHEC, KTSA, WTOC, KFH, WNOX. Also **11:15**—KERN, KMJ, KHJ, KOIN, KFBK, KGB, KFRC, KDB, KOL, KFPY, KWG, KVI, KLZ, KSL.

9:30—ED WYNN AND THE FIRE CHIEF BAND. Sponsor: Texas Co. NBC. WEAF, WCSH, WFI, KDYL, WSM, WFBR, WRC, WGY, WBEN, WEEI, WJAR, WCAE, WTAM, WWJ, WTAG, CFCF, WMAQ, KSD, WOW, WHO, WOC, WLW, WDAF, WIBA, KSTP, WEBC, WDAY, KFYR, WTMJ, WRVA, WWNC, KFSD, WIS, WJAX, WIOD, KVOO, WMC, WSB, WJDX, WSMB, WFLA, WBAP, KPRC, WKY, WOAI, KOA, KGIR, KGHL, KTAR, KTBS, KGO, KFI, KGW, KOMO, KHQ, KTHS.

10:00—LIVES AT STAKE. Male Trio and Orchestra. Sponsor: General Tire & Rubber Co. NBC. WEAF, WCSH, WFI, WFBR, WRC, WGY, WBEN, WTAM, WWJ, WENR, WCAE, KSD, WOC, WTAG, WHO, WSB, WMC, WJDX, WEEI, WSMB, WKY, WBAP, KPRC, KTBS, KOA, KTHS, WOAI, KDYL, KGO, KFI, KGW, WJAR, KOMO, KHQ, WDAF, KVOO, WEEI, WLW, WOW, WRVA, WSM.

10:00—HOUSEHOLD MUSICAL MEMORIES. Sponsor: Household Finance Corp. NBC. WJZ, WBZ, WBZA, WBAL, WHAM, KDKA, WJR, WREN, KSO, WSYR, KWK.

10:30—EDWIN C. HILL—"Human Side of the News." CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WHK, CKOK, WDRC, WFBM, KMBC, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WLBW, KTRH, KFAB, KLRA, WFEA, WREC, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KSL, WSBT, WMT, KFH, WSJS, WORC, WKBN, WIP.

10:45—HOWARD BARLOW'S SYMPHONY ORCHESTRA. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, CKOK, WDRC, WFBM, KMBC, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WLBW, KTRH, KFAB, KLRA, WFEA, WREC, WCCO, WODX, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KSL, WSBT, WMT, KFH, WSJS, WORC, WKBN, WIP.

WEDNESDAYS

5:45—LITTLE ORPHAN ANNIE. Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, WJR, WHAM, WGAR, WWNC, WRVA, WJAX, KDKA, WIS, CKGW, WLW. Also, **6:45**—WENR, KSTP, KOIL, WREN, WEBC, WDAY, KFYR, WOAI, WKY, KPRC, KTBS, KWCR, WFAA.

6:00—MEET THE ARTIST. Interview by Bob Taplinger. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WBBM, WHK, CKOK, WDRC, KMBC, WHAS, WJAS, WFBL, WSPD, WQAM, WDBO, WDAE, WGST, WLBZ, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WTAQ, WLBW, WBIG, KTRH, KLRA, WFEA, WREC, WISN, WCCO, WODX, WSFA, WLAC, WDSU, WTAR, KOMA, WMBG, WDBJ, KSL, KTSA, WSBT, CFRB, WACO, WMT, KFAB, WWVA, KFH, WSJS, WIP.

6:30—BACK OF THE NEWS IN WASHINGTON. Comment by William Hard. NBC. WEAF, WFBR, WBEN, WCKY, WEBC, WTIC, WMAQ, KSD, WDAF, WJAR, WOAI, KTBS, KFYR, WAPI, KHQ, KFSD, WJDX, WWNC, WIS, WMC, WIBA, KOA, WMSB, KVOO, KGO, KFI, KGW, KOMO, KTAR.

6:45—JUST PLAIN BILL. Drama. Sponsor: Kolynos Sales Co. CBS. WABC, WCAO, WAAB, WKBW, WHK, CKOK, WCAU, WJSV.

6:45—LOWELL THOMAS. News. Sponsor: Sun Oil Co. NBC. WJZ, WBZ, WBZA, KDKA, WGAR, WHAM, WLW, CKGW, WBAL, WJR, WSYR.

7:00—AMOS 'N' ANDY. Drama. Sponsor: Pepsodent Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WLW, CKGW, WMAL, WRVA, WPTF, WCKY, WIOD, WGAR, WFLA. Also, **11:00**—WMAQ, WENR, KWK, WREN, WDAF, KOIL, WTMJ, KSTP, WSM, WMC, WSB, WSMB, KTHS, KPRC, WOAI, WKY, KOA, KGO, WJR, KGW, KFI, KDYL, KOMO, KHQ, WHAM, WFAA.

7:15—BUCK ROGERS IN THE YEAR 2433. Drama. Sponsor: Kellogg Co. CBS. WABC, WNAC, WGR, WBBM, WHK, CKOK, WHAS, WCAU, KMOX, WCCO.

7:30—DOLPH MARTIN'S ORCHESTRA AND TRAVELERS' QUARTET. Sponsor: Tide Water Oil Sales Co. CBS. WABC, WOKO, WCAO, WNAC, WGR, WDRC, WCAU, WJAS, WEAN, WFBL, WJSV, WLBZ, WHP, WFEA, WHEC, WORC.

7:45—THE GOLDBERGS. Drama. Sponsor: Pepsodent Co. NBC. WEAF, WTAG, WSAI, WEEI, WJAR, WCSH, WFBR, WLIT, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WENR, WOW, WDAF.

7:45—BOAKE CARTER. News. Sponsor: Philco Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, CKOK, WCAU, WJAS, WJSV, WBT.

8:00—FANNY BRICE AND GEORGE OLSEN'S ORCHESTRA. Sponsor: Standard Brands, Inc. NBC. WEAF, WTIC, WTAG, WEEI, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WLS, KSD, WOW, WDAF, WOC, WHO, WCKY, CKGW, CFCF.

8:00—ENO CRIME CLUES. Drama. Sponsor: Harold F. Ritchie Co. NBC. WJZ, WBAL, WBZ, WMAQ, WLW, KWK, WREN, WMAL, WBZA, KDKA, WHAM, WGAR, WJR.

8:00—VOICE OF EXPERIENCE. Psychologist. Sponsor: Wasey Products, Inc. CBS. WABC, WCAO, WNAC, WGR, WKRC, WHK, WDRC, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WJSV.

8:30—WOODBURY PROGRAM. Orchestra and Vocalists. Sponsor: John H. Woodbury, Inc. NBC. WEAF, WTIC, WTAG, WEEI, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, KSD, WOC, WHO, WOW, WDAF, WSM, WMC, WSB, WJDX, WSMB, KVOO, WKY, KTBS, WOAI, WMAQ, WSAI.

8:30—KATE SMITH LA PALINA PROGRAM. Sponsor: Congress Cigar Co. CBS. WABC, WADC, WOKO, WCAO, WGR, WGN, WKRC, WHK, CKOK, WOWO, WFBM, KMBC, WHAS, WCAU, WJAS, KMOX, WFBL, WSPD, WJSV, WISN, WCCO, WHEC, WMT.

8:45—PHIL COOK AND HIS INGRAM SHAVERS. Sponsor: Bristol-Myers Co. NBC. WJZ, WBZ, WBZA, WJR, WBAL, WHAM, WMAL, WLS, WSYR, KWK, KWCR, KOIL, WREN, KSO, KDKA, WGAR, WCKY.

8:45—ABE LYMAN'S ORCHESTRA AND IRVING KAUFMAN. Sponsor: Sterling Products Co., Inc. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WGN, WKRC, WHK, CKOK, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WCCO.

9:00—FERDE GROFE'S ORCHESTRA WITH CONRAD THIBAULT. Sponsor: Philip Morris & Co. NBC. WEAF, WTIC, WEEI, WJAR, WCSH, WLIT, WRC, WGY, WBEN, WCAE, WTAM, WMAQ, KSD, WDAF, WWJ.

9:00—IRVIN S. COBB. Humorist. Sponsor: Gulf Refining Co. CBS. WABC, WOKO, WCAO, WNAC, WKBW, WKRC, WHK, CKOK, WOKO, WDRC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WLBZ, WBRC, WBT, WCAH, KRLD, WBIG, KTRH, KLRA, WFEA, WREC, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, KTSA, WTOC, WACO, WORC.

9:15—THE STREET SINGER. Sponsor: The Non-Spi Co. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WGN, WKRC, WHK, CKOK, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, KERN, KMJ, KHJ, KOIN, KFBK, KGB, KFRC, KDB, KOL, KFPY, KWG, KVI, WBT, KLZ, KSL.

9:30—WHITE OWL PROGRAM. Burns and Allen; Guy Lombardo's Orchestra. Sponsor: General Cigar Co. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WGN, WKRC, WHK, CKOK, WDRC, WFBM, KMBC, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, KRLD, KLZ, KTRH, WCCO, KOMA, KSL, KTSA, WORC.

10:00—CORN COB PIPE CLUB. Sponsor: Larus & Bro. Co. NBC. WEAF, WTIC, WTAG, WCSH, WRC, WFBR, WLIT, WGY, WBEN, WTAM, WCAE, WENR, WWJ, WLW, KSD, WOC, WHO, WOW, WDAF, KOA, KGIR, KGHL, KGO, KFI, KGW, KOMO, WEEI, WJAR, KHQ, KDYL, WTMJ, WIBA, WEBC, WDAY, KFYR, KSTP, WRVA.

10:00—OLD GOLD PROGRAM. Fred Waring's Pennsylvanians with "Mandy Lou." Sponsor: P. Lorillard Co. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WGN, WKRC, WHK, CKOK, WOWO, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, KERN, KMJ, KHJ, KOIN, KFBK, KGB, KFRC, KDB, KOL, KFPY, KWG, KVI, WGST, WPG, WLBZ, WBRC, WBT, WDOD, WCAH, KRLD, KLZ, WHP, KTRH, KLRA, WREC, WCCO, WLAC, WDSU, KOMA, WMBG, WHEC, KSL, KTSA, WIBW, WMT.

10:30—EDWIN C. HILL—"Human Side of the News." CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WBBM, WHK, CKOK, WDRC, KMBC, WHAS, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WLBZ, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WLBW, WBIG, KTRH, KLRA, WFEA, WREC, WODX, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KSL, KTSA, WSBT, WMT, KFH, WSJS, WORC.

10:45—LIGHT OPERA GEMS. Channon Collinge, conductor. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, CKOK, WDRC, WFBM, KMBC, WHAS, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WLBZ, WBRC, WICC, WBT, WDOD, KVOR, KJZ, WLBW, WBIG, KTRH, KFAB, KLRA, WFEA, WREC, WCCO, WODX, WSFA, WLAC, WDSU, WTAR, KOMA, WMBD, WMBG, WDBJ, WHEC, KSL, KTSA, WSBT, WMT, KFH, WSJS, WORC.

11:15—LITTLE JACK LITTLE. Vocalist & pianist. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, CKOK, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WLBZ, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WLBW, WBIG, KTRH, KFAB, KLRA, WFEA, WREC, WCCO, WODX, WLAC, WDSU, WTAR, KOMA, WMBD, WMBG, WDBJ, WHEC, KSL, WSBT, CFRB, WMT, WSJS, WORC.

THURSDAYS

5:45—LITTLE ORPHAN ANNIE. Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, WJR, KDKA, WGAR, WHAM, WLW, WIS, WWNC, WRVA, WJAX, CKGW, CFCF. **Also, 6:45**—WENR, KSTP, KOIL, WREN, WEBC, WDAY, KFYR, WOAI, WKY, KPRC, KTBS, WFAA, KWCR.

6:45—LOWELL THOMAS. News. Sponsor: Sun Oil Co. NBC. WJZ, WBAL, WBZ, WBZA, WJR, KDKA, WGAR, WLW, CKGW, WSYR, WHAM.

6:45—JUST PLAIN BILL. Sponsor: Kolynos Sales Co. CBS. WABC, WCAO, WAAB, WKBW, WHK, WCAU, WJSV, CKOK.

7:00—AMOS 'N' ANDY. Drama. Sponsor: Pepsodent Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WLW, WMAL, CKGW, WRVA, WPTF, WIOD, WFLA, WGAR. **Also, 11:00**—WMAQ, WENR, KWK, WREN, WDAF, KOIL, WTMJ, WSMB, KSTP, WSM, WMC, WSB, WHAM, KTHS, WFAA, KPRC, WOAI, WKY, KOA, KDYL, KGO, KFI, KGW, KOMO, KHQ, WJR, WBAP.

7:15—BUCK ROGERS IN THE YEAR 2433. Drama. Sponsor: Kellogg Co. CBS. WABC, WNAC, WGR, WBBM, WHK, WHAS, KMOX, CKOK, WCCO, WCAU.

7:15—BOOTH TARKINGTON'S MAUD AND COUSIN BILL. Drama. Sponsor: Great Atlantic & Pacific Tea Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WMAQ.

7:30—JACK DEMPSEY'S GYMNASIUM. Drama. Sponsor: Wyeth Chemical Co. CBS. WABC, WCAO, WKBW, WKRC, WHK, WCAU, CFRB.

7:45—THE GOLDBERGS. Drama, Sponsor: Pepsodent Co. NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WFI, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WENR, WOW, WDAF.

7:45—BOAKE CARTER. News. Sponsor: Philco Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, CKOK, WCAU, WJAS, WJSV, WBT.

8:00—FLEISCHMANN HOUR—RUDY VALLEE AND GUEST STARS. Sponsor: Standard Brands, Inc. NBC. WEAF, WTAG, WEEI, WCSH, WFI, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WMAQ, KSD, WOC, WHO, WOW, CKGW, WSB, CFCF, KSTP, WEBC, WIOD, WJAX, WFLA, KHQ, WMC, WAPI, WJDX, WJAR, WRVA, WSMB,

WOAI, WKY, KOA, KFI, KGO, KGW, KOMO, KTAR, KFYR, WDAY, WSM, KPRC, KDYL, WPTF, WDAF (WTMJ, WSAI, WCKY on 8:30) (WLW, KTHS off 8:30) WBAP, WPTF, KVOO, WSM.

9:00—CAPTAIN HENRY'S MAXWELL HOUSE SHOW BOAT. Charles Winniger, Lanny Ross, Annette Hanshaw, others. Sponsor: General Foods Corp. NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WFI, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WMAQ, KSD, WOC, WHO, WOW, WDAF, WTMJ, WRVA, WWNC, WIS, WJAX, WIOD, WFLA, WJDX, WMC, WSB, WAPI, WSMB, KTBS, WKY, KPRC, WOAI, WSM, WBAP, WCKY, KTSP.

9:30—WAYNE KING'S ORCHESTRA. Sponsor: Lady Esther. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, KSO, KWK, KWCR, KOIL, WENR, WREN, WGAR, WJR, WHAM.

10:00—JOHN HENRY—BLACK RIVER GIANT. Drama. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WBBM, WHK, CKOK, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WLBZ, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WLBW, WBIG, KTRH, KLRA, WFEA, WREC, WCCO, WODX, WLAC, WDSU, KOMA, WMBD, WMBG, WDBJ, KSL, KTSA, WMT, WWVA, KFH, WSJS, WORC, WKBN.

11:00—JAMES MELTON. Songs. NBC. WEAF, WFBR, WRC, WSAI, WCAE, WWJ, WOC, WHO, WTAM, WFI, CKGW, KSD.

FRIDAYS

5:30—WINNIE THE POOH. Children's drama. NBC. WEAF, WTAG, WEEI, WJAR, WFBR, WGY, WBEN, WWJ, WIOD, WTAM, WSAI, WMAQ, KSD, WOC, WHO, WCKY, WDAF, CKGW, CFCF, WIS, WIBA, WDAY, WSM, WSB, WMC, WSMB, WKY, KTBS, WOAI, KOA, KDYL, KGO, KOMO, KHQ, WEBC, WAPI, WJDX, WCAE.

5:45—LITTLE ORPHAN ANNIE. Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WJR, WGAR, WIS, WWNC, WRVA, WJAX, WHAM, CKGW, WLW, CFCF. **Also, 6:45**—WENR, KSTP, KOIL, WREN, WEBC, WDAY, KFYR, WOAI, WKY, KPRC, KTBS, KWCR, WFAA.

6:45—JUST PLAIN BILL. Sponsor: Kolynos Sales Co. CBS. WABC, WCAO, WAAB, WKWB, WHK, CKOK, WCAU, WJSV.

6:45—LOWELL THOMAS. News. Sponsor: Sun Oil Co. NBC. WJZ, WLW, WHAM, CKGW, WGAR, WBZ, KDKA, WBAL, WBZA, WJR, WSYR.

7:00—AMOS 'N' ANDY. Drama. Sponsor: Pepsodent Co. NBC. WJZ, WBZ, WBZA, WBAL, KDKA, WLW, CKGW, WRVA, WPTF, WMAL, WFLA, WIOD, WGAR. **Also, 11:00**—WMAQ, WENR, KWK, WREN, WDAF, KOIL, WTMJ, KSTP, WSM, WMC, WSB, WSMB, WFAA, KTHS, WCKY, KPRC, WOAI, KHQ, WKY, KOA, KGO, KFI, KGW, KOMO, WHAM, KDYL, WJR.

7:15—BOOTH TARKINGTON'S MAUD AND COUSIN BILL. Drama. Sponsor: Great Atlantic & Pacific Tea Co. NBC. WJZ, WBZ, WBZA, WBAL, KDKA, WMAQ.

7:15—BUCK ROGERS IN THE YEAR 2433. Drama. Sponsor: Kellogg Co. CBS. WABC, WNAC, WGR, WBBM, WHK, CKOK, WHAS, WCAU, KMOX, WCCO.

7:30—DOLPH MARTIN'S ORCHESTRA AND TRAVELERS' QUARTET. Sponsor: Tide Water Oil Sales Co. CBS. WABC, WOKO, WCAO, WNAC, WGR, WDRC, WCAU, WJAS, WEAN, WFBL, WSJV, WLBZ, WHP, WFEA, WHEC, WORC.

7:45—THE GOLDBERGS. Drama. Sponsor: Pepsodent Co. NBC. WEAF, WTAG, WENR, WOW, WEEI, WJAR, WCSH, WLIT, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WSAI, WDAF, WFBR.

7:45—BOAKE CARTER. News. Sponsor: Philco Radio & Television. CBS. WABC, WCAO, WNAC, WGR, WBBM, WHK, CKOK, WCAU, WJAS, WJSV, WBT.

8:00—JESSICA DRAGONETTE AND THE CAVALIERS. Sponsor: Cities Service Co. NBC. WEAF, WTIC, (WGY off 8:30) WDAF, WBEN, WTAG, WOAI, WTAM, WWJ, WSAI, KYW, KSD, WOC, WHO, WOW, CKGW, KOA, KPRC, KTBS (WTMJ on 8:30) WEBC, WKY, WFAA, WEEI, KDYL, WJAR, KVOO, KTHS, WCSH, WCAE, WLIT, WFBR, WRC.

8:00—NINO MARTINI. Songs. Accompanied by Howard Barlow's Symphony Orchestra. CBS. WABC, WADC, WOKO, WCAO, WHK, CKOK, WDRC, WFBM, KMBC, WCAU, WJAS, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WGST, WBRC, WICC, WBT, WDOD, KVOR, WTAQ, WLBW, WBIG, KTRH, WFEA, WREC, WISN, WCCO, WODX, WSFA, WLAC, WDSU, WTAR, KOMA, WMBG, WDBJ, WHEC, KTSA, WSBT, CFRB, WMT, WWVA, WSJS, WORC.

8:45—PHIL COOK AND HIS INGRAM SHAVERS. Sponsor: Bristol Myers Co. NBC. WJZ, WBAL, WBZ, WBZA, WHAM, KDKA, WCKY, WLS, WMAL, WSYR, KWCR, KWK, WREN, KOIL, KSO, WJR.

9:00—BEST FOODS MUSICAL GROCERY STORE. Tom Howard, Jeannie Lang, others. Sponsor: Best Foods, Inc. NBC. WEAF, WTIC, WTAG, WEEI, WJAR, WCSH, WGY, WBEN, KSD, WTAM, WWJ, WRC, WFBR, WLIT, WMAQ, WLW. **Also, 11:30**—KOA, KGO, KGW, KHQ, KOMO, KDYL, KFI, KFSD, KTAR, WDAF.

9:00—IRVIN S. COBB. Humorist. Sponsor: Gulf Refining Co. CBS. WABC, WOKO, WCAO, WNAC, WKBW, WKRC, WHK, CKOK, WDRC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WORC, WQAM, WDBO, WDAE, WGST, WLBZ, WBRC, WBT, WDOD, WCAH, KRLD, WBIG, KTRH, KLRA, WFEA, WREC, WSFA, WLAC, WDSU, WTAR, WMBG, WDBJ, KTSA, WTOC, WACO.

9:30—POND'S PROGRAM. Comedy and Songs. Sponsor: Lamont, Corliss & Co. NBC. WEAF, WDAF, WWJ, WTAG, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WSAI, WENR, KSD, WOC, WHO, WOW.

9:30—PHIL BAKER. Variety. Sponsor: Armour & Co. NBC. WJZ, WBAL, WBZ, WBZA, KGW, KOMO, KHQ, WHAM, KDKA, WGAR, WJR, WMAQ, KWK, WREN, KOIL, WTMJ, KSTP, WEBC, WRVA, WWNC, WJAX, WIOD, WSM, WMC, WSB, WAPI, WSMB, WFAA, KPRC, WOAI, WKY, KOA, KGO, KFI, KDYL, KSO.

9:30—THE INSIDE STORY. Interviews by Edwin C. Hill. Sponsor: Socony-Vacuum Corp. CBS. WABC, WADC, WOKO, WCAO, WNAC, WKBW, WGN, WKRC, WHK, CKOK, WOWO, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, KERN, KMJ, KHJ, KOIN, KFBK, KGB, KFRC, KDB, KOL, KFPY, KWG, KVI, WLBZ, WCAH, KRLD, KLZ, WLBW, WHP, KTRH, WKBH, KLRA, WFEA, WHAD, WCCO, KOMA, WMBD, WHEC, KSL, KTSA, WIBW, WACO, KFH, WORC, WMAS.

10:00—JACK BENNY AND FRANK BLACK'S ORCHESTRA. Sponsor: Chevrolet Motor Car Co. NBC. WEAF, WTIC, WTAG, WLIT, WFBR, WRC, WGY, WBEN, WWJ, WCAE, WTAM, WENR, KSD, WOC, WHO, WOW, WDAF, WTMJ, WIS, WIBA, KSTP, WRVA, WWNC, WIOD, WFLA, WSM, WMC, WSB, WJDX, WSMB, KTBS, WKY, WFAA, KPRC, WOAI, KOA, WJAX, WLW, KDYL, KGIR, KGHL, KGO, KFI, KGW, KOMO, KHQ, KFSD, KTAR, WCSH, WEEI, WJAR, WEBC, WDAY, KFYR, WPTF, WAPI.

10:00—CHESTERFIELD PROGRAM. Lou Holtz, Grace Moore, Leonard Hayton's Orchestra. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WGN, WKRC, WHK, CKOK, WOWO, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, KERN, KMJ, KHJ, KOIN, KFBK, KGB, KFRC, KDB, KOL, KFPY, KWG, KVI, WGST, WPG, WLBZ, WBRC, WBT, WCAH, KRLD, KLZ, KTRH, KLRA, WREC, WISN, WCCO, WLAC, WDSU, WTAR, KOMA, KOH, WMBG, WDBJ, WHEC, KSL, KTSA, WTOC, WMT, KFH, WORC.

10:30—RICHFIELD COUNTRY CLUB. Golf lessons by Alex Morrison; Music. Sponsor: Richfield Oil Corp. of N. Y. NBC. WEAF, WEEI, WTIC, WJAR, WLIT, WFBR, WRC, WGY, WBEN, WCAE.

10:30—THE FIRST NIGHTER. Drama. Sponsor: Campana Corp. NBC. WJZ, WBAL, WBZ, WHAM, KDKA, WTMJ, WGAR, WCKY, KWK, WREN, KTAR, KOIL, KSTP, KOA, WEBC, KDYL, WSB, KGO, KFI, KGW, KOMO, KHQ, KFSD, WOAI, KPRC, WKY, KTBS, WENR, WSM, WAPI, WSMB, WJR, WBZA.

10:45—FREDDIE RICH'S ORCHESTRA. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, CKOK, WDRC, WFBM, KMBC, WHAS, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WLBZ, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WLBW, WBIG, KTRH, KFAB, KLRA, WFEA, WREC, WCCO, WODX, WLAC, WDSU, WTAR, KOMA, WMBD, WMBG, WDBJ, WHEC, KSL, KTSA, WSBT, WMT, WSJS, WWVA, WORC, WIP.

SATURDAYS

2:30—SAVITT STRING QUARTETTE. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WBBM, WHK, WDRC, WFBM, WHAC, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WLBZ, WBRC, WBT, WDOD, KVOR, KLZ, WTAQ, WLBW, KTRH, KFAB, WFEA, WREC, WISN, WCCO, WODX, WSFA, WLAC, WDSU, WTAR, KOMA, WMBG, WDBJ, WHEC, KSL, KTSA, WSBT, WWVA, KFH, WSJS, WORC, WBIG.

4:00—WEEK-END REVUE. Variety. NBC. WEAF, WTAG, WEEI, WJAR, WFBR, WRC, WGY, WTAM, WWJ, WMAQ, WSAI, WCKY, WCAE, WOC, WHO, WDAF (WFI off 4:30) (WBEN, KSD, WOW on 4:30) (WCSH off 4:45).

5:45—LITTLE ORPHAN ANNIE. Drama. Sponsor: Wander Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WJR, WHAM, WGAR, WJAX, WLW, CKGW, WRVA, WWNC, WIS, CFCF. **Also, 6:45**—WENR, KOIL, WREN, WFAA, WKY, KWCR, KSTP, WEBC, WDAY, KFYR, KPRC, WOAI, KTBS.

7:00—POLITICAL SITUATION IN WASHINGTON TONIGHT. Frederic William Wile. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WBBM, WDRC, KMBC, WHAS, WCAU, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WLBZ, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WTAQ, WLBW, WBIG, KTRH, WFEA, WREC, WISN, WCCO, WODX, WSFA, WLAC, WDSU, WTAR, KOMA, WMBG, WDBJ, KSL, KTSA, WACO, WHEC, WMT, KFH, WSJS, WORC.

7:30—JACK DEMPSEY'S GYMNASIUM. Drama. Sponsor: Wyeth Chemical Co. CBS. WABC, WCAO, WKBW, WKRC, WHK, WCAU, CFRB.

8:00—ORTIZ TIRADO. Songs. NBC. WEAF, WTAG, WJAR, WRC, WBEN, WWJ, WSAI, WOC, WHO, WDAF, WWNC, WIBA, WDAY, WMC, KPRC, KTBS, WOAI, KFYR (WIS, KSTP, WMAQ on 8:15) KOA, WSMB (WCKY, KSD, off 8:15) WGY, WFI, WIOD, WEBC, WEEI, CKGW, WCSH, KHQ, KGO, KFI, KGW, KOMO.

8:15—THE MAGIC VOICE. Drama. Sponsor: Ex-Lax Co. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WGN, WKRC, WHK, CKOK, WDRC, WFBM, KMBC, WHAS, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WBT, KRLD.

9:00—FERDE GROFE'S ORCHESTRA WITH CONRAD THIBAULT. Sponsor: Philip Morris & Co. NBC. WEAF, WMAQ, WWJ, WEEI, WJAR, WCSH, WRC, WFI, WTAM, WCAE, KSD, WDAF, WGY, WBEN.

10:00—SATURDAY NIGHT DANCING PARTY. B. A. Rolfe's Orchestra. Sponsor: Hudson Motor Car Co. NBC. WEAF, WEEI, WJAR, WTAG, WCSH, WFI, WFBR, WGY, WBEN, WTAM, WCAE, WWJ, WLW, WMAQ, KSD, WOC, WHO, WOW, WDAF, WRC, CKGW, CFCF, KSTP, WSB, WSMB, WBAP, KOA, KDYL, KGO, KFI, WTMJ.

10:45—GERTRUDE NIESEN. Songs. Accompanied by Freddie Rich's Orchestra. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WDRC, WFBM, KMBC, WHAS, WJAS, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WLBZ, WBRC, WICC, WBT, WDOD, KVOR, KLZ, WLBW, WBIG, KTRH, KLRA, WREC, WCCO, WODX, WLAC, WDSU, WTAR, WMBD, WMBG, WDBJ, WHEC, KSL, KTSA, CFRB, WMT, WWVA, KFH, WORC, WIP.

SUNDAYS

11:15 A. M.—MAJOR BOWES' CAPITOL FAMILY. Variety. NBC. WEAF, WJAR, WFBR, WRC, WTAM, WDAF, WFLA, KFYR, WAPI, WSMB, KPRC, KOA, KDYL, WEBC, (WTAG, WBEN, WLIT, WGY on 12:00) WSAI, WHO, KSTP, WMC, WIOD, WKY, KTBS, WOAI, WOC, WWNC, WFAA, WMAQ.

11:45 A. M.—SALT LAKE TABERNACLE CHOIR AND ORGAN. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, CKOK, WDRC, KMBC, WEAN, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WBRC, WBT, WDOD, KVOR, KLZ, WTAQ, WLBW, KTRH, KFAB, KLRA, WFEA, WREC, WCCO, WODX, WDSU, KOMA, WMBD, WDBJ, WSBT, CFRB, WACO, WMT, WORC, WKBN.

12:15—RADIO CITY CONCERT. S. L. Rothafel (Roxy), master-of-ceremonies. Variety. NBC. WJZ, WBAL, WHAM, WGAR, WWNC, WLW, KDKA, KWK, WREN, KOIL, WJAX, WIOD KFSD, WBZ, WBZA, CFCF, WFLA, WDAY, KFYR, WSMB, KVOO, KPRC, KOA, KDYL, KGO, KFI, WJR, WMAQ, KGW, WAPI, WSYR, KTAR, CKGW (WIS on 12:30), WMAL, WEBC, KOMO, KHQ.

1:30—SABBATH REVERIES. Dr. Charles L. Goodell. NBC. WJZ, WBAL, WMAL, WSYR, WJR, KWCR, WREN, KOIL, WRVA, WWNC, WIS, WJAX, WIOD, WFLA, WIBA, KSTP, WEBC, WDAY, KFYR, WSM, WAPI, WSB, WSMB,

KVOO, WKY, WFAA, KPRC, KTBS. WOAI, KOA, KGO, KFI, KGW, KOMO, KHQ, KFSD.

1:30—LAZY DAN, THE MINSTREL MAN. Songs and humor. Sponsor: A. S. Boyle Co. CBS. WABC, WCAO, WAAB, WBBM, WKRC, CKOK, KMBC, WHAS, WCAU, WJAS, KMOX, WJSV, WCAH, WCCO, WMBG.

3:00—WAYNE KING'S ORCHESTRA. Sponsor: Lady Esther. NBC. WEAF, WTAG, WEEI, WCSH, WJDX, WLW, WRC, WGY, WBEN, WCAE, WTAM, WWJ, KYW, KSD, WOC, WHO, WOW, WRVA, WDAF, WTMJ, KSTP, KGW, KHQ, KVOO, WKY, WOAI, KPRC, WFAA, KOA, KGO, WLIT, KFI, WJAX, WFLA, WMC, WSMB, KOMO, WWNC, WIOD, WSM, WSB, KDYL, WJAR.

3:30—THE RADIO PULPIT. Dr. Ralph W. Sockman. NBC. WEAF, WEEI, KTHS, WTAG, WCSH, WFBR, WRC, WBEN, WJAR, WCAE, WTAM, WSAI, WOW, WDAF, WLIT, WEBC, KFYR, KSD, KOA, KVOO, KPRC, WOAI, WKY, KGHL, KGO, KGW, KHQ, WGY, KDYL, WCKY, WDAY, WRVA, WJDX, WWJ, WWNC, WJAX, KOMO, WIOD, WFLA, WSM, WSB, KGIR, WAPI, KFSD, WMC, WIS, KFI.

4:00—CATHEDRAL HOUR. Channon Collinge, conductor. Choir, orchestra and soloists. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, WHK, CKOK, WDRC, WFBM, KMBC, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WBRC, WICC, WBT, WDOD, KRLD, KLZ, WTAQ, WLBW, KTRH, KFAB, KLRA, WFEA, WREC, WISN, WCCO, WODX, WSFA, WLAC, WDSU, WTAR, KOMA, WMBD, WMBG, WDBJ, WHEC, WSBT, CFRB, WACO, WMT, KFH, WSJS, WORC, WKBN.

5:00—THE WORLD OF RELIGION. Dr. Stanley High. NBC. WJZ, WBAL, WBZ, WREN, WEBC, KFYR, WBZA, WGAR, KWK, WSM, WPTF, WIS, WWNC, KWCR, WIOD, WFLA, WSB, KOA, KGHL, KGW, WJDX, WOAI, KTBS, KGO, KHQ, WIBA, KFSD, KTAR, KOIL, WJAX, WSMB, WBAP, KOMO, WMS, WRVA, KGIR, KVOO, WHAM, WCKY, WCFL, WTMJ, KSTP, WKY, KPRC, WMAL, KDYL.

5:00—POET'S GOLD. Poetic readings by David Ross. CBS. WABC, WADC, WOKO, WCAO, WNAC, WGR, CKOK, WDRC, WFBM, KMBC, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WBRC, WBT, WDOD, KVOR, KRLD, KLZ, WTAQ, WLBW, KTRH, KFAB, KLRA, WFEA, WREC, WISN, WCCO, WODX, WSFA, WLAC, WDSU, WTAR, KOMA, WDBJ, WHEC, CFRB, WMT, WSJS, WORC, WKBN, WICC.

5:30—PAGES OF ROMANCE. Drama. Sponsor: Centaur Co. NBC. WJZ, WBAL, WBZ, WBZA, KDKA, WGAR, KYW, WLW, WJR, KWK, KSO, KWCR, WREN, KOIL, WTMJ, WIBA, KSTP, WEBC, WDAY, KFYR, KTBS, KVOO, WKY, WBAP, KPRC, KOA, WOAI, KDYL, KGIR, KGHL, KGO, KFI, KOMO, KHQ, KFSD, KTAR, KGW, CFCF, CKGW, WMAL, WSYR, WHAM.

5:30—FRANK CRUMIT AND JULIA SANDERSON. Songs. Sponsor. General Baking Co. CBS. WABC, WADC, WOKO, WCAO, WAAB, WGR, WHK, CKOK, WDRC, WFBM, KMBC, WHAS, WCAU, WEAN, KMOX, WFBL, WSPD, WJSV, WICC, WCAH, KFAB, WDSU, WTAR, KOMA, WHEC, WWVA, KFH, WORC.

6:00—CATHOLIC HOUR. NBC. WEAF, WTAG, WEEI, WJAR, WCSH, WLIT, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, WIOD, WEBC, KFYR, WRVA, WOAI, WSAI, WOC, WHO, WOW, WDAF, WIBA, WFLA, WSM, WMC, WSMB, WKY, KOA, KGHL, WJDX, KVOO, WBAP, KPRC, WWNC, KGIR, KPO, WAPI, WJAX, KECA, KGW, KSD, WIS, WDAY, WSB, KTBS, KDYL, KOMO, WENR, KSTP, KTAR.

6:30—ROSES AND DRUMS. Drama. Sponsor: Union Central Life Insurance Co. CBS. WABC, WADC, WCAO, WAAB, WGR, WBBM, WKRC, WHK, CKOK, KMBC, WHAS, WJAS, KMOX, WJSV, WGST, KRLD, KLZ, KTRH, KFAB, KLRA, WREC, WCCO, WDSU, KOMA, KTSA, WBRC, WBT.

7:45—ANGELO PATRI—"YOUR CHILD". Sponsor: Cream of Wheat Co. CBS. WABC, WCAO, WNAC, WGR, WGN, WKRC, WHK, CKOK, KMBC, WHAS, WCAU, WJAS, KMOX, WFBL, WJSV, WCCO. Also, 11:15—KERN, KMJ, KHJ, KOIN, KFBK, KGB, KFRC, KDB, KOL, KFPY, KWG, KVI, KLZ, KSL.

8:00—CHASE & SANBORN HOUR. Sponsor: Standard Brands, Inc. NBC. WEAF, WTIC, WTAG, WIOD, WFLA, WMC, WJDX, KTAR, WBEN, WCAE, WTAM, WWJ, WLW, KSD, WOC, WHO, WDAF, CFCF, WSB, KFYR, WWNC, WIS, KDYL, KPRC, WKY, CKGW, WTMJ, KSTP, WEBC, WDAY, KVOO, WFAA, WOAI, KOA, KGO, KFI, WFBR, WRC, WGY, KGW, KOMO, KHQ, WPTF, WSM, WOW, WJAR, WCSH, WMAQ, WRVA, WAPI, KTHS, WSMB.

9:30—AMERICAN ALBUM OF FAMILIAR MUSIC. Orchestra and vocalists. Sponsor: Bayer Co. NBC. WEAF, WTAG, WEEI, WCKY, WJAR, WCSH, WFI, WFBR, WRC, WGY, WBEN, WCAE, WTAM, WWJ, KSD, WSAI, WENR, WOC, WHO, WOW, WIOD, WFLA, WMC, WSB, WOAI, WJDX, WFAA, KFI, KGW, KOMO, KHQ, WSMB, KDYL, WKY, KOA, KPRC, KGO, WDAF, KVOO, WRVA, WJAX, WTMJ, KSTP.

9:38—ANDRE KOSTELANETZ PRESENTS. Mary Eastman and Evan Evans, vocal soloists, and male chorus. CBS. WABC, WADG, WOKO, WCAO, WNAC, WHK, CKOK, WDRC, WFBM, KMBC, WCAU, WJAS, WEAN, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WBRC, WICC, WBT, WDOD, KVOR, KRLD, KLZ, WTAQ, WLBW, KTRH, KFAB, KLRA, WFEA, WREC, WISN, WCCO, WODX, WSFA, WLAC, WDSU, WTAR, KOMA, WDBJ, WHEC, CFRB, WMT, WSJS, WORC, WKBN.

10:00—JOHN HENRY—BLACK RIVER GIANT. Drama. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WBBM, WHK, CKOK, WDRC, WFBM, KMBC, WCAU, WJAS, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WBRC, WICC, WBT, WDOD, KVOR, KRLD, KLZ, WLBW, KTRH, KLRA, WFEA, WREC, WISN, WODX, WLAC, WDSU, WTAR, KOMA, WDBJ, WHEC, WMT, WSJS, WORC, WKBN.

10:15—VINCENT LOPEZ'S ORCHESTRA. Dance Music. Vocal Soloists. Sponsor: Real Silk Hosiery Mills. NBC. WJZ, WBZA, KDKA, WHAM, KSO, WJR, KWK, WTMJ, WIBA, KSTP, WSM, WSB, WJDX, WSMB, WKY, WFAA, KPRC, WOAI, KOA, KDYL, KGO, KFI, KGW, KOMO, KHQ, WBAL, WBZ, WGAR, WLW, WMAQ, WREN.

10:15—COLUMBIA REVUE. Freddie Rich's Orchestra, chorus and soloists. CBS. WABC, WADC, WOKO, WCAO, WAAB, WKBW, WBBM, CKOK, WDRC, WFBM, KMBC, WCAU, WJAS, KMOX, WFBL, WSPD, WJSV, WQAM, WDBO, WDAE, WGST, WPG, WBRC, WICC, WBT, WDOD, KVOR, KRLD, KLZ, WLBW, KTRH, KLRA, WFEA, WREC, WISN, WCCO, WODX, WLAC, WDSU, WTAR, WMBD, WDBJ, WHEC, WMT, WSJS, WORC, WKBN.

Our "Uncle Sam" Says

WILL ROGERS' large radio salary for his Gulf Refining Company programs is turned over to the Salvation Army and the American Red Cross. . . . Some commercial announcements are so exaggerated and obnoxious that even the radio performers in the studios find it difficult to restrain from laughing at the absurd spiels. . . . Walter Winchell operates the telegraph key for the "flash" sound effects on his gossip programs. . . . Gypsy Nina, CBS vocalist, has the studio lights dimmed to suit her subtle moods. . . . George Hall, CBS maestro, was honored by artists of both chains at his opening night at the Hotel Taft, New York. . . . Log-rolling is getting to be one of the pestiferous aspects of broadcasting. . . . With newspaper publishers constantly making added restrictions on news broadcasting, it is possible that the broadcasters will get together to form a radio press association to fill their own needs. . . . Despite the busy blue pencils of network officials, many risqué jokes are getting on the air. . . . S. L. Rothafel (Roxy), fully recovered in health, again has the reins of the Radio City theatres and directs the Sunday afternoon program of the Roxy Gang. . . . More and more radio entertainers are going in for the idea of wearing costumes to fit their radio rôles. . . . Octavus Roy Cohen's "Townsend Murder Mystery" series on NBC was condensed to end at a much earlier date than originally planned. . . . Everett Marshal, baritone, is the new feature of the Westinghouse series. . . . Radio's three outstanding audible journalists—Edwin C. Hill, Lowell Thomas and Boake Carter—are among the more popular features on the air. . . . If advertising revenue is considerably diminished, it is possible that many radio stations will charge admission to the studios. . . . James Roosevelt, son of the President, proved to be a capable radio commentator during his recent CBS programs. . . . Many American network stars are getting European engagements. . . . Bob Taplinger's CBS "Meet the Artist" program gathered a huge following during its two years' existence. . . . Mary Livingston, of Jack Benny's Chevrolet Program, has developed into a real headliner comedian. . . . Most serialized radio dramas have proven to be flops unless each episode was written to be a complete story in itself. . . . The networks may revive television activities in a big way next Fall. . . . There has been a decline in mystery dramas on the air. . . . A large number of radio headliners are taking up aviation as a hobby. . . . The networks are still trying to outdo each other in stunt broadcasting, and the result is that the listening public is constantly getting a grand assortment of novel unsponsored programs.

WILL ROGERS

DOLORES GILLEN

Personal interviews with broadcast artists and executives

Backstage in

By Samuel

EVERY now and then, some especially refreshing feature looms across the radio horizon and makes listeners feel that sponsors are really alert to give the public what it wants. Such a series is the Sunday night Will Rogers periods, sponsored by the Gulf Refining Company over an NBC hook-up. The gum-chewing wit of Claremore is supported in his monologues by Al Goodman's Orchestra and the Revelers Quartet. Rogers philosophizes on the news and personalities of the day on his portion of the program. The cowboy humorist has been before the public as a stage and screen actor, writer and commentator since he first began mixing gags with rope tricks. Al Goodman conducted the Ziegfeld Follies orchestra while Rogers was starred in that famous presentation. As a worthy companion feature to the Rogers broadcasts, CBS is presenting a semi-weekly series starring Irvin S. Cobb, under the same sponsorship. The Cobb programs are heard Wednesdays and Fridays. Though he has been successful as an editor, novelist and playwright, Cobb is best known as a story-teller, and it is in the latter capacity that he is heard on the air. Goodman's orchestra is also heard on the Cobb programs.

IRVIN S. COBB

ORTIZ TIRADO, leading tenor of Mexico's National Opera Company and a popular radio star heard for two years over XEW, Mexico City, has been signed by the NBC Artists Service and is featured in a Saturday night series over an extensive hook-up. Tirado had previously made American microphone appearances over stations in Texas and California, but his current series marks his introduction to a network audience. Tirado was born in Mexico City and attended the National University of Mexico, where he studied medicine before deciding to study voice. He obtained his NBC contract within two days after his arrival in New York. His only previous visit to New York was six years ago. The tenor comes from one of the oldest families in Mexico. He is a cousin of Enrique Ruiz, Mexican Consul General in New York.

ORTIZ TIRADO

"THE Northwestern Chronicle," a Sunday afternoon NBC series sponsored by the Northwestern Yeast Company, boasts of a cast of Chicago radio veterans. The program, which originates in the NBC Chicago studios, features Bill Barth and Dolores Gillen in the leading rôles. Barth is regularly employed in the NBC Chicago music library. When the series was planned, auditions were held, but no satisfactory voice for the rôle of Buck Harkins was found until Barth wandered into the studio and asked for a microphone test. The audition clinched the job for him. Likewise, Miss Gillen's assignment to dramatic programs came about in an indirect way. She applied at the studios for a position as hostess. When the personnel director learned of her imposing dramatic background, she was sent to the studio for a dramatic audition. Bernardine Flynn, the Aunt Hessie of the program, has been on the air regularly for more than three years and is well known for her rôle of Sade in "Vic and Sade." Loretta Poynton, Eugene

MARY McCOY

ILOMAY BAILEY

BERT LAHR

Broadcasting

Chatty bits of news on what is happening before the microphone

Kaufman

McGillen and Merrill Fugit are also featured on the series.

WITH Eddie Cantor sojourning in California for the Summer, the Chase & Sanborn Sunday NBC Hour has turned to variety. Bert Lahr, stage comic, whose previous radio efforts were not so happy in results, was selected as the star of the series succeeding the Cantor program. At this writing, it is thought likely that Lahr will be retained throughout the Summer. The piano and vocal duo of Lee Sims and Ilomay Bailey was selected to co-star with Lahr. Dave Rubinoff and his orchestra were retained to supply the instrumental background to the hour. Original radio dramatizations by Louis Joseph Vance are also included in the Summer hour. Lahr's rise to fame on Broadway was rapid. About four years ago, he appeared in "Hold Everything," his first starring vehicle. Following this success, he appeared in George White's "Flying High" and Ziegfeld's "Hot-Cha." Eddie Cantor is scheduled to return to the Chase & Sanborn Hour in the Fall.

GYPSY NINA

RADIO listeners recently welcomed the return to CBS of the "Evening in Paris" programs sponsored by Bourjois, Inc. The new series supplanted the Monday night "Mysteries in Paris' feature which was sponsored by the same company. Woods Miller, baritone; Mary McCoy, soprano, and Nat Shilkret's Orchestra are the headliners of the new programs. Each program takes the form of a miniature musical comedy written especially for the series. Only the script is original, the songs heard on the broadcasts being established musical selections. Woods Miller, a protégé of Shilkret, is a comparative newcomer to radio. He is a native of Chicago and studied at the University of Illinois and Chicago University. His success in college musical shows caused him to quit school and go on the stage. He has appeared in the talkies and in Broadway musical productions. Miss McCoy has been an established radio star for several seasons and is well known to listeners of both the NBC and the CBS. She, too, has had extensive stage experience. Shilkret, a veteran radio conductor, is still popularly identified with the phonograph recording field, in which he earned wide fame.

WOODS MILLER

GYPSY NINA, soprano, star of the twice-weekly "Romany Romance" series of CBS, is a recent addition to the network's vocal staff. Her programs are presented Tuesday and Saturday evenings. Gypsy Nina accompanies herself on the accordion. She sings in nine languages—English, Spanish, French, Italian, Russian, German, Hungarian, Greek and Polish—and draws at least two numbers on each broadcast from her extensive repertoire of foreign tunes. The new Columbia songster has never taken music lessons other than the training she has had from her mother, who was also a singer. Gypsy Nina has sung and played the accordion ever since she can remember. She learned the many languages through extensive travel since childhood. She has had considerable stage experience

(*Continued on page* 124)

NINO MARTINI

The DX Corner

IN this fifth installment of the DX Corner we have listed a time schedule of Short-Wave Best Bets, a list of stations logged during the past month at the RADIO NEWS Short-Wave Listening Post in Westchester County, New York. The schedule includes only the best received stations, hourly, from 5 o'clock in the morning to 12 midnight, E. S. T. Space has been left for filling in local time. Space has also been left opposite the call letters for your own dial settings for each station you pick up. Unless otherwise noted stations are heard daily.

Short-Wave "Best Bets"

Wavelengths in Meters	*Call Letters*	*Dial Settings*
5 A. M. Eastern Standard Time		**Local Time**
19.8	GSF	
31.2+Sun.	VK2ME	
31.5 Wed., Sat.	VK3ME	
31.5	GSB	
70.2	RV15	
6 A. M. Eastern Standard Time		**Local Time**
13.9+	W8XK	
19.8	GSF	
31.2+Sun.	VK2ME	
31.3+	W1XAZ	
31.5 Wed., Sat.	VK3ME	
31.5	GSB	
49.4+	W8XAL	
70.2	RV15	
7 A. M. Eastern Standard Time		**Local Time**
13.9+	W8XK	
16.8+	W3XAL	
19.6	FYA	
23.3+Sun.	RABAT	
25.5	GSD	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
49.4+	W8XAL	
70.2	RV15	
8 A. M. Eastern Standard Time		**Local Time**
13.9+	W8XK	
16.8+	W3XAL	
16.8+ Irregular	PHI	
19.6	FYA	
19.7	DJB	
23.3+ Sun.	RABAT	
25.3	GSE	
25.4	I2RO	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
31.5	GSB	
49.4+	W8XAL	
49.9+	VE9DR	
70.2	RV15	
9 A. M. Eastern Standard Time		**Local Time**
13.9+	W8XK	
16.8+	W3XAL	
16.8+ Irregular	PHI	
19.6	FYA	
19.7	DJB	
19.7	W8XK	
25.3	GSE	
25.4	I2RO	
31.3+	W1XAZ	
31.5	GSB	
49.4+	W8XAL	
49.9+	VE9DR	
10 A. M. Eastern Standard Time		**Local Time**
13.9+	W8XK	
16.8+	W3XAL	
16.8+ Irregular	PHI	
19.6	FYA	
19.6+	W2XE	
19.7	W8XK	
19.7	DJB	
25.3	GSE	
25.4	I2RO	
25.5 Irregular	DJD	
25.6	VE9JR	
26.8+ Sun.	CT3AQ	
31.3+	W1XAZ	
31.5	GSB	
49.4+	W8XAL	
49.9+	VE9DR	
11 A. M. Eastern Standard Time		**Local Time**
13.9+	W8XK	
16.8+	W3XAL	
19.6+	W2XE	
19.7	W8XK	
19.7	DJB	
25.2	FYA	
25.2	W8XK	
25.3	GSE	
25.4	I2RO	
25.5 Irregular	DJD	
25.6 Irregular	VE9JR	
26.8+ Sun.	CT3AQ	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
49.2 Sun.	VE9GW	
49.3+ Sun.	W9XAA	
49.9	VE9BJ	
49.9+	VE9DR	
12 NOON Eastern Standard Time		**Local Time**
13.9+	W8XK	
16.8	W3XAL	
19.7	W8XK	
25.2	FYA	
25.4	I2RO	
25.5 Irregular	DJD	
25.6	VE9JR	
31.2+	W3XAU	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
31.3+	DJA	
49.2 Sat., Sun.	VE9GW	
49.3+ Sun.	W9XAA	
49.9	VE9BJ	
49.9+	VE9DR	
1 P. M. Eastern Standard Time		**Local Time**
16.8	W3XAL	
19.7	W8XK	
25.2	FYA	
25.4	I2RO	
25.5	GSD	
25.5 Irregular	DJD	
25.6	VE9JR	
30.4 Sat.	EAQ	
31.2+	W3XAU	
31.2+ Sun.	VK2ME	
31.3+	W1XAZ	
31.3+	DJA	
31.5	GSB	
49.2 Sat., Sun.	VE9GW	
49.3 Sun.	W9XAA	
49.4+	W8XAL	
49.5 Temporary	OXY	
49.9+	VE9DR	
50.0+	HVJ	
2 P. M. Eastern Standard Time		**Local Time**
16.8	W3XAL	
19.5 Sun.	W2XAD	
19.7	W8XK	
25.2	FYA	
25.4	I2RO	
25.3+	W2XE	
25.5 Irregular	DJD	
25.5	GSD	
30.4 Sat.	EAQ	
31.2	W3XAU	
31.3	HBL (code)	
31.3+	W1XAZ	
31.3+	DJA	
31.5	GSB	
49.2 Sat., Sun.	VE9GW	
49.3 Sun.	W9XAA	
49.4+	W8XAL	
49.5 Temporary	OXY	
49.6+ Sun.	W1XAL	
49.9+	VE9DR	
3 P. M. Eastern Standard Time		**Local Time**
16.8	W3XAL	
19.5+Ex.Tue.,Thur.	W2XAD	
19.7	W8XK	
25.2	W8XK	
25.3+	W2XE	
25.4	I2RO	
25.5 Irregular	DJD	
25.5	GSD	
25.6	FYA	
30.4 Sat.	EAQ	
31.2	W3XAU	
31.3+	W1XAZ	
31.3+	DJA	
31.5+	GSB	
32.3 Sun.	RABAT	
45.3+ (chimes)	REN	
48.8+	W8XK	
49.1+ Except Sat.	W9XF	
49.2 Sat., Sun.	VE9GW	
49.3 Sun.	W9XAA	
49.4+	W8XAL	
49.5 Temporary	OXY	
49.6+ Sun.	W1XAL	
49.9+	VE9DR	
50.0	RV59	
4 P. M. Eastern Standard Time		**Local Time**
25.2	W8XK	
25.3+	W2XE	
25.4	I2RO	
25.5	GSD	
25.5	DJD	
25.6	FYA	
31.2	W3XAU	
31.2+ Tues., Fri.	CT1AA	
31.3+	W1XAZ	
31.3+	DJA	
31.5	GSB	
49.5 Temporary	OXY	
32.3 Sun.	RABAT	
46.7 Irregular	W3XL	
48.8+	W8XK	
49.1+	YV1BC	
49.1+ Sat.	W3XAL	
49.1 Except Sat.	W9XF	
49.2 Fri., Sun	VE9GW	
49.3+ Sun.	W9XAA	
49.4+	W8XAL	
49.9+	VE9DR	
50.0	RV59	
5 P. M. Eastern Standard Time		**Local Time**
19.8	HVJ	
25.2	W8XK	
25.3+	W2XE	
25.4	I2RO	
26.8+ Tues., Thurs.	CT3AQ	
30.4	EAQ	
31.0	T14NRH	
31.2+	W3XAU	
31.2+ Tues., Fri.	CT1AA	
31.3 Sun.	HBL	
31.3+	W1XAZ	
31.3+	DJA	
32.3	RABAT	
38.4+ Sun.	HBP	
46.7 Irregular	W3XL	
48.8+	W8XK	
49.0	W2XE	
49.1+	YV1BC	
49.1+ Sat.	W3XAL	
49.1+ Except Sat.	W9XF	
49.2 Fri., Sun.	VE9GW	
49.3+ Sun.	W9XAA	

49.4+	W8XAL	.....
49.5 Temporary	OXY	.....
49.8	DJC	.....
49.9	VE9DR	.....
50.0	RV59	.....
50.6 Irregular	HJ4ABE	.....
6 P. M. Eastern Standard Time....Local Time		
25.2	W8XK	.....
25.6	FYA	.....
25.6 Tues., Fri.	VE9JR	.....
26.8+ Tues., Thurs.	CT3AQ	.....
30.4	EAQ	.....
31.0	TI4NPH	.....
31.2+ Tues.. Fri.	CT1AA	.....
31.3+	W1XAZ	.....
31.3+	DJA	.....
31.4+	W2XAF	.....
31.5	GSB	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.1+	YV1BC	.....
49.1+ Sat.	W3XAL	.....
49.1+ Except Sat., Sun.	W9XF	.....
49.2	VE9GW	.....
49.4+	W8XAL	.....
49.3+ Sun.	W9XAA	.....
49.5 Temporary	OXY	.....
49.6	GSA	.....
49.8	DJC	.....
49.9+	VE9DR	.....
50.6 Irregular	HJ4ABE	.....
7 P. M. Eastern Standard Time....Local Time		
25.	W8XK	.....
25.6 Tues., Fri.	VE9JR	.....
25.6	FYA	.....
31.3+	W1XAZ	.....
31.3 regular	DJA	.....
31.4+	W2XAF	.....
31.5	GSB	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.1+	YV1BC	.....
49.1+ Sat.	W3XAL	.....
49.2	VE9GW	.....
49.3+ Sun	W9XAA	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.6	GSA	.....
49.8	DJC	.....
49.9+	VE9DR	.....
50.6 Irregular	HJ4ABE	.....
8 P. M. Eastern Standard Time....Local Time		
25.2	W8XK	.....
25.6	FYA	.....
25.6 Tues., Fri.	VE9JR	.....
31.3+	W1XAZ	.....
31.4+	W2XAF	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.1+	YV1BC	.....
49.1+ Sat.	W3XAL	.....
49.1 Except Sat.	W9XF	.....
49.3+ Sun.	W9XAA	.....
49.2 Fri., Sun.	VE9GW	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.8	DJC	.....
49.9+	VE9DR	.....
50.5	HJ1ABB	.....
50.6	HJ4ABE	.....
51.0	HJ2ABA	.....
9 P. M. Eastern Standard Time....Local Time		
31.0	T 4NRH	.....
31.3+	W1XAZ	.....
31.4+	W2XAF	.....
45.3 Thurs.	PRADO	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.1+	YV1BC	.....
49.1+ Sat.	W3XAL	.....
49.1+ Except Sat.	W9XF	.....
49.2 Fri., Sun.	VE9GW	.....
49.3+ Sun.	W9XAA	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.9+	VE9DR	.....
50.5	HJ1ABB	.....
50.6 Irregular	HJ4ABE	.....
51.0	HJ2ABA	.....
10 P. M. Eastern Standard Time....Local Time		
31.0	TI4NRH	.....
31.3+	W1XAZ	.....
31.4+	W2XAF	.....
45.3 Thurs.	PRADO	.....
45.0 Fri.	TGW	.....
48.8+	W8XK	.....
49.0	W2XE	.....
49.1+ Sat.	W3XAL	.....
49.1+ Except Sat.	W9XF	.....
49.2 Fri., Sun.	VE9GW	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.9+	VE9DR	.....
11 P. M. Eastern Standard Time....Local Time		
31.3+	W1XAZ	.....
45.0 Fri.	TGW	.....
48.8+	W8XK	.....
49.1+ Sat.	W3XAL	.....
49.1 Except Sat.	W9XF	.....
49.2 Fri.	VE9GW	.....
49.4+	W8XAL	.....
49.5	W3XAU	.....
49.9+	VE9DR	.....

Station Locations

Wavelengths in Meters	Call Letters	City Country
13.9+	W8XK	Pittsburgh, Pa.
16.8+	W3XAL	Bound Brook, N. J.
16.8+	PHI	Huizen, Holland
19.5	W2XAD	Schenectady, N. Y.
19.6	FYA	Pontoise, France
19.6+	W2XE	New York, N. Y.
19.7	W8XK	Pittsburgh, Pa.
19.7	DJB	Zeesen, Germany
19.8	GSF	Daventry, England
19.8	HVJ	Vatican City
23.3		Rabat, Morocco
25.2	FYA	Pontoise, France
25.2	W8XK	Pittsburgh, Pa.
25.3	GSE	Daventry, England
25.3+	W2XE	New York, N. Y.
25.4	I2RO	Rome, Italy
25.5	GSD	Daventry, England
25.5	DJD	Zeesen, Germany
25.6	FYA	Pontoise, France
25.6	VE9JR	Winnipeg, Canada
26.8+	CT3AQ	Funchal, Madeira
30.4	EAQ	Madrid, Spain

Short-Wave DX Listeners, Attention!

IN this fifth installment of this department we can state that the response has been more than sufficient to make it a regular feature in the magazine. But it is up to you, our short-wave listeners, to co-operate with us in making this service the best of its kind in the world!

Every one of you can help to make it more and more perfect by keeping a log of stations you receive on the short waves, noting the call letters, the time the station is on the air, the wavelength or frequency and any other identifying parts of the program, such as announcements, station signals, etc. If our readers, individually, will keep such a log and send them in to the DX Editor, care of RADIO NEWS, they will be of great help at our stations to check up on transmissions. Or if you get any letters from the short-wave stations themselves giving their programs, you may forward a copy of it to the DX Editor. Every letter will be acknowledged, although at present we are behind on this work. During the month of July RADIO NEWS is to select a number of proficient RADIO NEWS listening posts from amongst its readers who respond to this request and who show their ability in keeping a several months' accurate log of stations. These will be chosen from the many thousands of short-wave listeners who have already co-operated in this way. The listeners obtaining appointments will receive an official letter from RADIO NEWS, indicating their appointment, that will be suitable for framing and hanging on the wall of their stations. We expect to appoint one official listener in each state, as well as a number of official listeners in strategic locations around the world.

31.0	TI4NRH	Heredia, Costa Rica
31.2+	W3XAU	Philadelphia, Pa.
31.2+	VK2ME	Sydney, Australia
31.2+	CT1AA	Lisbon, Portugal
31.3	HBL	Geneva, Switzerland
31.3	GSC	Daventry, England
31.3+	W1XAZ	Springfield, Mass.
31.3+	DJA	Zeesen, Germany
31.4+	W2XAF	Schenectady, N. Y.
31.5	VK3ME	Melbourne, Australia
31.5	GSB	Daventry, England
32.3		Rabat, Morocco
38.4+	HBP	Geneva, Switzerland
45.0	TGW	Guatemala
45.3	PRADO	Riobamba, Ecuador
45.3+	REN	Moscow, U. S. S. R.
48.8+	W8XK	Pittsburgh, Pa.
49.0	W2XE	New York, N. Y.
49.1+	YV1BC	Caracas, Venezuela
49.1+	W3XAL	Bound Brook, N. J.
49.1+	W9XF	Chicago, Ill.
49.2	VE9GW	Bowmanville, Can.
49.3+	W9XAA	Chicago, Ill.
49.4+	W8XAL	Cincinnati, Ohio
49.5	W3XAU	Philadelphia, Pa.
49.5	OXY	Skamleback, Denmark
49.6	GSA	Daventry, England
49.6+	W1XAL	Boston, Mass.
49.8	DJC	Zeesen, Germany
49.9	VE9BJ	New Brunswick, Can.
49.9+	VE9DR	Montreal, Can.
50.0	RV59	Moscow U.S.S.R.
50.0+	HVJ	Vatican City
50.5	HJ1ABB	Barranquilla, Colombia
50.6+	HJ4ABE	Medellin, Colombia
51.0	HJ2ABA	Tunja. Colombia
70.2	RV15	Khabarovsk, Siberia

Atmospheric Conditions

On the 49-meter band, atmospherics have been quite heavy and bothersome of late, interfering somewhat with DXing for the weaker distant stations. This has been true to a lesser extent on the 25 and 31-meter bands. The 15 and 19-meter bands have not been bothered with static and signals on these frequencies are reported coming in with extra strength.

Schenectady Transmissions

We have received an official communication from the General Electric Company stating that short-wave station W2XAD will be on 19.56 meters Mondays, Wednesdays and Fridays, from 3 to 4 p.m., E.S.T., and on Sundays from 2 to 5 p.m., E.S.T. Short-wave station W2XAF will be on 31.48 meters daily from 6:45 to 10:00 p.m., E.S.T. These are developmental stations and the schedules may be changed or discontinued without notice.

W9XF Transmissions

An official communication from the National Broadcasting Company, Chicago, states that short-wave station W9XF will be on the air Mondays, Tuesdays, Wednesdays, Thursdays and Fridays from 3:30 to 7:00 p.m. and from 8:30 p.m. to 1:00 p.m., E.S.T. On Saturdays there is no schedule. Sundays this station will be on the air from 3:30 to 6:00 p.m. and from 8:00 p.m. to 1:00 a.m., E.S.T.

W3XAU Transmissions

An official communication from the WCAU Broadcasting Company states that shortwave station W3XAU will be on the air on 9590 kc. from 11:00 a.m. to 5:00 p.m. and on 6060 kc. from 7:00 p.m. to midnight, E.S.T. The power used by this station is 1 kilowatt.

W8XK and W1XAZ Transmissions

Short-wave station W8XK will be on the air on 48.86 meters, daily, from 4:30 p.m. to sign off, E.S.T. They will be on the air on 25.27 meters, daily, from 4:30 to 10:00 p.m. They will be on the air at 19.72 meters, daily, from 10:00 a.m. to 4:15 p.m. They are on the air on 13.93 meters, daily, from 7:00 a.m. to 2:00 p.m., E.S.T. W8XK operates in conjunction with and relays the programs of KDKA.

Short-wave station W1XAZ is on the air on 9570 kc. from 7:30 a.m. to 1:00 a.m. the following morning, E.S.T. This station relays programs offered over the long-wave transmitter WBZ-WBZA. As a matter of interest, a new installation is contemplated shortly, during which time the station will be silent. Upon completion of the new station it will assume regular service at its new location, Millis, Massachusetts

VK2ME-VK3ME Transmissions

We have received an official communication from the Amalgamated Wireless (Australasia), Limited, regarding the stations VK2ME and VK3ME. Short-wave station VK3ME will be on the air on 31.54 meters

(*Continued on following page*)

Who Will be the First World's

CHAMPION DX'ER

Radio fans interested in the DX Corner will probably be glad to see this notice of a championship contest which is to begin in August for those who believe they have ability in logging short-wave stations

A SHORT-WAVE "battle of the century," where fans will compete for honors, has just been announced by the International Short-Wave Club. The contest will be held to determine beyond dispute the name of the short-wave listener who can bring in the greatest number of short-wave broadcast stations over a six-month period. Verifications from the various stations will constitute proof of reception.

The fortunate winner will be declared world's champion short-wave listener-in for 1933-1934 and will receive a trophy in the form of a silver globe representing the earth. The winner's name and a record of his achievement will be suitably engraved on the trophy.

The contest is scheduled to begin August 1, 1933, and to terminate February 1, 1934. The judges of the contest will include Laurence M. Cockaday, editor of RADIO NEWS; O. H. Caldwell, former Federal Radio Commissioner and editor; H. G. Cisin, inventor and radio writer; Clifford E. Denton, short-wave designer and author; Arthur J. Green, president of the International Short-Wave Club; Capt. H. Hall, Lt.-Commander, U. S. Navy, retired; Jacob Kleimans, of the International Short-Wave Radio Club; Arthur H. Lynch, originator of the first international broadcasting contest in 1923; Joseph B. Sessions, president Sessions Foundry Company; Joseph G. Reaney.

The following rules have been tentatively adopted for the contest:

1. Any short-wave "listener-in" in any part of the world is eligible to take part in this contest.
2. The prizes will be awarded to the contestants presenting the greatest number of verifications from short-wave broadcast stations. In case of a tie, mileage will be computed and the question of superiority will be decided upon the basis of total number of miles received. This will be the airline distance between the receiver and each of the transmitters. The finding on this question of mileage will be made by the judges.
3. All rulings of the judges are to be final. Only one prize will be awarded to any one winner. Judges will not be permitted to compete in this contest, nor members of their families.
4. The contest begins August 1, 1933, and terminates February 1, 1934.
5. All verifications must be submitted by April 15, 1934. Prizes will be awarded at the earliest possible moment after April 15, 1934, depending upon the amount of work involved in the compilation of the records. The date of the awards will be suitably announced in the press.
6. Judges will assume no responsibility for verifications unless they are listed and receipted for, or sent by registered mail. Verifications must bear post-marks or dates, indicating that the program was received by the contestant between August 1, 1933, and February 1, 1934.
7. Verifications will be accepted for entry into the contest from any part of the world. The verifications and lists must be forwarded to Clifford E. Denton, 23 Park Place, New York, N. Y., accompanied by a self-addressed and stamped envelope or container, together with sufcient postage or international reply coupons to cover return by registered mail. Judges will not be responsible for loss of verifications. All letters and cards of verifications, together with envelopes or other wrappers, should be presented. Stamps should not be removed or postmarks defaced.
8. In cases such as English, Swiss and German stations, where different call letters and wavelengths are used for the same stations, and where the call letters covering the frequency being transmitted are not mentioned on the verification, these will be counted as only one verification. If verification is received for several sets of call letters and several frequencies, then each verification will count as an individual station.
9. No code stations, amateur, aircraft, police, ship or commercial stations will be considered in this contest.
10. Only one verification from each short-wave broadcast station will be allowed.

The silver trophy, constituting the first prize, has been donated by Clifford E. Denton and the contest will be known as the "Denton Trophy Contest." The second prize will be a medal, suitably engraved, stamped or designed. It will bear the name of the winner and will mention the circumstances under which it was awarded. The third prize will be a medal similar to the second prize. Second and third prizes will be awarded by the International Short-Wave Club and its New York Chapter. The fourth to one hundredth awards will consist of engraved scrolls in the form of honorable-mention certificates, suitably inscribed with the name of the winner and calling attention to the excellence of their receiving ability.

In writing to the various short-wave stations for verifications, it is suggested that the listeners-in mention the fact that such verifications are to be used in the "Denton Trophy Contest." The coöperation of the various stations is being arranged for by the Trophy Committee. For a complete set of rules governing this contest, write to Clifford E. Denton, 23 Park Place, New York, N. Y.

The DX Corner

(*Continued from preceding page*)

on Wednesdays from 5:00 to 6:30 a.m., E.S.T., and on Saturdays from 5:00 to 7:00 a.m., E.S.T.

Short-wave station VK2ME will be on the air on 31.28 meters on Sundays from midnight to 2:00 a.m. and from 4:30 to 8:30 a.m. and from 11:30 a.m. to 1:30 p.m., E.S.T., during the month of July. (In Best Bets we have listed them on the air only during the times when they are best heard in America.)

The German Transmitting Stations

An official communication received from Reichspostzentralamt, Berlin, states that the German transmissions are being sent out by two transmitters located at Zeesen. Four wavelengths are used, with a number of antennas. DJB transmits on 19.737 meters from 8:00 a.m. to noon, E.S.T. DJA transmits on 31.38 meters from 12:30 p.m. to 6:30 p.m. and in some cases till 7:30 p.m. These two stations use the same transmitter. The second transmitter works from 10:00 a.m. to 4:00 p.m., E.S.T., on 25.51 meters with the call letters DJD, and from 5:00 p.m. to 9:00 p.m. on 49.83 meters under the call letters of DJC. The antenna output is 5 kilowatts, the percentage of modulation is 70%. Every day at 10:00 a.m. the program for the following day on 19.737 and 25.51 meters is given in the German and English languages.

Short Waves at Binghamton, N. Y.

Mr. I. H. Kattell reports reception on an all-wave Bosch model 260C receiver as follows: 96 short-wave broadcasting stations from 15 to 175 meters. He has verifications from VK2ME, VK3ME, I2RO, FYA, GSA, GSB, GSD, GSF, EAQ, DJA, DJB, DJC, VE9JR, etc.

Best Reception in Honolulu

Mr. O. F. Sternemann reports that he gets W8XK on 19 meters from 7:30 to 8:30 a.m., on 25 meters from 2:00 to 4:30 p.m. and on 48 meters from 3:30 to 7:30 p.m., Honolulu time. The other stations he receives best are W3XAL, W9XF, W1XAL, W2XAF, W1XAZ, W2XE, RV15, KWO, W9XAA, W3XAU, W4XB, VK2ME. On the long waves he has received some eighty odd stations, including Australia, Japan, China and the United States. He has heard, on these waves, the Eastern American stations WHAM, WTIC, WCAU, WBT, WSM, WABC and KDKA. Mr. Sternemann uses an RCA-Victor 18-A with a Silvertone four-tube, short-wave converter.

Reception in Mississippi

Dr. J. P. Watson, of Hazlehurst, sends the following information: "At the present time in South Mississippi, short-wave fans will receive greatest satisfaction on frequencies of 19.6 meters, Pontoise, France; 25.3 meters, Daventry, England; 30.4 meters, EAQ; 31.3 meters, GSD., and many stations between 48 and 50 meters. I am using a ten-tube all-wave, 12 to 550-meter superheterodyne, No. 1020, made by Ozarka."

Best Reception in Ohio

Mr. Louis Du Bois, of Yorkville, Ohio, reports the following best bets: VK3ME, VK2ME, EAQ, FYA, GSA, GSC, YV1BC,

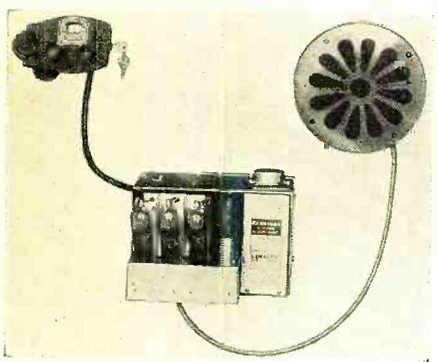
(*Continued on page* 125)

What's New IN AUTOMOBILE RADIO

With summer and the vacation touring season upon us, a multitude of car owners are contemplating radio installations. Brief descriptive data is given here on a number of the newest models, showing important new developments

Self-Contained Auto Radio with Class B Output

Description—Announcement is made of the new Audiola Model S7, seven-tube superheterodyne automobile radio receiver. The single metal container, measuring 10¼ inches by 7¾ inches by 6½ inches, houses both the receiver chassis and B power supply. The receiver is so designed as to eliminate the



necessity of spark-plug suppressors. The set features convenience of installation, Class B amplification, automatic volume control and a Jensen 8-inch size dynamic type speaker. The following type tubes are used: two –6D6, one –6C6, one –37, one Wunderlich, one –79 and one BR type rectifier. The steering-column remote-control unit is of the gear-driven type.

Maker—Audiola Radio Co., 430 So. Green St., Chicago, Ill.

Single-Unit Receiver

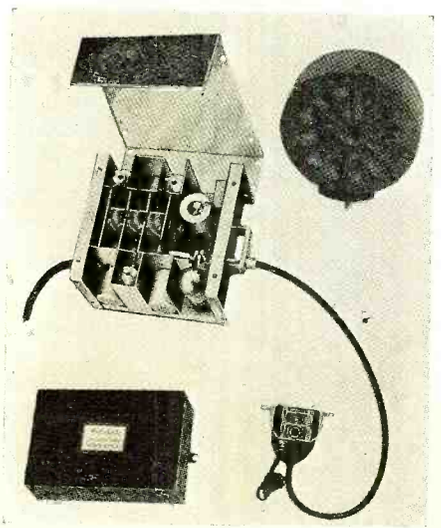
Description—The illustration covers the Wells-Gardner Model Z6Z1 six-tube superheterodyne automobile radio receiver. This new receiver is attractively designed and is made for universal application to all types of motor cars. It features direct control, dynamic type speaker and automatic volume

control.. The receiver chassis, B power supply, reproducer and controls are all enclosed in a single metal container which measures 12 inches by 6¼ inches by 5½ inches. The following type tubes are utilized: one –77 as combined detector and oscillator, two –78 for the r.f. and i.f. stages, one –75 for the second detector and first audio stage, one –41 for the output power stage and one –84 type rectifier. A steering-column, remote-control unit can be supplied where desired. The net weight of this receiver is 18 pounds.

Maker—Wells-Gardner & Co., 816 N. Kedzie Ave., Chicago, Ill.

Single Knob Control

Description—The Motovox Model 10A is a five-tube motor-car receiver of the superheterodyne type. It is designed for simplicity of operation and ease of installation. The B power supply is contained in a separate container to lessen the possibility of hum. This compact receiver is sturdily constructed and features automatic volume control, a dynamic type speaker and single-knob control. The manufacturer calls attention to the economical operation of the set. The chassis may be mounted in any convenient location and it is only necessary to drill a ⅜-inch hole to accommodate the single bolt for mounting the speaker. The tuning unit is designed for fastening to the instrument board. The single knob on the

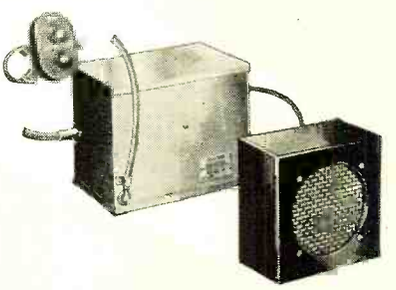


control unit turns to the right or left for selecting stations and pulls out or pushes in for controlling volume. The receiver employs the following tubes: three –36 type for combined first detector and oscillator circuit and for the r.f. and i.f. stages respectively. One –85 type combines the functions of second detector and automatic volume control tube, and one –41 type is used in the power output stage. This company also announces the model 10E battery-operated receiver, a five-tube tuned r.f. circuit using four –36 and one –41 type tubes. Both the electric and battery-operated sets are furnished with 6 spark-plug suppressors and 2 condensers for eliminating car ignition noise.

Maker—MotoMeter Gauge & Equipment Corp., Toledo, Ohio.

Compact Design

Description—The new Sparton Model 33 auto radio receiver is combined with the B eliminator in a metal container measuring only 9⅜ inches by 7⅝ inches by 5⅜ inches. The electrodynamic speaker is housed in a wooden cabinet and is designed to be operated at full volume without loss of tone quality. This compact receiver features easy installation, economical operation and undistorted reception. The cover of the receiver chassis can be easily removed for checking

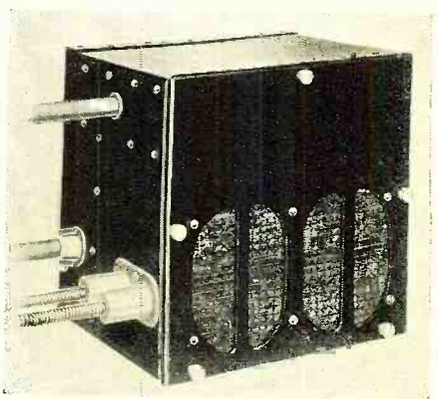


tubes or adjusting circuits. The manufacturer calls attention to the counterbalanced tuning condensers, which prevents detuning. The six-tube superheterodyne circuit utilizes the following type tubes: two –39 pentodes as r.f. amplifiers, one –36 type as detector and oscillator, one –85 as second detector, automatic volume control and audio amplifier, one –41 type for output power stage and one –84 full-wave vacuum type rectifier. The remote-control tuning unit which mounts on the steering column is calibrated in kilocycles, permitting easy selection of stations.

Maker—Sparks-Withington Co., Jackson, Mich.

Compact Automobile Receiver

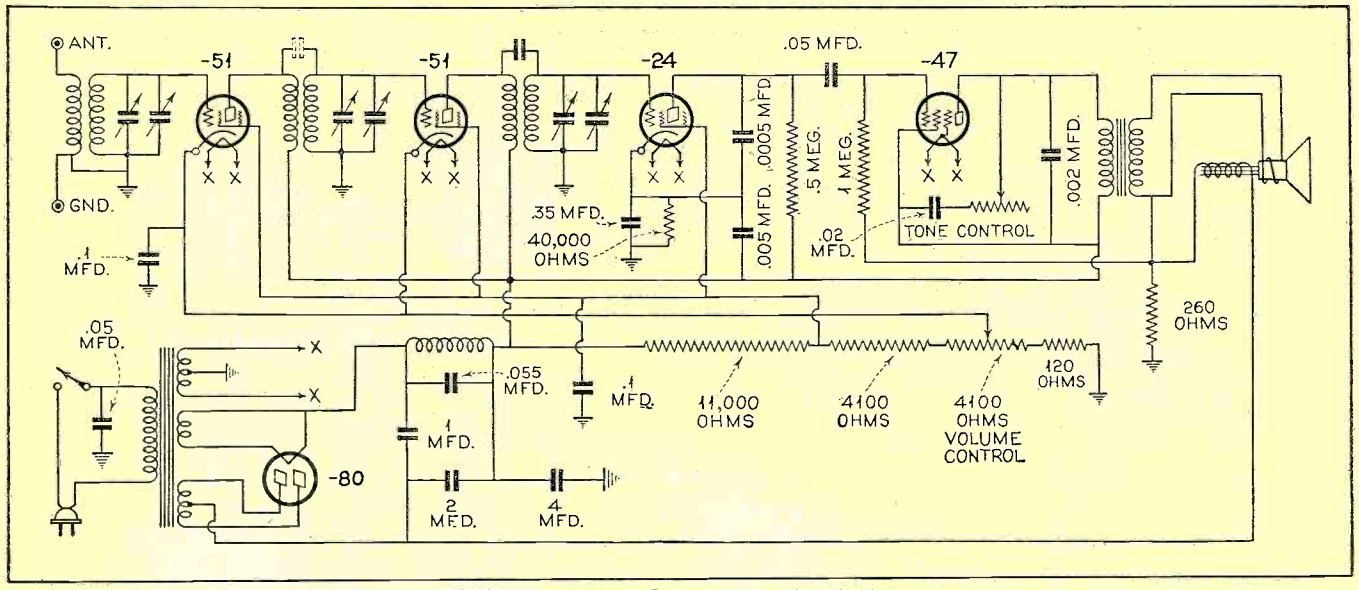
Description—The American Bosch Model 150 automobile six-tube receiver measures only 9⅛ inches wide by 8 15/16 inches high by 7⅛ inches deep. The receiver chassis, B



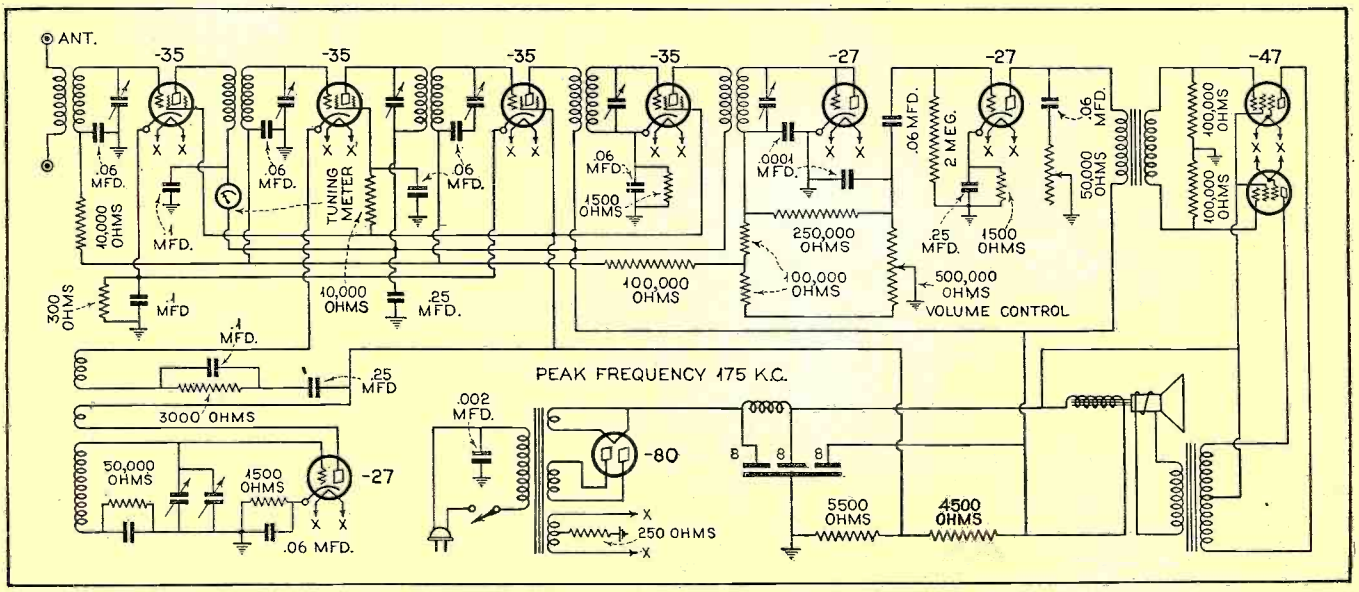
battery eliminator and dynamic type speaker are all housed in the one container. The set is tuned from an attractive instrument board control unit which is connected to the set by two flexible cables. This control unit is calibrated in kilocycles and the figures are large, therefore easily read. Both

(*Continued on page* 121)

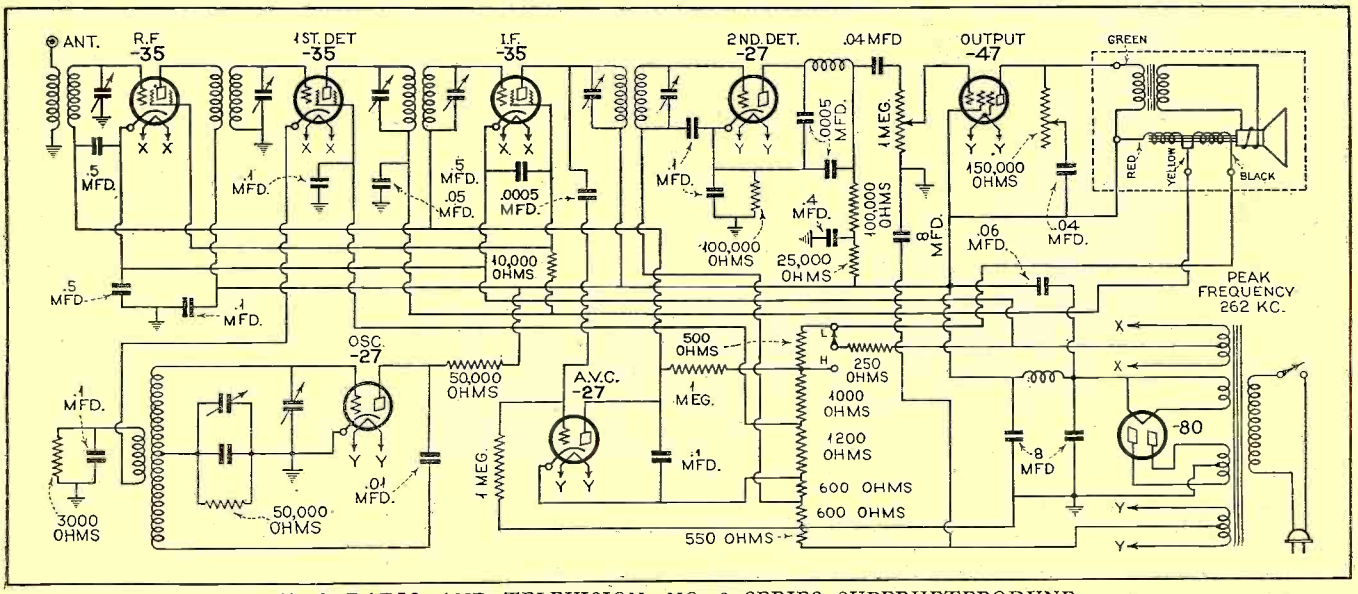
Service Data for Servicemen



COLUMBIA PHONOGRAPH CO., MODEL 31-33



COLIN B. KENNEDY, MODEL 62 SUPERHETERODYNE (A. V. C.)



U. S. RADIO AND TELEVISION, NO. 8 SERIES SUPERHETERODYNE

Compiled from J. F. Rider's Perpetual Trouble Shooter's Manual.

Technical Review

RADIO SCIENCE ABSTRACTS

Radio engineers, laboratory and research workers will find this department helpful in reviewing important current radio literature, books, Institute and Club proceedings and free technical booklets

Conducted by

Joseph Calcaterra

Principles of Radio Communication, by J. H. Morecroft. Third Edition. John Wiley and Sons, Inc., 1933. Radio's progress during the last five years has called for a thorough revision of Prof. Morecroft's famous book. Some of the old text on spark telegraphy has been deleted, while considerable new material has been introduced dealing with later developments. Sections on microphones, crystal oscillators, short waves, etc., will be especially valuable to the radio engineer.

The first chapters contain a complete and detailed account of the fundamental theory of electrical circuits, oscillatory circuits, coupling, etc. This part remains about the same as the previous edition, except for the addition of material on electrolytic condensers and shielding. Then follows a general review of radio communication and a chapter on spark telegraphy. Vacuum tubes and their circuits have been treated exhaustively. This chapter alone covers 250 pages. The discussion includes screen-grid tubes, the pentodes, and there is a brief explanation of type -55. Magnetron, dynatron circuits, the Barkhausen oscillators, etc., are among the subjects discussed. The last four chapters are, of course, of the greatest interest to the radio engineer. They deal with continuous-wave telegraphy, radio telephony, antennas, radiation and amplifiers. Systems of modulation are thoroughly treated in Chapter VIII; they include the single side-band transmission and elimination of the carrier current. This chapter also gives information on microphones (carbon, condenser and dynamic) and shows their response for various frequencies. Loudspeaker design is another of the subjects found in this chapter. The last chapter, on amplifiers, gives many valuable pointers concerning the design of receivers.

The treatment is mostly mathematical and restricts itself to the principles involved, since all forms of practical applications could not be covered within such a volume. This does not mean that a reader with a limited knowledge of mathematics could not derive considerable benefit from its study.

Theory of Thermionic Vacuum Tubes, by E. Leon Chaffee. McGraw-Hill Book Co. 1933. At last there has appeared a complete and up-to-date book on vacuum tubes and their circuits, including the multi-element tubes of the present time. There is no doubt but that this text will be welcomed by all radio engineers. Mr. Chaffee's book deals with tubes and circuits of low power, chiefly restricted to receivers and low-power amplifiers. Transmitters and modulation have not been discussed. The introduction contains a historical sketch from 1873 up to the present time. Then the reader is taken through chapters on the structure of matter, conduction of electricity in gases and emission of electrons. The chapter on practical sources of emission treats of the emissive properties of various metals.

Mr. Chaffee devised his own system of letter symbols for the circuit analysis in his book. This is explained in a separate chapter.

There is also an unusually complete account of the triode. The influence of the plate circuit on the grid circuit and vice versa are made clear with the aid of unusual illustrations. Equivalent circuit theorems are derived in Chapter VIII. The circuits of the triode are thoroughly discussed in the next chapters, covering the tube as an amplifier, detector and oscillator with a separate chapter on regeneration. The last part of the book deals with multi-element tubes —the screen-grid tube, the pentode, etc. Theorems are derived which are applicable to tubes of any number of elements.

Radio International, by Ernset A. Pariser. Union Deutscher Verlagsgesellshaft. A dictionary of radio technical terms in five languages: German, English, French, Spanish and Italian. Approximately 90 terms are given; the booklet restricts itself to word roots and does not go into all possible compound words.

The first section contains all terms, alphabetical (in German), with their foreign equivalents behind them. These terms are numbered. Then follow four sections, one each for English, French, Spanish and Italian —which contain alphabetical lists of the terms in these languages. The number behind the term refers to their occurrence—in the first section.

Applications of the Cathode-Ray Oscillograph in Radio Research, by R. A. Watson, J. F. Herd and L. H. Bainbridge Bell. Published by H. M. Stationery Office of the Department of Scientific and Industrial Research (Great Britain). This volume describes the extensive applications of the cathode-ray oscillograph which has been developed in the work of the Department's radio research station at Slough. While not intended as a general textbook either on oscillography generally or on cathode-ray oscillography in particular, the work is a textbook on the use of the device in wireless investigations of practically every kind. Although the book, as a whole, is less concerned with the oscillograph itself than with the applications of it, a brief study of the oscillograph itself is inevitable. Such a study forms the opening of a general introductory part, with a discussion of the technical properties of the modern low or medium voltage sealed-off oscillograph tube. Following this is a chapter devoted to the practical operation and manipulation of the tube.

The second main part of the book is given over to the study of the variation of phenomena with time. Features of this section which are new and interesting comprise methods of synchronizing the time base to the recurrence frequency of the phenomenon under examination, automatic release time sweeps for the delineation of transient phenomena, and time scales giving particularly wide separation of phenomena.

The third part of the book is devoted to details of applications of particular interest in the work of the authors; namely, the recording of atmospherics and the reception of short-duration impulses for the study of the ionized region of the upper atmosphere.

The fourth part of the volume deals with what are described broadly as "voltage comparators," in which two e.m.f.'s are studied for their relative instantaneous amplitude and phase.

The fifth part of the volume is devoted to

entirely novel material. This is based on the use of the oscillograph as a relay device by employing an additional electrode or electrodes within the tube as collectors of the electron beam when the whole or part of it is directed on them. This permits the oscillograph to be used as a relay controlling an external circuit. Other arrangements described use the fluorescent indication of the beam in conjunction with a photo-electric cell for the maintenance of a fixed course.

The last part of the book deals with photographic methods and auxiliary apparatus.

Review of Articles in the May, 1933, Issue of the Proceedings of the Institute of Radio Engineers

On the Collection of Sound in Reverberant Rooms, with Special Reference to the Application of the Ribbon Microphone, by Harry F. Olson. A discussion of the advantages and use of the directional properties of the ribbon microphone in eliminating acoustical shortcomings of studios by discriminating against reverberation effects.

A High-Quality Ribbon Receiver, by Harry F. Olson and Frank Massa. An explanation of the theory and practice involved in the design of a ribbon headphone receiver to produce high-quality reproduction.

Permissible Amplitude Distortion of Speech in an Audio Reproducing System, by Frank Massa. This paper gives the results of a study of the amount of distortion which can be tolerated in an audio-frequency amplifier having a relatively flat frequency-response characteristic from 80 to 14,000 cycles. The effect of distortion on the character of reproduction was observed when the transmission band was cut off at 5000 cycles, 8000 cycles and 14,000 cycles.

Ferro-Inductors and Permeability Tuning, by W. J. Polydoroff. Constructional details of various forms of variable ferro-inductors are given in this article, together with a brief analysis which shows how tuning, by variation of inductance in such manner that L/R of the circuit is kept constant, results in uniform selectivity and amplification throughout the tuning range.

The Spray Shield Tube, by H. W. Parker and F. J. Fox. The advantages in tube construction resulting from the use of a spray shield, formed on the glass tube envelope and the shell of the base of the tube, are discussed in this paper. A historical sketch of the development of the spray shield, its manufacture and its action is also given.

Abstracts of Four Articles Appearing in Electrical Engineering for May, 1933

Transoceanic Communication, by H. H. Beverage, C. W. Hansell and H. O. Peterson. The article reviews the growth of the R.C.A. transoceanic communication system. A brief description is given of the transmitting equipment, the receiving station—including the application of diversity reception—and frequency measuring apparatus.

Neon Tube Characteristics, by R. W. Lohman. A set of oscillograms and explanations are given confirming the studies of voltage and current waves in neon tubes published in a previous issue of Electrical Engineering (Nov., 1932, pages 772-5).

Radio Aids to Air Navigation, by C. F. Green and H. I. Becker. An article on the radio compass and its application in aiding the pilot to steer a straight course (correcting for wind drift). Automatic steering is discussed, also landing, both by means of radio and magnetic compass combined.

Power, Power Factor and Reactive Volt Amperes, by C. L. Fortescue. This paper discusses the relations between power, reactive volt-amperes and power factor for sinusoidal and non-sinusoidal electromotive forces and currents. Vector equations for these relations are derived and polyphase power and reactive volt-amperes are defined. Non-linear circuits are discussed.

Review of Contemporary Literature

The Reproduction of Orchestral Music in Auditory Perspective. Bell Laboratories Record, May, 1933. This article gives a rather detailed discussion which points out the difference between good and perfect reproduction and reports the experiments and demonstrations to determine the effect of auditory perspective on reproduction, and how perfect reproduction could be attained by careful considerations in the design of transmission systems and associated apparatus.

New Radio-Telephone Equipment for Transport Planes, by D. K. Martin. Bell Laboratories Record, May, 1933. This article points out the rapid development in radio equipment and its effect in increasing the safety and efficiency of air service lines.

A Three-Frequency Radio-Telephone Transmitter for Airplanes, by W. C. Tinus. Bell Laboratories Record, May, 1933. A description of the circuits and control methods used to enable quick changeover, without tuning adjustments, in the special airplane transmitters to any of the three frequencies used in airplane communication.

A Crystal Control Superheterodyne Receiver, by H. B. Fischer. Bell Laboratories Record, May, 1933. A description, with simplified circuit diagram of the new Western Electric 12A receiver designed for airplane use, together with a discussion of the factors which must be taken into consideration in the design of an efficient airplane receiver.

The Simplification of Accurate Measurement of Radio Frequency, by W. H. F. Griffiths. The Wireless Engineer and Experimental Wireless, May, 1933. The historical development of radio-frequency measuring instruments is traced in this article and complete information is given on the latest type of a stable oscillating wavemeter, having a range of from 150 to 10,000 meters which may be extended down to 30 meters, if desired. Performance curves of the instrument are given. Calibration of the meter is independent of tube-characteristic variations of replacement tubes.

Automatic Volume Control for Radio Receivers, by C. B. Fisher. The Wireless Engineer and Experimental Wireless, May, 1933. A discussion of the value of automatic volume control for receivers and a description of developments in such circuits up to the present time.

A Wavemeter with Alternative Close and Open Scales. The Wireless Engineer and Experimental Wireless, May, 1933. A description of an absorption wavemeter which can be used either with a wide frequency range or with a restricted frequency range and correspondingly greater openness of scale. The use of wavemeters in connection with receivers is described.

The Measurement of the Power Factor and Capacitance of a Condenser by Comparison with a Mutual Inductance, by Arthur Whitmore Smith. The Review of Scientific Instruments, May, 1933. In the method described in this article, a capacitance is compared with a mutual inductance in a 1000-cycle a.c. network, and the capacity can be determined very accurately. By observing certain conditions, the value of power factor can be read directly.

Perfect Quality and Auditory Perspective in the Transmission and Reproduction of Music, by Dr. Frank B. Jewett, Science. An account of the experiment recently conducted by the Bell Telephone Laboratories, when the music of the Philadelphia orchestra was transmitted by wire to Washington and reproduced with better quality than ever before. Three different communication channels provided auditory perspective; the volume range was for the first time greater than that of the orchestra itself.

Radio and Forest Fires, by F. V. Horton. The Military Engineer, May-June, 1933. A non-technical discussion of a very light and fool-proof portable receiver and transmitter which has proven successful in combating forest fires.

Photoelectric Color Measuring Instruments, by Herbert Neustadt, Jr. Electronics, May, 1933. A description of photoelectric color analyzers and color comparators by means of which colors can be analyzed and compared with greater accuracy and economy and without the necessity of specially trained operators.

Bridge Type Push-Pull Amplifiers, by Leonard Tulauskas. Electronics, May, 1933. A method of obtaining harmonic cancellation in the output, such as is obtained with push-pull amplification, without using the cumbersome split-secondary input transformers usually used in push-pull stages. The bridge type circuit also lends itself admirably to compact assemblies without introducing any appreciable hum.

Radio Receiver Situation for 1933. Radio Engineering, May, 1933. A survey of the present conditions in the industry with respect to the demand for different types of receivers and the various features which are available or will be in demand in the new crop of receivers.

The Use of Instruments in Radio Receiver Manufacturing, by J. H. Miller. Radio Engineering, May, 1933. This article gives an interesting and valuable exposition of the various testing instruments which should be available in radio receiver manufacturing plants for checking components and performance during various stages of manufacture, together with information on their proper use.

Electrolytic Condensers, by Wm. W. Garstang. Journal of the Institute of Radio Service Men, January-February, 1933. A comparatively simple explanation of the theory, action and use of electrolytic condensers.

Advertising Methods for Servicemen, by J. P. Kennedy. Journal of the Institute of Radio Servicemen, January-February, 1933. This article gives, in interesting, readable form, some important facts which should be taken into consideratidon and followed by servicemen to create a good impression on prospective and present customers in an effort to get and keep profitable business.

Record Keeping for the Serviceman, by Henry A. Fischer. Journal of the Institute of Radio Servicemen, January-February, 1933. This article indicates the need for record keeping as a means of showing income and outgo in doing service work so that a serviceman can determine whether he is making or losing money in his business.

Sample record forms are given.

Getting Quality Performance with Class B Modulation, by Arthur A. Collins. QST, May, 1933. A presentation of practical design and operating data for the best tube combinations, with tables showing the conditions giving the best results.

A Sensitive Tuning Indicator, by J. D. Blitch. QST, May, 1933. A description of a simple, inexpensive, sensitive indicator using a copper-oxide rectifier and a 0-1 d.c. milliammeter in a pick-up coil circuit.

We'll Buy Your Time Paper If— Radio Retailing, May, 1933. A frank discussion of the financing situation as it applies to radio time paper and the steps which must be taken by manufacturers and dealers to produce healthier condition in this necessary method of financing the sale of radio merchandise.

Fixed Resistors, by Jesse Marsten. Radio Retailing, May, 1933. This articles gives information on the characteristics and measurement of noise, voltage coefficient and resistance of fixed resistors. It also brings out the importance of the humidity, load and ageing characteristics of such units.

How to Get Copies of Articles Abstracted in This Department

The abstracts of articles featured in this department are intended to serve as a guide to the most interesting and instructive material appearing in contemporary magazines and reports. These publications may be consulted at most of the larger public libraries, or copies may be ordered direct from the publishers of the magazines mentioned.

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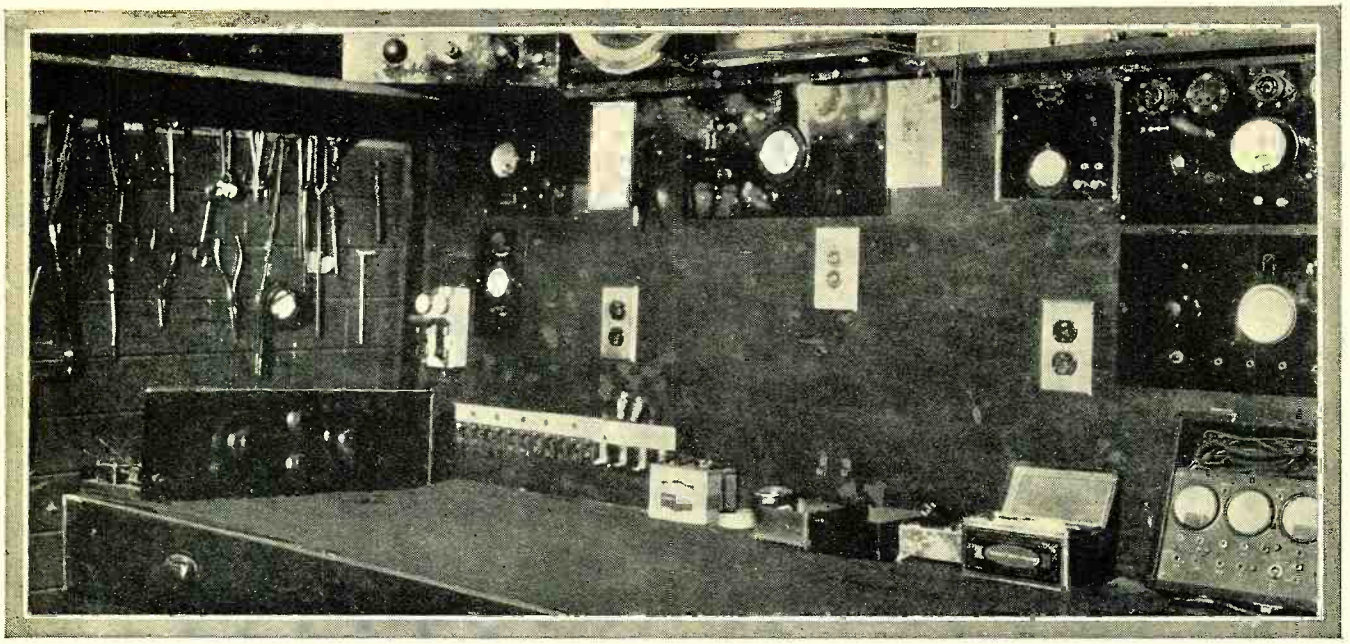
Review of Technical Booklets Available

1. *Radio Parts and Sets 1933 Spring and Summer Catalog No 54.* A catalog of 152 pages, issued by the Wholesale Radio Service

(*Continued on page* 115)



The Service Bench

Mathematics for the Serviceman—Selling Noise-Reduction Antennas—Service Sales Promotion—Service Shops—The Day's Work—Warming-Up Howls—Superhet Adjustments—Kit Kinks—Condenser Speaker Repair—Hum

Conducted by
Zeh Bouck

How Much Math Should the Serviceman Know?

THIS article is written in response to a general question asked by both veteran servicemen and those first considering the possibilities of the radio service business. The beginner necessarily raises the point as he checks off his mental and technical equipment before making a commercial enterprise of what was formerly perhaps only a hobby. The experienced serviceman asks himself the same question when occasionaly he tackles a particularly baffling problem, or, philosophically, wonders whether he is making the most of his profession.

The desired degree of a serviceman's mathematical proficiency is somewhat of a variable factor, depending upon the extent of the individual serviceman's activities and upon his equipment. If the serviceman limits himself to the installation and repair of radio receivers with the readily available standardized parts, and possesses a complete array of oscillators, ohmmeters, resistometers, tube checker, set analyzer and a library of service manuals, the arithmetic he learned in public school will carry him through in flying colors. His knowledge of the parameters associated with vacuum-tube design need be no more intimate than an automobile mechanic's acquaintance with the calculus of stress and strain. Indeed, he need not even be able to manipulate the simple algebra of Ohm's law.

The analogy is an excellent one. The expert auto mechanic possesses a theoretical knowledge of brakes, carburetion, ignition and lubrication which in no way involves mathematical considerations. His skill enables him quickly to diagnose troubles, and to make the adjustments which his experience teaches him will best fulfill the requirements for satisfactory operation. If he replaces a faulty coil in the ignition system with a slightly different type, he will appreciate the necessity for changing the condenser across the points in order to obtain a combination of coil and condenser effecting a minimum of sparking. Similarly, the radio serviceman may replace a grid suppressor resistor with one of a lower value in order to bring up the sensitivity of a receiver. However, he will not choose too low a resistor, for his experience and theoretical knowledge have warned him of resulting instability. All without so much as even adding two and two.

The entire theory of radio (or anything, for that matter) can be told without mathematics. Mathematics is merely a short, concise method of telling what happens to physical things.

So, if the serviceman possesses adequate equipment and experience, he probably can get by if he knows only the simple arithmetic involved in the presentation of his bill!

Such a serviceman, however, will not make the most of his profession. There are few articles written for the serviceman in which mathematics somewhat higher than arithmetic does not appear. To the uninitiate, the hieroglyphics of exponents and radical signs will often discourage the assimilation of the non-mathematical portions of an important article or paper, thus limiting the extent of his theoretical knowledge. This must be compensated by experience (but this is not always possible), which places the non-mathematical serviceman several years behind his competitors who have graduated from the multiplication table class.

Also, the serviceman who has no working knowledge of elementary algebra may have to buy his equipment ready-made at a price many times the cost of designing and making it himself. Current shunts, voltage multipliers and ohmmeters all function in accordance with Ohm's law, and their design involves algebraic equations. Wattage dissipation is a consideration of almost every resistance-controlled circuit and may call for calculations in square root. Parallel resistors and capacitors further complicate the equation with reciprocals.

The comparison betwen the automobile mechanic and the radio serviceman fails in one respect. The line of demarkation between the mechanic and the automotive engineer is sharp, while the difference between the serviceman and the radio engineer is only a matter of degree. As the serviceman increases his theoretical knowledge, as he branches forth more in the closely related electrical sidelines, he becomes more and more of an engineer. P.A. work, for instance, involving the design of attenuation pads, is on a higher enginering level than the simple repair of radio receivers. There is no reason why the radio serviceman should not aspire to an engineer's qualifications. Here, of course, mathematical training of a high order is essential—advanced algebra, trig, plane, solid and analytical geometry and the calculus.

The final product, however, will be an engineer, not a serviceman, and we have deviated from our subject of how much "math" should a *serviceman* know. Let us consider the serviceman who wishes to make the most of his profession—a serviceman who will design and make a good portion of his technical equipment, who desires to derive the greatest possible benefit from technical articles dedicated to servicing and who intends taking full advantage of service sidelines, such as public-address work.

This serviceman need know nothing of the calculus, logarithms, analytical geometry or trigonometry. On the other hand, he should have an intimate working knowledge of simple algebraic equations, reciprocals, roots and powers, and co-ordinate geometry (curves and graphs). He should be able to operate a slide rule for roots and powers, proportions, ratios, conversion to decimals, multiplication and division. He should own preferably a K and E ten-inch polyphase slide rule.

The following brief bibliography will be of use to such a serviceman:

"Mathematics for the Practical Man"—By George Howe. Published by D. Van Nostrand, N. Y. C. Excellent chapters on elementary algebra and co-ordinate geometry.

"Algebra"—J. E. Smith. RADIO NEWS, *February, March, April and May, 1931.*

"The Slide Rule"—By J. E. Smith. RADIO NEWS, *January, 1931.*

"Graphs and Charts"—By John M. Borst. RADIO NEWS, *February, April, May, June and July, 1932.*

SERVICE SALES PROMOTION

Philco recommends a $10.00 installation fee for their new transmission-line antenna system, netting the serviceman a $7.00 profit for a job that should average a little over one hour. Studying the sales angle of noise-reduction antennas, Philco points out the following leads:

Whom to Sell

"1. *Radio Set Customers:* Every customer to whom you have sold a radio set in the past few years is a prospect for the Philco three-purpose antenna system. This is particularly true of those customers who, because of their desire for finer reception, have purchased the more expensive sets.

"2. *Owners of Old Sets:* People who have radio sets two or three years old and who have paid high prices for these sets are excellent prospects. Many of these people realize that their $250.00 radio receiver, purchased a few years ago, is not as good as the average $100.00 radio today, and yet in their minds, they still have a $250.00 set. Perhaps they are not in a position to purchase a new set at the present time, but they *will* buy a new super-antenna system which will afford as good performance on the old set as they might expect from a new radio. When they finally get the new radio, the improved performance will still be proportionately better.

"3. *Set Prospects You Have Failed to Sell:* No doubt you have a number of people on your list to whom you have tried to sell radio sets in the past few months, but for one reason or another they have not yet decided ot buy. Approach these people with the Philco three-purpose antenna system. It will help to re-establish their confidence in you and will afford you an excellent entré for selling them a radio set.

"4. *Those Who Want Better Reception:* Every radio owner wants better radio reception, but there are some radio enthusiasts who demand the best at all times. You can, no doubt, think of at least a half dozen people in a few minutes who would welcome any suggestions for improving their radio reception, both from the standpoint of noise reduction and better quality. Too, the distance fan will buy a system which will get more stations.

"5. *Owners of Two or More Radios:* When you sell a Philco Baby Grand or a Compact as a 'second set,' sell the customer a three-purpose antenna system so that he can operate more than one radio from a single antenna. Sales of this type can also be closed with apartment houses, hotels, schools, office buildings, etc.

How to Sell

"1. *Pick Your Prospects Carefully:* Every radio set owner is a prospect, but it is obvious from the suggestions outlined above that you can employ your time to best advantage by choosing your prospects carefully. Go after those who you know will need and appreciate the system most.

"2. *Talk of New Radio Performance:* The thing which interests your prospect most is better performance. Don't try to sell him a new aerial installation, but sell him a complete new system which affords far superior performance.

"3. *Get People Talking About It:* Every installation you make will give the customer so much better radio performance that he will hasten to tell his friends about it. Be sure that your first installations are for influential people. Their word-of-mouth advertising will sell plenty for you.

"4. *Kill the Inside Aerial Bugaboo:* Explain the fact that an inside aerial will generally pick up more noise for a given volume of music than an outside aerial properly installed. Many radio salesmen and customers are under the impression that a modern radio, because of its extreme sensitivity, does not require a good outside aerial. Why pay a high price for a good radio and then immediately throw away all of the advantages that have been gained—by connecting it to a poor antenna installation? The Philco three-purpose antenna system eliminates noise picked up in the lead-in, and because of its increased reception efficiency, affords an increased ratio of signal volume to noise.

What to Sell

"1. *Noise Reduction:* In practically every city and town location there is a certain amount of noise which the Philco three-purpose antenna system will reduce. Man-made static, particularly in the congested areas, is one of the most detrimental factors to radio reception. The Philco three-purpose antenna system permits good performance in spite of the presence of such interference in the neighborhood.

"2. *Improved Reception:* The system is just as important to the man in the suburbs who is not troubled with interference as it is to the man who lives in a crowded downtown section. Stations which are now heard satisfactorily will be heard even better and with less background noise. More stations will be received than ever before. Once the customer has experienced the thrill of quality of reception, using the Philco three-purpose antenna system, he will never be satisfied to go back to the old system.

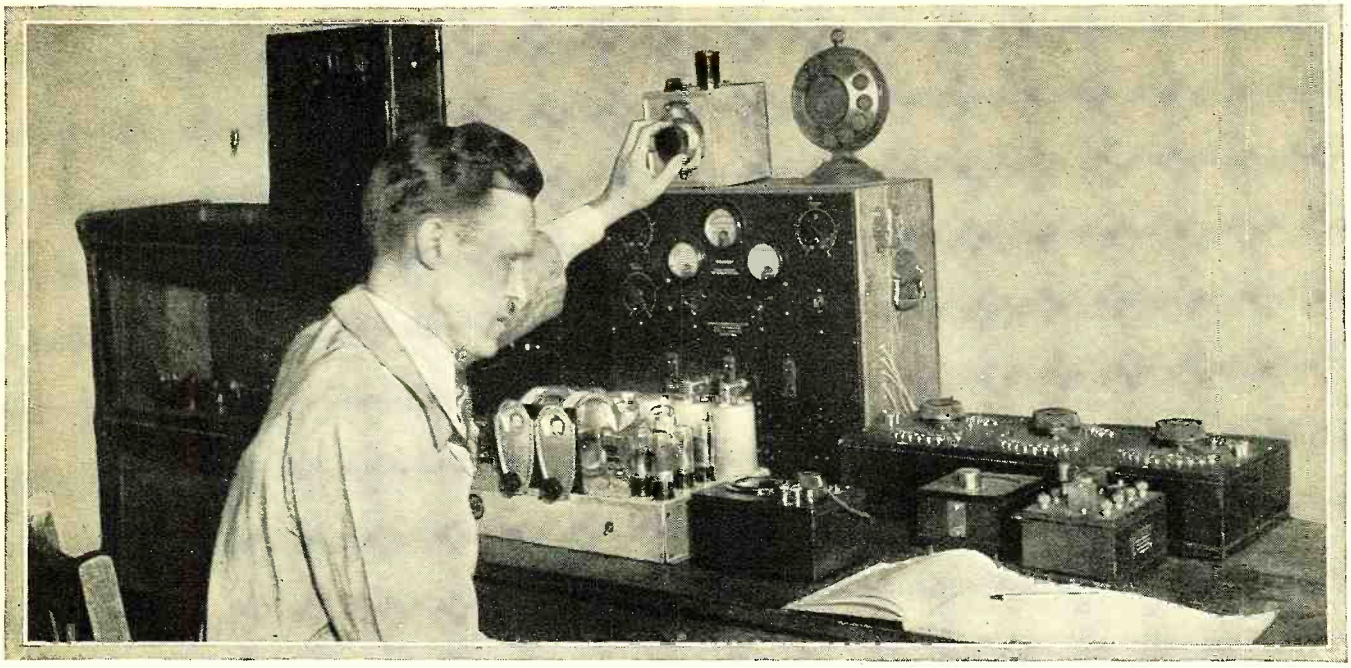
"3. *Multiple Set Operation:* When operating from two to four radio sets from a single antenna, the Philco three-purpose antenna system will give perfect performance on each set without causing interference of one set with another. The losses which are usually experienced in an installation of this kind because of the long lead-in to one or another of the sets are entirely eliminated with the use of the Philco system."

The same general sales arguments can, of course, be applied to other noise-reduction antenna systems, such as Lynch, Tobe, Akraformer, etc. The Philco arrangement, however, looks like an excellent bet for the serviceman. A particular feature not stressed by the manufacturer is the fact that it is so designed as to permit pick-up by that portion of the down lead which is outside of the interference area, thus making it unnecessary to erect an extra-long horizontal aerial to compensate the loss of lead-in pick-up usually experienced with noise-reduction systems.

THIS MONTH'S SERVICE SHOPS

Our lead photo shows a view of the service shop operated by Wilkinson and Son of Unity, Sask., Canada. Located in a section largely rural, specialization in battery type receivers is a feature of this organization, and the usual test equipment is augmented by additional apparatus and potentials facilitating service on such receivers. Appreciating the psychological value of a neat display, the shelves in the stock room, as will

(*Continued on page* 127)



With the Experimenters

Home-made Magnetizing Equipment, New Ultra-Short-Wave Tube, Simple Modulated Oscillator, Home-made Test Adapter, Noise Control for Receivers, Soldering Iron Rest and Cleaner, Inexpensive Test Clips

Conducted by
S. Gordon Taylor

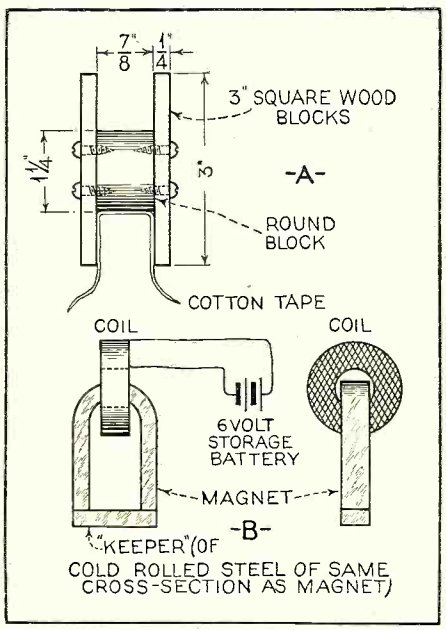
Magnetizing Coil for Permanent Magnets

In constructing a ribbon (velocity) microphone of the permanent-magnet type, it is imperative that the magnets be magnetized to saturation, otherwise the microphone will provide an extremely low output. Where magnets are purchased as part of a kit intended for this purpose, the manufacturer ships the magnets fully saturated and ready for use, and packs them carefully to insure their reaching the consumer in that condition. But where magnets are picked up at a bargain counter it is highly probable that they have lost part of their original strength in knocking around. In this latter case, they should be magnetized before assembling the microphone.

Magneto service stations are equipped to do this, at a cost of a few cents. However, if there is no such service station handy, it is a simple matter to construct a charging coil for the purpose. Such a coil is illustrated herewith. It consists of 196 turns of No. 16 d.c.c. copper wire wound in 14 layers of 14 turns each, and requires one pound of this wire. The most convenient method is to make a winding form as shown at (a).

After making form, first wind two layers of wrapping paper, ⅞ inch wide, over the wood core. Next place several 8-inch strips of ½-inch cotton tape in the trough of the form, temporarily fastening them to the walls with a little mucilage if necessary. Then wind on the wire. After the 196 turns are in place, the cotton tapes are tightly tied to hold the coil in its proper shape. Finally, the end pieces of the form are detached from the core and removed. The core is likewise removed, together with the paper which was wound over it. The coil is now completed, ready for use. If desired, an additional binding of cotton tape or friction tape may be placed on it for greater security.

To charge a magnet, first procure a piece of cold rolled steel of the same cross-section as the magnet. Slip the coil over one leg of the magnet [it may be placed anywhere on either leg, not necessarily in the bow, as shown at (b)], then bridge the piece of steel across the open end of the magnet. The purpose of this is to complete the path for the charging flux. Finally connect the two ends of the coil winding to the terminals of a 6-volt storage battery. The battery need not be left connected more than a second, as the magnetizing process is instantaneous. The current drain on the battery is approximately 12 amperes, a drain which is well within the limitations of any radio or automobile storage battery.



Such a magnetizing coil as described here will be found adequate to saturate all types of small permanent magnets, including the magnets of magnetic type speakers, etc. For that reason it will prove to be a most useful addition to the equipment of any service or experimental shop.

L. H. WADSWORTH,
New York City.

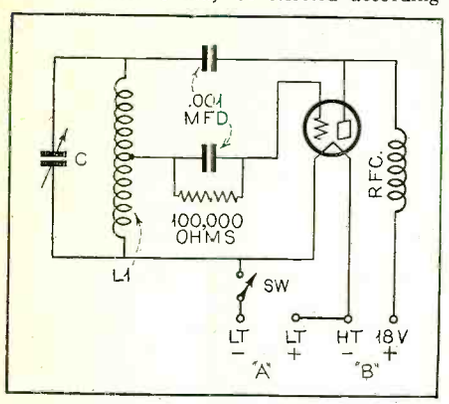
New Ultra-Short-Wave Tube

The short-wave and ultra-short-wave experimenter will be interested in a new tube recently developed and marketed by the Triad Company. This is known as the "Triad type 30 Special" and is said to offer considerable advantage for short-wave work and particularly for ultra-short-wave work —both transmission and reception. It is in many respects similar to the standard -30 type tube except that the inter-electrode capacity has been considerably reduced through wider spacing of the wires in the glass stem and through bringing the plate lead out at the top of the tube rather than at the base. In addition to this decreased capacity, the wider spacing of the wires in the glass stem aids in reducing losses.

Modulated R.F. Oscillator

Having seen in your columns a number of circuits using audio transformers to modulate r.f. oscillators, I thought some of your readers would be interested in the accompanying diagram of an oscillator which I am using. This dispenses with the audio transformers, and the oscillator is made self-

modulating by means of properly selected values of grid leak and condenser. The circuit is self-explanatory. The coil L1 and the condenser C may be selected according

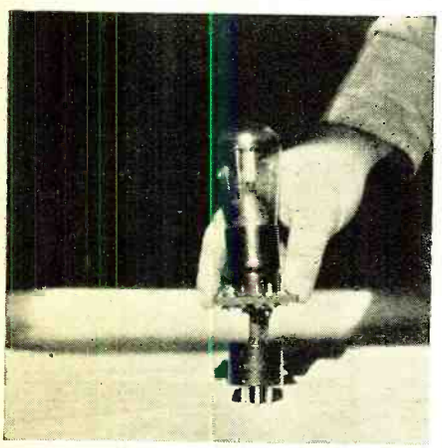


to the frequency range to be covered. The audio pitch can be varied by substituting different values for the grid leak. Higher values will provide a lower note, while lower resistor values will raise the pitch.

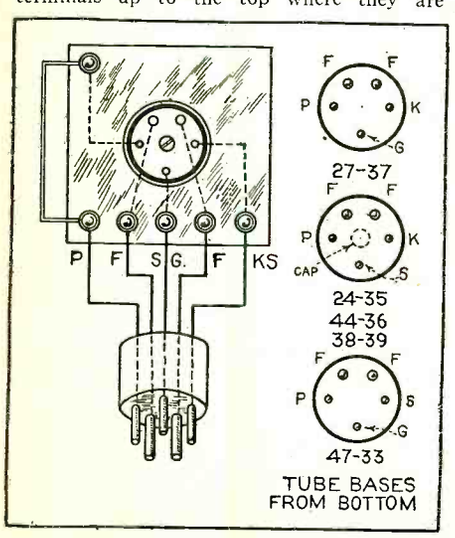
P. MIDDLETON,
Doncaster, Yorks, England.

Test Adapter

Most radio troubles can be located by checking the various voltages at the tube base. However, as the modern radios have the socket terminals underneath the chassis,

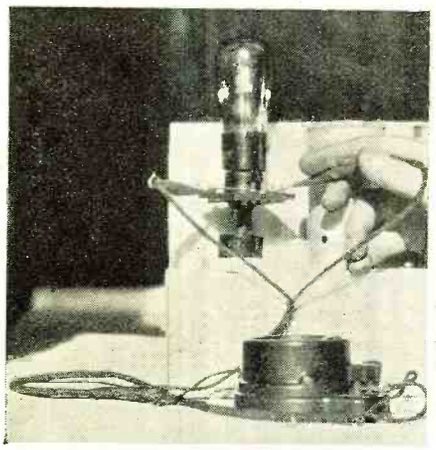


it makes it troublesome to make any tests. The adapter shown serves to bring all the terminals up to the top where they are



plainly marked. With all the terminals in a row on top, the filament, plate, or any of the grid voltages may be easily tested. An opening, which may be shorted, is left in the plate circuit to test the plate current, etc.

The adapter is made of an old U Y 227 base (or a four- or six-prong base) which is used as the plug. This is fastened by a ¼-inch bushing 2½ inches long to a 2 inch by 2½ inch panel and socket as shown in the picture. Five machine screws and nuts are used to bring the terminals on the top. The sixth one is connected with a wire to the plate terminal and if this wire is removed it provides a convenient place to connect a



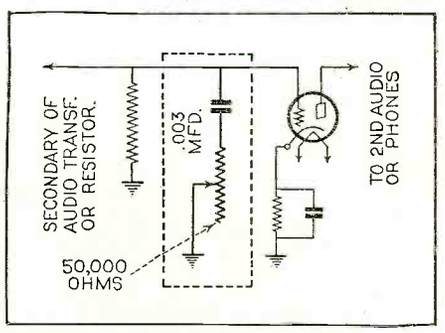
milliammeter in series with the plate circuit. The terminals were marked with white ink; two of which have two certain letters corresponding to the elements in the different tubes as shown in the picture.

Besides testing all the voltage readings at the tube base and the plate current the adapter may also be used to connect a pair of phones in any of the audio circuits, or to connect in another loud speaker.

GEORGE JOHNSON,
Brooklyn, N. Y.

Noise Control for S.W. Sets

I found a noise control consisting of an .003 mfd. condenser and 50,000 ohm variable resistor indispensible on my short-wave set. It minimizes QRM (interference) and heterodyne frequency whistles caused by two sta-



tions operating too close to the same frequency; also background noises of the receiver are greatly reduced. True some volume is sacrificed when the tone control is set for "deep" but this drop in volume is compensated for by clear signals.

ALLEN D. RICKERT, JR.
Souderton, Pa.

Soldering Iron Support and Cleaner

A convenient arrangement of a support for use with an electric soldering iron is illustrated in the accompanying sketch. A piece of half-inch hardwood, about six-inches wide by a foot long, has a layer of thick asbestos cloth fastened to its top. Near one end of the board, a wooden-handled wire brush, which can be secured at any dime store, is

(*Continued on page* 124)

Radio Physics Course

LESSON TWENTY—ELECTROMAGNETS

By Alfred A. Ghirardi

IF a bar of iron or some other magnetic substance is placed in a coil of wire when a current is flowing, as shown at (A) of Figure 1, the iron becomes magnetized. This forms what is called an *electromagnet*. When the iron is magnetized, the orbits of the rotating electrons are turned around until their own magnetic fields are in the same direction as the field produced by the current in the winding. Needless to say, the addition of all of these fields of the atoms to the external field produced by the current in the coil alone, greatly strengthens the total field. We are really calling in the aid of the atomic currents—ready-made currents which only require turning around—to obtain the powerful magnetic fields which electromagnetic fields can be designed to produce. Thus, the magnetic core greatly strengthens the magnetic field. This may be explained as follows: When the magnetizing force is removed, most of the electron orbits remain in their new positions, being held there by their mutual attractions. In this case, we have "residual magnetism." If the iron is struck a sharp blow, the mechanical disturbance makes the electron orbits swing back to their haphazard arrangement. In hard steel, tungsten steel, cobalt steel, etc., considerable residual magnetism remains, even when the external magnetizing force is reversed, until the reversing field acquires considerable strength (coercive force). This indicates that in hard steel, the electron orbits are so large, or so close together, that when they are once in line a considerable force is required to turn them back to their former haphazard arrangement.

Kinds of Electromagnets

Electromagnets are made in different shapes according to the uses for which they are designed. A straight *bar electromagnet* is shown in (A) of Figure 1. At (B), a simple *horseshoe electromagnet* is shown. This is the form usually employed in earphones and other sensitive electromagnetic devices, due to the fact that the magnetizing force is applied mostly to iron, thus turning many electron orbits around and obtaining the additional strength created by the many electronic fields. Only a small air gap is in the magnetic circuit. It would be mechanically inconvenient to wind coils of wire on the ends of a U-shaped core. Therefore the two coils of horseshoe electromagnets are usually wound separately on spools which are slipped over the cores. The coils are both wound in the same direction for manufacturing convenience, and are then connected together as shown, so that the current will flow through them in opposite directions and produce the proper sequence of magnetic poles shown. The cores are then attached to the ends of a bar of soft iron called the *yoke* to present a good magnetic path.

Where a very strong field is desired, the special *ironclad* form of horseshoe electromagnet is used. This is the type employed in lifting electromagnets used to pick up scrap iron and steel, steel rails, etc. It also is used in telephone switchboard apparatus and for the field magnets of electrodynamic loudspeakers in radio receivers, where a very intense magnetic field is required in the air gap in which the voice-coil moves.

An electrodynamic speaker field is shown at (C) of Figure 1. The coil is wound on a short, straight, round, silicon steel core, and this is bolted to the center of a round enclosing shell-shaped casting of steel. When the current is sent through the coil, lines of force from the inner end of the core extend through around the steel to the edges of this housing, then through the short circular air-gap to the core again. The outside shell of the core also forms a protective housing for the winding. Notice that this construction provides a very good magnetic path of large cross-section area. As we shall now see, the strength of an electromagnet depends not only on the ampere-turns, but also on the magnetic qualities (permeability) of the material used for the core, and on the length and cross-section area of the magnetic path.

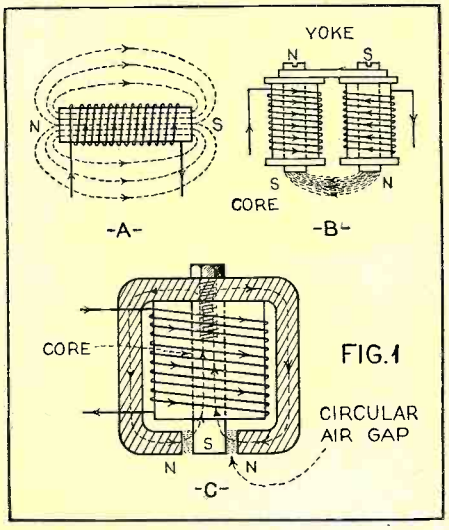


Fig. 1. Three different forms of electromagnets: (A) A straight bar electromagnet. (B) A form of horseshoe electromagnet. (C) An iron-clad electromagnet (coil completely enclosed by iron)

The magnetic polarity of electromagnets is found by the same right-hand rule as used for solenoids.

Electromagnets of the horseshoe type are used extensively for strongly magnetizing horseshoe permanent magnets. The permanent magnet is placed in an inverted position with its poles resting on the poles of the electromagnet. Then the current is turned on and the permanent magnet is struck sharply with a hammer to aid the electron orbits to turn around so they all face in the same direction. Within a few seconds the current is shut off, and the magnetized permanent magnet is removed. The magnetizing force should be great enough to *saturate* the steel of the permanent magnet. Only direct current should be sent through the coil. Electromagnets for this purpose are usually designed for operation from the 110-volt direct current lighting socket. In order to preserve permanent horseshoe magnets from loss of strength, a piece of soft iron called the "keeper" is usually kept across its poles when it is not in use. The keeper furnishes a short closed path for the lines of force of the magnet and thus retains the atoms and molecules in their regular arrangements. Permanent magnets may be "aged" after being magnetized, by keeping them at a temperature of about 100° C. (in boiling water) for several hours.

Permeability

If the m.m.f. (amperes × turns) of a solenoid with air core is kept constant, magnetic flux of a constant strength will be produced. If a soft iron core is slipped into the solenoid, thus forming an electromagnet, the magnetic flux will be increased about 300-fold without any increase in m.m.f. If

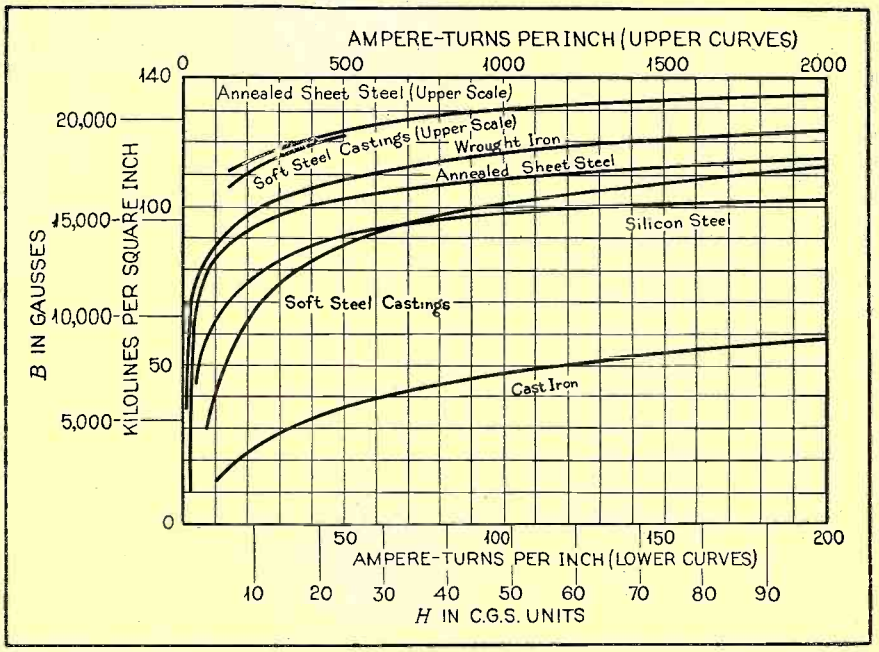


Fig. 2. "B-H" curves showing the relation between the magnetizing force H and the corresponding flux density B produced in various kinds of iron and steel. Fig. 3. Curves showing how the permeability of iron and steel varies when the magetic flux density is varied

* Radio Technical Pub. Co., Publishers' Radio Physics Course.

a core of "permalloy" (alloy of nickel and iron containing from 45% to 80% of nickel), is inserted, the magnetic flux will be increased another 300-fold (provided the magnetizing force is low enough to prevent saturation). If a cast-iron core were inserted, the magnetic flux would be weaker.

It is evident then that the "multiplying power" or the *strength* of an electromagnet depends upon the material used for the core. The ratio of the strength of the magnetic field with a given substance forming the entire core, to the strength of the field if air is used as the core is known as the *permeability* (μ). The reciprocal of permeability, that is, 1 divided by permeability, $\frac{1}{\mu}$, is called the *reluctance* of the substance. Non-magnetic substances all have a pemeability of 1. All magnetic materials have permeabilities much greater than 1, as shown in Figure 3. Substances of high permeability are, of course, preferable for use as cores of electromagnets, but the elements of cost an saturation characteristics must also be considered when selecting a magnetic material.

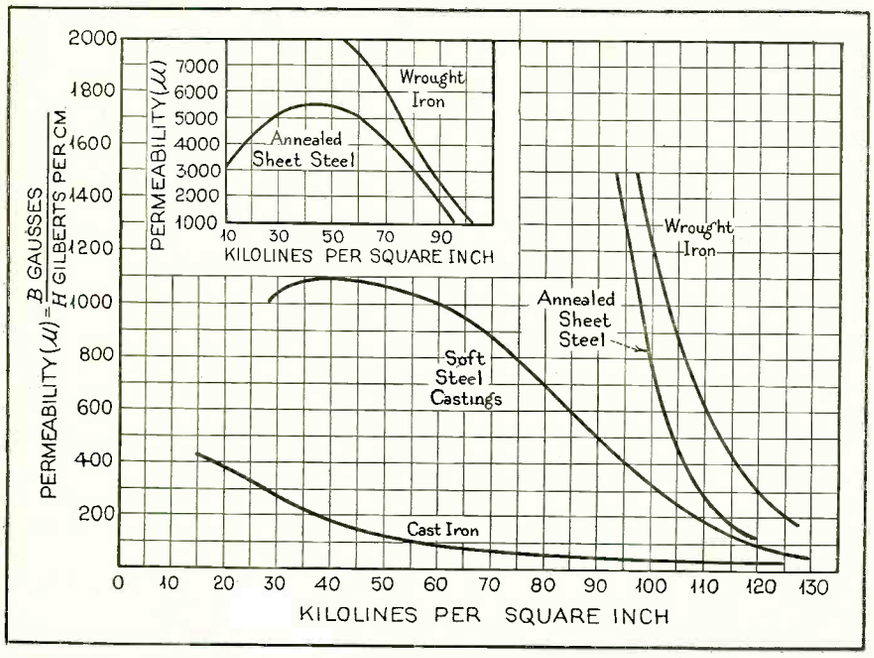


Figure 3. Curves showing how the permeability of iron and steel varies when the magnetic flux density is varied

Magnetization Curve

Figure 2 shows the comparative increase in magnetism for five common magnetic materials, for a given increase in magnetomotive force in ampere-turns per inch length of magnetic circuit. This is called the *characteristic curve of magnetization,* or the *B-H curve.* The horizontal scale represents the increase in magnetomotive force in ampere-turns and the vertical scale represents the increase in magnetic lines of force or magnetic flux in kilolines (1000 lines) per square inch of cross-section area. To use this B-H curve, follow the lower horizontal line to any of the numbers representing the magnetomotive force in ampere-turns per inch; then follow up the vertical line from this point until it intersects the curve of the material considered, from which point follow the horizontal line to the left side where the number of lines of force produced in the material, per square inch of cross-section, is recorded.

Thus, a m.m.f. of 100 ampere-turns per inch will produce about 47,000 lines (47 kilolines) of force per square inch in cast iron, 100,000 lines in soft steel castings and 116,000 lines in wrought iron. Wrought iron, which is very soft (annealed), will accommodate more lines of force than any similar material and hence is said to have high permeability. Mild steel is second and cast iron is third in this respect. Of course different grades of these materials vary in their permeability.

When all the electron orbits of a magnetic material have been turned around by the magnetizing force, the material is *saturated,* and an increase of applied magnetizing force does not result in noticeable increase of magnetism. Examination of the curve for annealed sheet steel, for instance, shows that for magnetizing forces up to about 10 ampere-turns per inch a large number of lines of force are produced per ampere-turn. Increasing the m.m.f. from 10 to 20 ampere-turns per inch only increases the flux from 83,000 lines per square inch to 93,000 lines; increasing the m.m.f. to 40 ampere-turns per inch only increases the flux to 100,000 lines and increasing the m.m.f. to 200 ampere-turns per inch only increases the flux to 114,000 lines. The nearer the B-H curve approaches to being a vertical line, the greater is the number of lines of force produced by a given number of ampere-turns. The point where it begins to flatten out is called the "knee" of the magnetization curve. Good design dictates that the cross-sectional area of the magnetic circuit should be made ample, so that the density of the flux in the magnetic material is not very much above the knee of the curve.

The peculiar shape of the magnetization curves may be explained by the electronic theory of magnetism. At magnetizing intensities which are insufficient to break up the the permanent atomic groupings, the permeability is low; at intermediate intensities under which the groupings become unstable and start to break up, the maximum permeability occurs. An almost steady value of permeability is found as saturation occurs. The permeability decreases as the magnetizing force is increased after saturation has been reached; and a "residual" flux due to stable atomic groupings is formed while the atoms are aligned.

Magnetic Calculations

The number of lines of force per unit area is called the *field intensity* or *flux density,* and when one line goes through one square

(*Continued on page* 123)

Latest Radio Patents

A description of the outstanding patented inventions on radio, television, acoustics and electronics as they are granted by the United States Patent Office. This information will be found a handy radio reference for inventors, engineers, set designers and production men in establishing the dates of record, as well as describing the important radio inventions

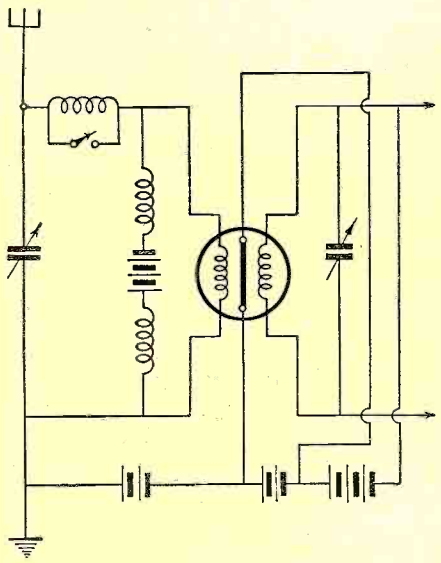
By Ben J. Chromy*

1,888,065. DIFFERENTIAL VOLUME CONTROL FOR DIVERSITY RECEPTION. HAROLD H. BEVERAGE, Riverhead, N. Y., assignor to Radio Corporation of America, a Corporation of Delaware. Filed Dec. 11, 1928. Serial No. 325,304. 10 Claims.

6. A diversity receiving system comprising a plurality of antennas having different fading characteristics, an amplifier coupled to each of the antennas, volume control means following each of the amplifiers, and means so coupling each of the volume control means to the amplifiers as to control the gain in the amplifiers partially in accordance with the magnitude of the energies from the other amplifiers, and partially in accordance with the magnitude of their own outputs, in order to strengthen the maximum signal and to make the change-over from one signal to another more stable and less noticeable, means to combine the volume controlled energies, and means to translate the combined energy.

1,883,520. THERMIONIC RELAY AND CIRCUITS THEREFOR. HARRY F. BRECKEL, Cincinnati, Ohio. Filed Mar. 31, 1928. Serial No. 266,338. 20 Claims.

1. In a short-wave signaling system, a three electrode vacuum tube comprising a cathode, an anode, and a control element comprising an inductance coil interposed in the dis-

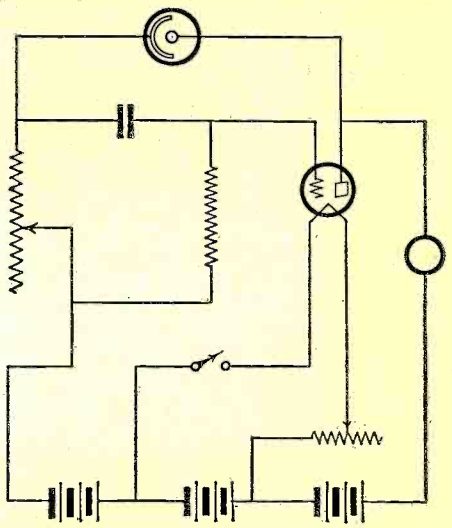


charge path between the anode and cathode and arranged to magnetically control the electron emission from said cathode, an input circuit including said coil connected directly in series therewith, and means for tuning the input circuit to establish current resonance in the control coil, said coil consisting substantially the entire inductance in the tuned input circuit.

* Patent Attorney, Washington, D. C.

1,889,758. MEANS FOR TRANSFORMING LIGHT IMPULSES INTO CURRENT IMPULSES. THEODORUS HENDRIK NAKKEN, Brooklyn, N. Y., assignor to Nakken Patents Corporation, a Corporation of Delaware. Filed Oct. 27, 1928. Serial No. 315,562. 16 Claims.

1. Means in combination for transforming

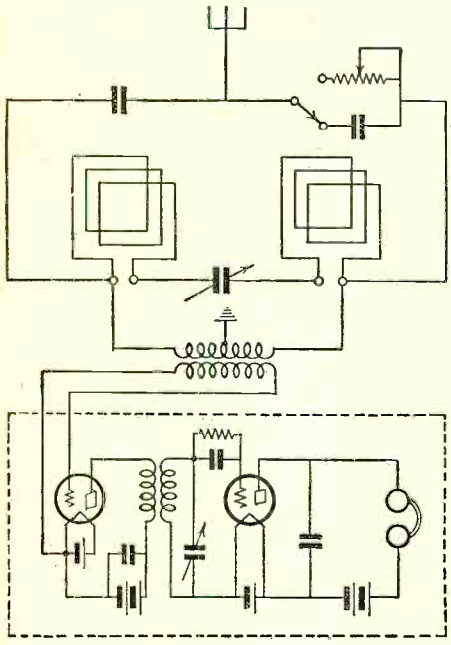


light impulses into electric current impulses comprising a cathode, a grid and a plate, a plate circuit including a source of current for the traverse of said electric current impulses; a photoelectric body adapted to be subjected to light impulses constituting the cathode-electrode of a photoelectric couple; an envelope for maintaining said body in a co-operative atmosphere; an anode within said envelope and within said envelope electrically disconnected and separated from said body and constituting the second electrode of said photoelectric couple; provisions tending to produce and maintain negative normal potential for said body but themselves incapable of maintaining said potential when said body is being subjected to light; and a link-means including a condenser electrically connecting said body and said grid and adapted to impart potential variations to said grid corresponding to those which take place on said body.

1,892,151. DIRECTION-FINDING SYSTEM. LAWRENCE A. HYLAND, Washington, D. C., assignor to Wired Radio, Inc., New York, N. Y., a Corporation of Delaware. Filed Apr. 18, 1929. Serial No. 356,135. 5 Claims.

1. In a direction-finding system, the combination of an antenna having a substantially non-directional characteristic, a directional antenna, said directional antenna comprising a plurality of sections, a condenser connected to said sections for tuning said directional antenna, a condenser connected between said non-directional antenna and one of the sections of said directional an-

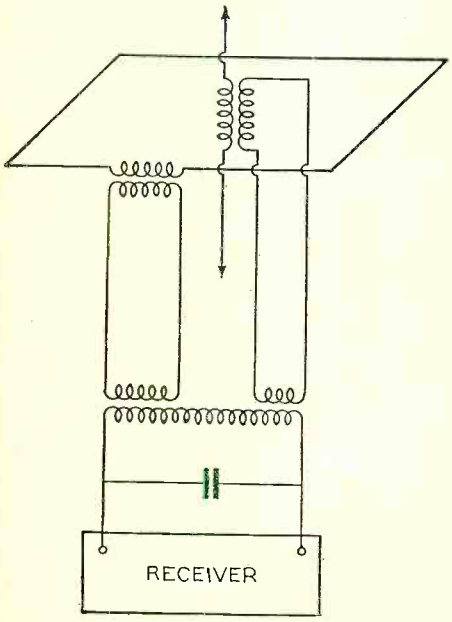
tena, a resistance unit, a second condenser, means connected with said resistance unit and said last-mentioned condenser for selectively connecting either said resistance or said last-mentioned condenser into circuit between another one of the sections of said



directional antenna and said non-directional antenna, and a coupling device associated with the circuits of said antennæ for transferring energy therefrom.

1,892,221. POLARIZATION DIVERSITY RECEPTION. WILHELM RUNGE, Berlin, Germany, assignor to Telefunken Gesellschaft für Drahtlose Telegraphie m. b. H., Berlin, Germany, a Corporation of Germany. Filed Jan. 30, 1929, Serial No. 336,125, and in Germany Feb. 18, 1928. 1 Claim.

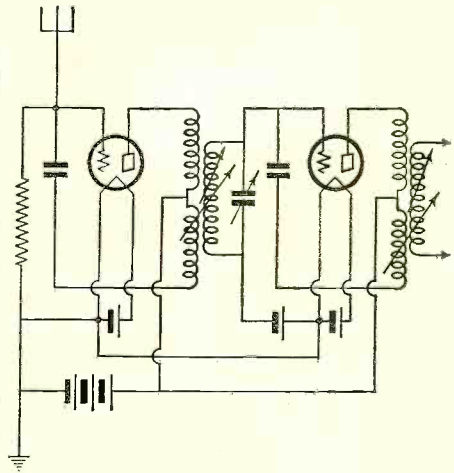
An arrangement for the reception of electromagnetic waves comprising a vertical antenna and a horizontal antenna at right



angles to each other, said antennæ being connected transmission lines with a joint radio-frequency circuit, one of said transmission lines being longer than the other by a length equivalent to one quarter of the communication wave whereby the oscillations of both antennæ are fed to said radio-frequency circuit with a 90° phase displacement.

1,894,503. RADIO-FREQUENCY AMPLIFIER. LINCOLN WALSH, Elizabeth, N. J., assignor to Hazeltine Corporation, Jersey City, N. J., a Corporation of Delaware. Filed Sept. 26, 1927. Serial No. 222,009, and in Canada Dec. 14, 1927. 20 Claims.

1. In a vacuum-tube amplifier, a plurality of vacuum tubes, a tunable coupling means interconnecting the output side of one of said tubes with the input side of another of said tubes, said coupling means comprising a transformer having a primary winding and a secondary winding and a variable tuning condenser, and means operable to vary, simultaneously, the tuning capacity, the secon-



dary self-inductance, the mutual inductance and the ratio of secondary to mutual inductance of said transformer whereby the degree of amplification may be increased as the frequency to which the amplifier is tuned is decreased.

1,848,888. TRANSMISSION AND RECEPTION OF PICTURES. JAMES M. KENDALL, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed Aug. 20, 1929. Serial No. 387,176. 5 Claims.

1. A picture-producing apparatus comprising a light control screen including a plurality of electrostatically controlled pivotally mounted shutters, means for projecting light through said screen, and means for causing said shutters to assume positions of light interception dependent on the shade of the picture to be produced.

1,869,735. TELEVISION AND LIKE APPARATUS. JOHN LOGIE BAIRD, London, England, assignor to Television Limited, London, England, a British Company. Filed Oct. 7, 1929, Serial No. 397,983, and in Great Britain Oct. 10, 1928. 7 Claims.

1. In apparatus of the class described, the combination with a rotatable element having a record thereon representing variations in light intensity derived by scanning an image, of means for reproducing the variations in light intensity from the record thereof, and scanning means associated with said first-named means for deflecting light beams from the latter across a field of vision.

1,857,154. TELEVISION RECEIVER. RAY D. KELL, Scotia, N. Y., assignor to General Electric Company, a Corporation of New York. Filed Apr. 1, 1930. Serial No. 440,845. 9 Claims.

1. Television receiving apparatus comprising a member which becomes double refracting when put under electric strain, optical means associated therewith for rendering visible those portions thereof subjected to electric strain, and means for subjecting points of the member successively to electric strain varied in accordance with the received signal.

?QRD?

A column devoted to the commercial operator and his activities

Conducted by GY

THE R.M.C.A. has come forward with an improvement on the type of antenna used for the reception of facsimile weather charts. The other type, which has been described in this column a few issues back, although efficient, was found to be of too wide a spread and interfered with the guys, rigging and other aerial gear. This new antenna combines the virtues of the "doublet" and the "Zeppelin" antennas in a single design. The horizontal "doublet" section intercepts radio waves of horizontal polarization and the "Zeppelin" part picks up waves of vertical polarization. Each section of the antenna is connected to a separate radio receiver and the amplified results of the two are combined in a common output which operates the facsimile reproducer. Fading will be almost cut to zero because of this improvement, and it is expected that speedier transmission of charts and also news pictures will be the result.

And did you know that the new 500,000-watt station at Noginsk, which is about forty miles outside of Moscow, will employ a 3000-foot antenna to carry its programs to the world? And someone called it wireless!

It has happened, old salts of the glass wrists! Yea, verily, plus forsooth, were it not for our honor, Old Glory, the few shekels and what-have-you in this game, it would not be worth a candle—and a Roman one, at that. Where before, in the good old days, "sparks" was a man to be worshipped! Yea, an Op was a king, a man of unusual intelligence, a gentleman of parts and knowledge who carried an aura of mystery around his person. But who was it who said "You can't fool some of the people when they have their eyes open," or something like that? Anyhow, the brotherhood have been betrayed, and by none other than a sweet little lass of eight Summers and a few Falls. List to me, brethren! Bend thine earflaps, break out the towels and buckets! Miss Jean Hudson, sweet, pert and astride a few dictionaries, accurately copied 20 w.p.m., which helped her to pass the exams for an Op with the mark of 80 percent. Of course, it is all in the family, as her OM is an Amateur, so I suppose one would say that the kid was born with a "bug" in her mouth, what.

But there is still hope for the tribe, now that the 3.2 taps have been turned loose on the proletariat. Kings Brewery, in Brooklyn, New York, recently had installed in their 20 trucks receivers of the type employed in police cars, for the purpose of expediting shipments of the fluid to their customers. If a customer calls the plant after the truck has left the premises, the truck will be notified to drop a few bottles at his place. And that is while en route! Not so bad, eh? And this will require servicing, controlling, monitoring, etc., and perhaps a few more will get the idea.

If any of the short-wave enthusiasts become tired waiting for verification cards from England or Spain, it is suggested that they pick up one of the Russian stations on about 50 meters. For prompt service they are second to none. One of the boys wrote for a card and received by return mail (all in one envelope) two post card views of Moscow, a typed letter in excellent English, a list of the principal radio stations of the U.S.S.R. and the program of English broadcasts for the whole month!

Having occasionally listened in on Ham "breeze" via the short waves, familiarity with the colloquial expression is about three —minus. Vernacularly speaking, the abbreviations sound to a layman like so much alphabet soup. Therefore, imagine our embarrassment upon learning that YL and XYL is not "you're a liar" and "you're an extra liar," but that they stand for Young Lady and Ex Young Lady. The ARRL informs us that the Ex is one who has been able to throw an anchor around some chap's neck to have him around the shack while she honors him with her cooking (that's what some of them call it). Some of these chaps come in handy for scaring the birds away from the antenna. Continuing to learn, it seeps through the cranium that there are about 190 of these feminus Americanus floating around, and for the info of those who care to know, there are quite a few of the YL's paddling their own canoes and might need a coxswain or a bow hook.

The automatic SOS transmitter may become standard enquipment for American vessels if it receives the approval through the Senate's ratification of the Safety of Life at Sea Convention, which was held in London last year. It is understood to have received the O.K. of the U. S. Bureau of Navigation. The Xmitter is operated by means of a vibrator which is operated by a switch installed on the bridge of the vessel. The switch automatically actuates this vibrator which starts the transmitter flashing the SOS signals from an endless tape. On other ships there is a receiver which is always tuned to the frequency of 600 meters and which not only picks upon the call but also actuates a bell upon the reception of it, so as to notify the operator, should he happen to be away from the shack or nose deep in a detective novel. The continuous signal would be of aid in finding the distressed ship by aid of the direction finder which is now on 'most all ships. And the gang growls!

Have you ever been in on a confab of Hams? Does it not remind you of a bunch of fishermen talking about their big catches? The only difference between them and the Hams is that the Ham occasionally tells the truth, because he has a verification card to prove himself. Recently at one of the K.K. (koffe klotches), Nat F. Schilling, W2DT, who often takes his cans off his ears to try a case in court, told a "whopper" that still has the boys gasping for air. On 40 meters at 1645 E.S.T., he picked up VK5MV, Australia, and received an FB from him. He says the conversation continued for 45 minutes, and at the end of the conversation a listener-in from England repeated the whole conversation to him and declared that reception from both stations was perfect. Well, we are still waiting for the veri. card! Incidentally, Schilling has his teeth all bared and set to clench onto the seat of Counsel to the A.R.R.L., which will be left vacant upon the resignation of the present incumbent, who is Paul M. Segar. Wl, lots of luck, OM.

The Question and Answer Department is still doing business at the old stand, with the result that the blue-eyed, fair-haired mailman is acquiring a slouch to his left shoulder. From way back in Nampa, Idaho, we hear from Lenny Hill, who must be driving a stagecoach now. . . . Jimmie Bowers sends

greetings from Couna, Mich., and Charlie Lohner sends regards to the VWOA from the same state. . . . Chris Whyte craves to know why the RMCA buzzer rooms don't carry a better assortment of funny magazines to keep the boys cheerful, and K. L. Moran sends 73's from Stewardson, Ill. S'funny what trails the fellows hit after getting away from salt water. They all come back—but how! J. F. Craves to know what happened to Jack Schauffler from the Airways, and Herb Kapan sez that if the 18th Amendment falls down, he might do the country a favor and never leave it. So what, sez we. We learn that Ray Meyers will be back in town after his operation for mastoids in a Philly hospital and that Geo. Smith is managing a concession up in Bear Mountain and wants the gang to look him up. . . . So, with a wish for a lotta foam and a big cheerio plus 73's. . . . GY.

Technical Review

(*Continued from page* 105)

Co., one of the oldest mail-order houses. The catalog contains illustrations, descriptions, specifications, list and net prices of a variety of radio parts, tools, replacement, items, receiver chassis, complete sets, public-address systems and electrical merchandise required by dealers, servicemen, set builders, amateur and commercial operators, experimenters and engineers.

2. *1933 R.F. Parts Catalog.* An 8-page folder containing specifications on the line of Hammarlund variable and adjustable condensers, r.f. transformers, sockets, shields and miscellaneous parts for broadcast and short-wave receivers, complete short-wave receivers and transmitting variable condensers.

4. *A 15 to 200-Meter Comet "Pro" Superheterodyne.* A description of the outstanding features of the Hammarlund-Roberts high-frequency superheterodyne designed especially for commercial operators for laboratory, newspaper, police, airport and steamship use.

5. *A 1933 Volume Control, Fixed and Variable Resistor Catalog.* This 12-page catalog, issued by Electrad, Inc., gives data on standard and special replacement volume controls, Truvolt adjustable resistors, vitreous wire-wound fixed resistors, voltage dividers and other resistor specialties and public-address amplifiers (using new tubes). Many revisions and additions to the Electrad 1932 line are included.

6. *Line Voltage Control.* Characteristics and uses of a voltage regulator and chart showing the correct amperite recommended by set manufacturers for their receivers. Also tells how to improve your customers' sets and make a profit besides.

7. *Rich Rewards in Radio.* This 64-page book is filled with information on the growth of radio and the opportunities existing in the field of radio manufacturing, radio servicing, broadcasting, talking pictures, television, public-address systems and commercial station operation on land and sea, for men who are trained to fill the many jobs created by the radio and allied industries. The book also contains detailed information on the home-study courses in radio and allied subjects offered by the National Radio Institute. This book is available only to the RADIO NEWS readers who are over 16 years of age and who are residents of the United States or Canada.

16. *RMA Standard Resistor Color-Code Chart.* A handy postcard-size, color-code chart designed by the Lynch Mfg. Co. to simplify the job of identifying the resistance values of resistors used in most of the standard receivers. It also contains a list of the most commonly used values of resistors with their corresponding color designations. A catalog of Lynch products is included.

18. *Volume Controls, Fixed Resistors, Motor-Radio Spark Suppressors and Power Rheostats.* A 1933 catalog containing descriptions, specifications and prices of the line of Centralab standard, special and replacement volume controls for receivers, amplifiers, public-address systems and talkie installations, fixed resistors, motor-radio spark suppressors, wire-wound rheostats and potentiometers. Details are given on how to obtain, without charge, a copy of the 64-page Centralab volume control guide for servicemen.

25. *Noise-Reducing Antenna Systems.* This folder describes the two types of noise-reducing systems perfected by the Lynch Mfg. Co. for both broadcast and short-wave reception. The transposition type can be used on both long and short waves and is especially adapted for use in connection with all-wave and amateur receivers. The shielded transmission type is especially suited for use on broadcast receivers.

29. *Practical Radio Engineering.* This 32-page catalog gives details on the courses offered by the Capitol Radio Engineering Institute of Washington, D. C., to fit the requirements of professional radiomen, radio servicemen, operators and technicians, who are ambitious to get into the higher paid positions in radio reserved for those with advanced training. Three types of courses are offered: (1) an intensive 9-months full-time resident course requiring regular attendance at classes; (2) a home-study course which can be mastered entirely at home and (3) a combination home-study and post-graduate resident course consisting of the regular home-study course followed by 10 weeks' practical training at the school with regular full-time attendance at classes. (Please do not write for this catalog unless you are interested in taking up a course on radio.)

34. *Serviceman's Replacement Volume Control Guide.* A 44-page vest-pocket-size

AUGUST, 1933

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New York, N. Y.

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☐ Jobber
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☐ Licensed Amateur
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booklet containing a revised list, in alphabetical order, of all old and new receivers showing model number, value of control in ohms and a recommended Electrad control for replacement purposes. Contains specifications and volume-control circuits for over 2000 different receiver models. A handy booklet which should be in every serviceman's kit.

39. *Radio Servicing and Radio Physics.* A 4-page folder which gives descriptions and tables of contents of two inexpensive books on every phase of radio. The books are written by A. A. Ghirardi and Bertram M. Freed and should be in the libraries of every radio student, experimenter and serviceman. The fact that they are used as standard texts by many radio schools and that chapters have been reprinted in RADIO NEWS Magazine is an indication of their value.

40. *Resistor Indicator.* A description of an instrument designed by the International Resistance Co. to enable servicemen and other radiomen to determine the exact resistance value of a defective resistor without the use of meters, wiring diagrams or specifications of the receiver circuit. This small, handy instrument should be in every serviceman's kit.

42. *How to Build Useful Servicing and Testing Instruments with Simple, Standard Meters.* This bulletin gives complete data, with diagrams, show how any meter—preferably a low-range milliammeter—can be used to measure amperes, volts and ohms over any desired range through the use of proper shunt and series resistors. The bulletin has been prepared by the Lynch Mfg. Co. and gives both the theoretical and practical data required to make all the calculations to convert or change the range or function of a given meter.

43. *How to Modernize Old Set Analyzers.* This valuable folder describes the new set analyzer remanufacture plan perfected by the Supreme Instruments Corp. for the conversion of obsolete set analyzers such as the Jewell Pattern 198, 199, 408 and 409 analyzers; Weston Model 537, 547, 565 and 566 set testers; and Supreme 99-A, 400-A and 400-B diagnometers into efficient, up-to-date testing equipment, at low cost. Servicemen and experimenters who have been working under the handicaps imposed by the use of analyzers which are no longer able to cope efficiently with the problems introduced by new tubes and receivers, will find this folder of great value. Special auxiliary units for increasing the usefulness of standard analyzers are also described.

44. *How to Add a Remote-Control and Station-Selector Unit to Any Receiver.* A descriptive folder published by Wholesale Radio Service which shows how any single tuning-control receiver can be converted into a remote-control and station-selector set, at a total cost of only $12.50. The RCA-Victor automatic remote-control unit used makes it possible to operate a set at distances up to 75 feet from the tuner. Information is also given on how to add a remote-control unit to a P.A. tuner.

45. *Condenser Bulletin for 1933.* This bulletin gives descriptions, specifications and prices on the entire line of Potter paper and electrolytic condensers for by-pass, filter and replacement use in home and auto radio sets. It also describes the Potter interference filters and tone controls.

46. *Book of Facts on High-Speed Radio and Telegraph Code Sending and Receiving.* A 24-page book which explains the opportunities for pleasure and profit in radio and telegraph operating and the three inexpensive courses available through the Candler System for attaining high speed in sending, receiving and copying code on the "mill." Different courses are suited for different students, such as beginners and experienced operators who wish to increase their speed. Please do not send for this material unless you are interested in learning how to operate or increase your speed.

47. *A Modern, Low-Cost Portable Public-Address System.* This bulletin describes and gives the specifications and price of an efficient, low-cost, portable, public-address system—the type U-19—designed and manufactured by the United Sound Engineering Co. The unit employs the latest tubes and a 10-inch dynamic speaker, and is capable of amplifying normal speech and music for crowds up to 1000 people. With auxiliary equipment, it can be used for crowds up to 3000 people.

48. *A Low-Cost Superheterodyne Receiver.* This folder describes the Goldentone midget radio, manufactured by the Fordson Radio Mfg. Corp. It is especially suited to fill the needs of the serviceman seeking a well-designed chassis for replacement purposes. The set contains many modern improvements and features not usually available in a set in its low-price class. The set is sold on a 30-day free-trial basis.

49. *Portable and Home Type Receivers.* This folder gives descriptions and prices of the line of receivers and chassis made by the Commonwealth Radio Mfg. Co. The list of receivers ranges from the most inexpensive midget sets to the higher-cost console models. The line offers many profitable sales opportunities for dealers and servicemen.

50. *An Accurate, Direct-Reading, Low-Cost Oscillator for Testing and Trouble-Shooting.* This folder describes an inexpensive, accurately calibrated, direct-reading signal generator, made by the J. M. P. Mfg. Co., which is capable of producing frequencies from 100 to 1500 kilocycles and higher, for testing receivers, lining up tuning circuits of radio-frequency receivers and superheterodyne intermediate stages, etc. It can also be used to test the comparative sensitivity and selectivity of any receiver.

51. *How to Build a 5-Tube Portable A.C.-D.C. Receiver at Low Cost.* Details of the "Pal" kit of parts, designed by Wholesale Radio Service to meet the need for an efficient but low-cost universal portable receiver, which can be built by servicemen and experimenters in their spare time and sold at a profit.

52. *The Servicer.* A monthly house-organ published by the International Resistance Co. It contains helpful information for the serviceman to do better work and to make more money doing it. A sample copy will be sent on request through this booklet service, after which you can subscribe to it, if you like it, by writing direct to the International Resistance Co.

PLEASE NOTE: To avoid disappointment, please make your selection of booklets from the latest issue of RADIO NEWS, since our supply of booklets not listed in the current issue is exhausted. The list and coupon contained in this (August) issue should not be used after August 31, 1933.

The National Hymn of Austria

VIENNA—According to the wish of the government the Austrian Broadcast Company resolved to terminate all transmissions with the Austrian National Hymn.

Diversity Reception

(*Continued from page 73*)

misses its aim so that one of the antennas does not receive a signal while another, a short distance away, does. Thus, the three receivers and antennas in the diversity system substitute "the broad side of a barn" for the bull's-eye of a target to make up for the poor aim of the Heaviside layer. In actual practice the improvement effected by a diversity system depends upon the number of antennas, their spacing, the fading ratio, and the length of the fading periods, but to give an idea of the improvement effected a simple case will be taken. Let us take the case of a three-antenna, diversity set-up with the signals from each antenna fading in a random manner, and let us assume that the fading is such that the signal fades out one-quarter of a minute, for each minute of reception, on each antenna. By the laws of probability, the chance of receiving a signal from any antenna of two of them would be 16 to 1, so that the signal would have a fading time of one-sixteenth of a minute with a two-antenna diversity. For the three-antenna diversity, the signal would likewise have a fading time of one sixty-fourth of a minute for each minute of reception. Thus, in this typical case, the signal instead of fading fifteen seconds of every minute as it would on a single antenna, fades only about one second in each minute. Of course, this is a hypothetical case, but since it is a case which is quite likely to occur, it gives an insight as to the improvement possible.

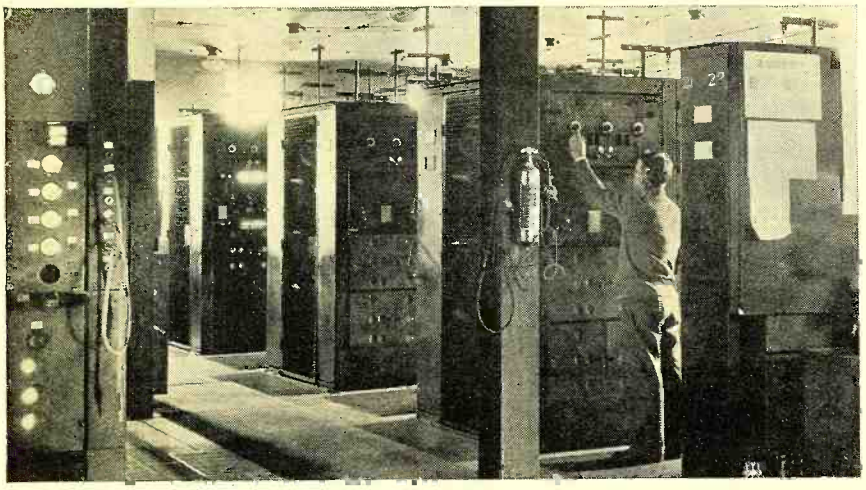
Space Diversity Versus Frequency Diversity

At the present time there is in use a method for reducing fading whereby the transmitter sends out a keyed modulated wave instead of a keyed continuous wave. Such a modulated transmitter sends out a carrier and side-bands, instead of a single frequency, so that when "selective" fading causes one side-band to fade, another is present to convey the signal. Such a system might be called a "frequency-diversity" system whereby the carrier and two side-bands are relied upon to carry the signal instead of just one carrier. Due to the fact that only a limited amount of modulation may be applied without broadening the signal too much and causing interference, such a "frequency-diversity" system, in my opinion, is far inferior to the "space" diversity system now in use. There are some stations on the air at present who are using an excessive amount of modulation, so that they cause interference to the adjacent frequencies. In view of the congestion of the ether in the short-wave band, such a modulated type of transmission becomes a "road hog" and will probably be prohibited sometime in the future, just as spark transmitters are now prohibited in certain wavebands. Also, with the narrowing down of the assigned band widths as is required to accommodate more stations, the band widths will soon be so restricted as to make such a modulated wave impossible; consequently, space diversity will be the only allowable means of fading reduction.

Signals Converted to Keyed Tone

The receiving station at Riverhead has completed its duty when it has caught the signal as it is ricocheted from the Heaviside layer, removed the excess static, noise and interference, eliminated the fading and converted the signal to a steady, keyed tone. This keyed tone is then transmitted to the central office at 66 Broad Street, New York City, by means of wire lines. Since the output of the receivers varies in frequency, due to the frequency variations at the transmit-

ter and receiver, the receiver outputs are arranged to key a tone which is steady in frequency and amplitude. Consequently, several signals may be sent to New York on the same line by employing different tone frequencies and separating them at New York by means of filters. Such a system is coded by operators who read the signal from paper tape upon which it is recorded by an ink recorder. Since the ink recorder accurately writes the dots and dashes down on the tape, two or more operators may be employed to decode the tape from the same signal. Consequently the speed of transmis-



PRESENT DIVERSITY SET-UP

A portion of the 41 receiving systems required for signals from 26 countries

a form of multiplexing and is similar to the carrier-wave telephony used by telephone companies.

Messages Decoded in New York

At the central office, the messages are de-

sion may be carried on at a rate which is many times faster than an operator can copy it directly by ear. Thus the only limited factor of the speed of transmission is the signal-to-noise ratio of the wave as it is picked up on the antennas.

The "Discoverer Five"

(*Continued from page* 77)

receiver we use the opposite principle, wherein the tube is constantly oscillating and has to be pulled out of oscillation for voice reception or music. Therefore, keep the antenna trimmer condenser C16 constantly tuned to resonance. Turn the regeneration control dial and after the whistle of an incoming carrier has been heard, carefully adjust the main tuning control and adjust C16 for absolute resonance. Then you will find that you can advance the regeneration control with the resultant greater signal output.

The following components comprise the kit for "The Discoverer." These kits are produced by Federated Purchaser, Inc.

Parts List

BP1, BP2—Dual antenna ground binding-post strip
C1, C2—Acratest two-gang variable condenser, .0001 mfd. each section, model No. 6708
C3, C4, C5, C10, C11—Acratest .02 mfd. 300-volt cartridge condensers, model No. 2817
C6—Acratest .5 mfd., 200-volt condenser, model No. 2836
C7, C8—Mica condensers, .0001 mfd., model No. 6630
C9—Acratest 2 mfd., 400-volt electrolytic condenser, model No. 6665
C12—Acratest .1 mfd., 200-volt condenser, model 5637
C13—Acratest 25 mfd., 25-volt electrolytic condenser, model 6646
C14, C15—Acratest dual 8 mfd. electrolytic condenser, model No. 7735
C16—Midget variable condenser, 25 mmfd., model No. 5256
J1—Phone jack "Discoverer"
L1, L2, V1, V2—Acratest 6-prong wafer type Isolantite sockets
L3—Acratest short-wave r.f. choke, model No. 6755
R1—Acratest 300-ohm resistor, model No. 5660
R2, R9—Acratest 2000-ohm resistors, model No. 5660
R3—Acratest 25,000-ohm resistor, model No. 5660
R4—Acratest 3 meg. resistor, model No. 5860
R5, SW1—Frost 25,000-ohm potentiometer (R5) and switch (SW1) model No. 6745
R7, R11—Acratest .5 meg. resistors, model No. 5660
R8—Acratest .1 meg. resistor, model No. 5660
R10—Acratest 50,000-ohm resistor, model No. 5660

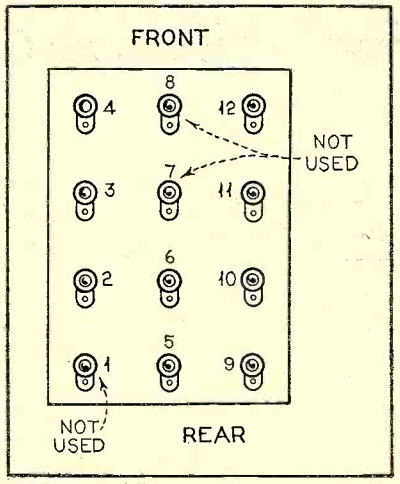


FIGURE 3

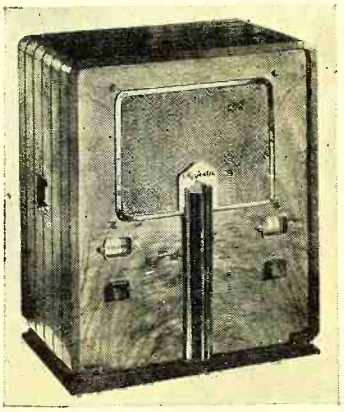
R6, R12—Acratest .25 meg. resistor, model No. 5660
R13—Acratest 25,000-ohm resistor, model No. 5660
T1—Acratest power transformer, model No. 6757
V1, V2—Type -58 tubes with sockets (specified above as V1, V2)
V3—Type -56 tube with 1 Acratest 5-prong wafer type socket, type 4063
V4—Type -59 tube with 1 Acratest 7-prong wafer type socket, type 7524
V5—Type -80 tube with 1 Acratest 4-prong wafer type socket, type 4062
1 illuminated full-vision vernier tuning dial pilot light and escutcheon, model No. 7174
1 Acratest 5-prong wafer type 4063
2 Acratest tube shields, model No. 7270, for V1 and V2
1 drilled metal chassis, cadmium plate, 11½ inches by 9⅜ inches by 2 inches high
1 power supply cord and plug, model No. 7304
2 screen-grid clips, model No. 3872
3 small knobs
1 set of 8 special "Discoverer" short-wave coils
1 5-prong speaker plug, model No. 5869
1 dynamic speaker with 1800-ohm field tapped at 300 ohms, model No. 497
1 ornamental metal cabinet, gunmetal finish, hinged cover, 11⅝ inches by 9½ inches by 7 inches high

What's New in Radio

(*Continued from page* 83)

new Majestic line. The above illustration covers the consolette Model 77 receiver. This is a seven-tube superheterodyne circuit featuring full-range tone control, duo-diode

detection, automatic volume control and pentode audio amplification. The second illustration is on the Master 6 Model 461, a six-tube superheterodyne receiver. With its



center panel of matched butt walnut and chromium-bordered grille, this makes a striking-looking mantel type set. The dimensions of the cabinet are: 17 inches high by 13¼ inches wide by 8¾ inches deep. This set is

equipped with tone control, dynamic type speaker and automatic volume control. In addition to the regular broadcasting band this set takes in the police calls. Both these receivers employ the Majestic spray-shield type tubes.

Maker—Grigsby-Grunow Co., 5891 W. Dickens Ave., Chicago, Ill.

Radio and Static

(*Continued from page 71*)

discriminate between the two. For both static and signal are carried by a single plate current, and lowering the current weakens them both in the same proportion. A strong crash of static may be limited to the strength of the signal, but in doing so the signal may entirely disappear. The signal is continually rising and falling in strength and is definitely harder to copy than when no limiting device is used.

Marconi once employed a limiting receiver on shipboard stations in which two carborundum detectors were connected in the secondary circuit, in opposition to each other.[15] The first detector was biased with a dry cell in the usual way for maximum sensitivity, while the second was biased to become effective only after a radio-frequency voltage of a certain strength had been reached. For ordinary signals it was not effective, but when a strong impulse of static was received it would pass through the second detector and be sent through the phones in opposition to the first, thereby weakening the static to a certain extent. These receivers were used on British ships at one time, but are now obsolete.

Limiting devices appear to have possibilities, for before static becomes troublesome it must be hundreds of times stronger than the signal. Ordinary commercial signals are seldom over 100 or 200 microvolts per meter in strength, while the static measured by the Radio Research Board in London was as high as 100,000 microvolts, or 0.1 volt, per meter.[10] If static can be reduced to the strength of the signal, it becomes a negligible factor and is scarcely noticeable. The principal reason for this is the difference in duration. A discharge of static carries only a few cycles of oscillation, while a single dot of the radio code at 600 meters has about 50,000 cycles. These sustained signal waves have a building-up effect on the receiver that one or two cycles do not possess. The analogy can be compared to hitting a pendulum one or two blows, in which it will start to swing, but as more blows are struck, of the same strength and timing, the swing of the pendulum will be greatly increased. A heavy blow, struck only once, will produce no more of a swing than a series of light blows regularly timed, while a light blow, struck only once, will hardly start any movement. There are many patented devices that purport to block out the short, momentary impulse of a static discharge while allowing the sustained waves of a signal to pass through and still others that purport to filter out the weak energy of a signal while forming no obstacle to the stronger current of static, after which the remaining static is combined with the output of another receiver, as in Fessenden's basic circuit.

Dieckmann Cage

The Dieckmann cage was a shielded aerial brought out in 1912, though Pickard experimented with the same thing six years earlier. The aerial was surrounded by loops of wire about a foot in diameter and space about two feet apart and were all grounded. Static waves, though to travel at right angles to radio waves, were supposed to collect on the bands and become grounded while signal waves would be picked up in the usual way.

It was evolved from the Faraday "cage" experiment, in which an observer inside a large metal box was unable to get the slightest indication of an electric field being present on an electroscope, although the box was charged so high from a static machine that blue corona appeared at all its edges. This brought forth the law that a static field will concentrate on the surface of an object and will not penetrate to the inside.

De Groot claimed the Dieckmann cage was used with good results in the Dutch stations in Java, but no one in this country was ever able to make it work.[17]

Radio Translator

Another class of static eliminators well represented in the patent files is that which takes advantage of the acoustic difference in pitch between static and a continuous-wave signal. Various forms of receiver diaphragms and resonant chambers are employed to accentuate this difference. The Radio Translator, developed by the Army, is typical of this class.[18] The usual telephone diaphragm is replaced by a "vibrating reed" having a natural frequency of about 2000 cycles. It responds to signals of this pitch much better than to signals of a lower pitch, or to static. A resonant air chamber, also having a period of 2000 cycles, is placed directly in front of the reed and reinforces signals of this pitch while further weakening all sounds of a lower pitch. Reception is carried on through the medium of two rubber tubes, like a stethoscope, which enter the air chamber at the far end. The method, no doubt, improves reception, but, to my knowledge, it has never been adopted commercially.

Nature of Static

One of the reasons why static has never been conquered is because it has never been thoroughly understood, in either origin or nature. For a good many years the idea prevailed that all static was made up of a series of single discharges, having no oscillations (or, if any, highly damped) and affecting all wavelengths the same way. It was thought that a crash or a click heard on one wavelength would be heard exactly as a crash or a click on every other wavelength, except for a gradual weakening as the lower wavelengths were approached. All balanced eliminators of the Fessenden type depended on this theory, and if it were true, static would never have become more than a minor problem.

But it is now recognized that a considerable part of static is oscillatory in character and different wavelengths respond to it in different ways.[19] A sharp click on a low wavelength may often be heard as a brief hiss, or "mushy" static, on a higher wavelength, though both are caused by the same disturbance.[20] Static on 20 meters has little resemblance to static on 30 meters, and practically no resemblance to static on longer wavelengths. The difference begins to take place just as soon as the tuning dial is turned, and the continuous roar that is heard on the longer wavelengths when static is bad is caused in a large measure by different manifestations on each frequency and not by the spreading of homogeneous disturbances over the whole band.[11] It is believed that various wavelengths, differing by as little as 1000 cycles, will not always respond to static in the same way, and that oscillograph records, made simultaneously, will show disturbances on one wavelength that are not recorded on the other.[20]

A certain part of static is non-oscillatory and jars all wavelengths into oscillation by shock excitation. Two different wavelengths will register the same impulse, but due to reflection or other causes the waves may travel different routes and be far out of phase by the time they reach the receiving aerial. For the same reason that causes fading, the phase may be constantly changing, and with no way to regulate it, neutralization is, of course, impossible.

The waves produced by grinders have all the characteristics of radio waves and affect a receiver the same way. They may be considered as a series of short "key clicks" being sent out on the particular wavelength it is desired to receive on. Any attempt to get rid of the clicks only results in getting rid of the signal, too, for no instrument yet devised has been able to differentiate between the two.

Oscillograph Pictures

The oscillograph pictures made by the Radio Research Board have brought out many interesting facts.[21] They show that the average static impulse is a single rise and fall of the earth's electric field, lasting one or two thousandths of a second, and of a strength many hundreds and even many thousands of times greater than any signal impulse. Some of these pictures show a smooth rise and fall, comparable to a sinusoidal curve, with no oscillations present, while others show many fine ripples superposed on the main half-cycle. These ripples occur at a frequency that would correspond to wavelengths between 10,000 and 100,000 meters, with an average around 40,000 meters. It is believed that the ripples themselves are the main cause of radio disturbances, but it is not understood how those surges that show no ripples can have such a powerful effect on a radio receiver as they seem to do. Professor Eckersley, a British authority on atmospherics, has shown that before a disturbance can be serious, it must be close to the time period, or wavelength, of the receiver, but he does not explain how simultaneous disturbances are heard with nearly equal intensity on wavelengths thousands of meters apart.[22]

Static centers can be located by direction finders, just as radio stations can. By this means it has been determined that most of the static in this country comes from regions around the Gulf of Mexico, that Japan's static comes from the vicinity of Java,[23] and that Panama's static center follows the declination of the sun, moving from the Andes Mountains north to Central America, in accordance with the time of year.[24]

The advancing low of a storm area is nearly always the source of grinders, and in Europe rain and thunderstorms have regularly been located and track up to distances of 1500 miles by means of cross bearings taken on loops.[25] Static may be the bane of a radio man's life, but the weatherman may soon look on it as a most valuable and accurate help in forecasting weather.

It was once believed that lightning flashes, principally in the tropics, were the cause of all static, and much argument has centered around the question. Data has been compiled to show that at any instant the lightning flashes in various parts of the world amount to 6000 flashes per minute, which is declared to be sufficient to cause all the disturbances heard in a radio receiver.[26] Lightning always causes local static, but it has not been proved that the waves set up by a lightning flash can travel thousands of miles. On prearranged tests, stations in Berlin, California and Hawaii have all recorded the same crash of strong static,[27] and Holton, Maine, has traced static centers as far away as Africa, South America, the West Indies, and Texas.[28] Lightning is declared to be without exception non-oscillatory,[29] and to account for the ripples observed on oscillograph pictures it is suggested that discharges of electron clouds into the Heaviside layer may be the source of their origin.

The only advance made against static has been to *avoid* it, as much as possible, rather than *conquer* it. The more selective a receiver is, the *less static it will respond to.* The more directive an aerial is, the *less static it will pick up.* And this combination is the *most advanced means of working*

through it. Directive aerials are the only effective weapon against it, and point-to-point stations, on both the long and short waves, use sharply directive Beverage wave antennas in some form.[30] An aerial six miles long is used on the long-wave trans-atlantic telephone receiving station, solely to work through static.

The ideal static eliminator would be a small auxiliary attachment that would fit any receiver or aerial and which would effectually block out all static while allowing the signal to come through free and clear, ready for tremendous amplification. The facts in the case point against the probability of any such device ever being invented, but as long as there is radio it will be a goal that countless experimenters will search for and some day might possibly find.

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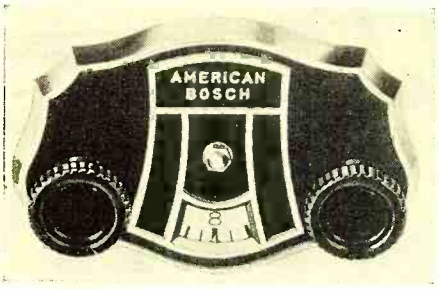
Automobile Radio

(*Continued from page* 101)

these features simplify tuning. The set is equipped with automatic volume control and is effectively shielded against ignition noises

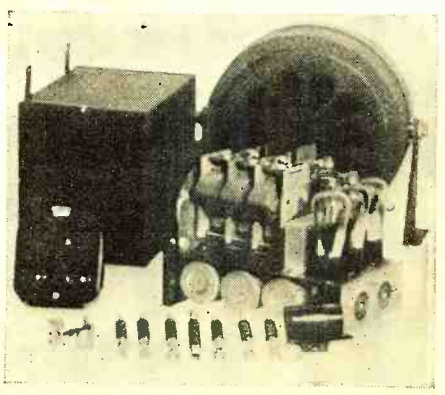


and the B power unit. The following type tubes are employed: two –36, one –39, one –85 and two –41 type power tubes.

Maker—United American Bosch Corp., Springfield, Mass.

Compact Receiver

Description—The new Autocrat Model 41 automobile receiver is a six-tube tuned r.f. circuit employing the following type tubes: two –39 for the r.f. stages, one –36 for the combined detector and semi-automatic volume control, one –37 for the first audio stage and two –41 type tubes in the push-pull power stage. Its wavelength range is 175 to 550 meters, covering the police band in addition to the regular broadcast range. This compact set, measuring only 8¼ inches by 6½ inches by 5¼ inches, is designed for quick and easy installation in any make of motor car.



Maker—Autocrat Radio Co., 3855 N. Hamilton Ave., Chicago, Ill.

Radio Phenomena

(*Continued from page* 85)

but in a very short time the molecular and the electronic pressures of the vapor are in balance with the molecular and the electronic pressures of the liquid mercury for the temperature in question. If a current is sent through the mercury and its vapor, the contact difference of potential either aids or opposes the flow of current electrons, depending on the direction of the contact potential and the direction of the current flow (thus, by allowing more current to flow in one direction than in the other, it sets up a rectifying action if alternating current is used).

Change in other conditions of the system, as well as a change of temperature, influence the magnitude of the contact potential, such as a change in pressure, incident light or magnetic field. Again we repeat the generality that a change in one condition means a change in all. Evidently the way in which all of these factors enter into the problem is much too complex for more than a general prediction to be made of the magnitude and the direction of the resulting potential. It is necessary to fall back on the experimental values which have been tabulated for a large number of substances and which furnish invaluable data for the design of vacuum and photo-electric tubes.

In the case of simple contact the energy which goes into the creation of the potential difference comes from the energy of the moving molecules, atoms, and electrons. If mechanical work be done by moving one part against the other, an increase in the motion of the particles results. This increased agitation in one part will be passed along to surrounding regions which is similar to the direct application of heat to the bodies, thereby affecting the rate of escape of the electrons and thus the values of the contact potentials.

In the case of non-conductors in which differences of potential have little chance to set up current flow, contact difference of potential gives rise to static charges. Basically the production of electricity by the various friction methods rests on the differences of electron pressure in the substances in contact. The potential difference observable when a glass rod is brought in contact with silk is due to the differences of contact potential of the glass and the silk. By the operation of rubbing fresh points are brought in contact and the small charges are accumulated until the whole surface is electrified. The rubbing complicates the action by creating differences of temperature which varies the electron pressure, locally. The rise in temperature would tend to increase the electron pressures in both materials, however, the temperature coefficients of the two, in general, are not the same.

We can now examine the action of heat in the case of two pieces of the same substance. Let us examine two pieces of zinc, one at a higher temperature than the other. The greater motion of the particles of the hotter piece causes an increase in the number of the electrons, with kinetic energy sufficient to escape from the surface of the metal or to parts which are at a lower temperature. This gives an electron diffusion into the parts which are not so crowded or agitated and, as a flow of electrons constitutes a current, we have an electric current produced in a material by a difference of temperature. If, in addition to the local current in the zinc, another current is sent through it by the application of an external source or difference of potential, its passage will be either aided or retarded by the local current caused by the heat. If the two currents aid each other the motion of the electrons will be increased and therefore the heat will be increased. On the other hand, if the two currents oppose each other, the resultant motion of the particles will depend on the relative magnitudes of the two potential differences, the one caused by the external source, the other caused by the heat. Under the last set of conditions heat is absorbed in proportion to the difference of potential. This action is the Thomson effect, being predicted and later discovered by Professor Thomson (later Lord Kelvin). This effect is present whenever there is a temperature and a current gradient in the same material as in a filament heated by direct current. This tends to make one end hotter than the other; an action necessary to take into consideration in the design of vacuum tubes. Eccles has made use of the Thomson effect in his theories of crystal rectification. He assumed a steep temperature gradient at the contact. However, his treatment of the problem was based primarily on other heat effects, the Joule, the Seebeck, and the Peltier effects.

The quantitative relationships between current flow and temperature in the Thomson effect have been determined in a number of materials and it has been observed that the current set up by a difference of temperature is not always in the direction from the hot to the colder part. This seems to be a failure of the electron theory but it may be explained on the assumption that other internal rearrangements take place in these substances which are the exceptions causing the electrons to flow toward the hotter parts. Iron has an effect which is the reverse of that of copper. Lead shows an absence of the effect with the usual methods of measurements.

S.W. "Master Six"

(*Continued from page* 87)

An earphone jack and phonograph pick-up posts are included. The output of even the first audio stage is sufficient to operate a magnetic speaker quite nicely on many stations. No output transformer is supplied with the set, as this is included on practically all dynamic loudspeakers. The power pack is fitted with two binding posts to which the field winding of the speaker may be connected for field excitation. If this is done, the second choke, T4, may be eliminated and its cost saved.

The assembly of the kit of parts is very simple, as all holes are already drilled in the chassis. The various tube and coil sockets are held by small machine screws; the tuning and trimming condensers and the control potentiometers by their own mounting nuts. The only parts requiring mounting on the underside are the interstage transformer T1 and the dial mechanism. All of the fixed resistors, condensers and r.f. chokes are mounted by their own connecting wires as the wiring proceeds. The cabinet may be stood on any side, top or bottom during the assembly and wiring work, a feature that will be appreciated by anyone who has ever put together sets with flimsy, wobbly shields. After the set is finished, a bottom plate is screwed on and the top merely slides into its hinges. Plenty of ventilating holes are provided, as the 2A5's become rather hot in normal operation.

The construction of the power unit is simple and is obvious from the accompanying illustrations.

As for results: stories of short-wave DX reception are rapidly getting into the "fish this long" class, but actually the "Master 6" does "pull 'em in." In various locations around New York, where conditions are by no means good, excellent loudspeaker results are enjoyed on such stations as EAQ, Ma-

drid; I2RO, Rome; the various GS- British Empire stations at Daventry; "Radio Colonial," near Paris; the new German stations at Konigswusterhausen, whole flocks of Central and South Americans, the various trans-oceanic radiophones (whenever they use "clear" transmission instead of "scrambled" speech) and even a few antipodal stations such as VK2ME in Sydney and VK3ME in Melbourne, if the operator cares to stay up late enough and watch the sun come over the horizon. There are no tricks in the circuit; it is utterly reliable, and with the aid of the smooth regeneration control it brings in just about everything on the short waves worth hearing. The aim of the designers has been to produce a good set at a reasonable price, and it is believed that this aim has been accomplished.

Parts List

The following list of "Lafayette" parts constitutes the complete kit for this receiver ("Lafayette" being the trade name of the Wholesale Radio Service Co., Inc.):

C1—35 mmfd. midget condenser
C2, C3—90 mmfd. midget condensers
C4—.1 mfd. mica condenser
C5, C6, C8—1 mfd. electrolytic condensers
C7—.0001 mfd. mica condenser
C9—.01 mfd. mica condenser
C10—1 mfd. electrolytic condenser
C11—25 mfd. electrolytic condenser
C12—.5 mfd. electrolytic condenser
C13, C14, C15—8 mfd. each electrolytic condensers
C16—.00025 mfd. mica condenser
J—Double closed-circuit 'phone jack
L1, L2—Plug-in coils (set of 8 coils)
R1—50,000-ohm resistor
R2—300-ohm resistor
R3—100,000-ohm resistor
R4—5-megohm resistor
R5, R6—50,000-ohm resistors
R7—75,000-ohm resistor
R8—100,000-ohm resistor
R9—500,000-ohm resistor
R10—300-ohm resistor
R11—200-ohm resistor
R12—12,000-ohm resistor
RF1, RF2, RF3—2½ mh. r.f. chokes
SW—Power switch on R1
T1—Push-pull input transformer
T2—Power transformer
T3, T4—30-henry, 100-ohm chokes
V1, V2—Type -58 tubes
V3—Type -56 tube
V4, V5—Type 2A5 tubes
V6—Type -80 rectifier
1 metal cabinet, crackle finish
2 coil sockets, 6 prongs
5 wafer sockets, 6 prongs
1 waver socket, 5 prongs
1 wafer socket, 4 prongs
2 tube shields (VT1, VT2)
1 6-prong plug
1 8-wire cable
1 double-tip jack
1 vernier illuminated drum dial
2 2-gang binding-post strips
1 2-gang binding-post strip
1 power pack chassis, cadmium-plated steel
1 power cord and plug
1 8-inch dynamic speaker, 450-ohm field, equipped with input transformer for 2A5 tube

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Radio Physics

(*Continued from page* 111)

centimeter the field strength is one *Gauss* or one *Maxwell per square cm.* When one line goes through one square inch, the field strength is *one line per square inch.* The total number of lines through any given area is called the *flux* (Φ). To find the flux, multiply the flux density B by the area A, using the proper units. Thus:

$$\text{flux } \Phi = B \times A$$

The total flux produced in a magnetic circuit is proportional to the m.m.f. applied, and inversely proportional to the reluctance of the circuit. This is analogous to Ohm's law for the electric circuit. The reluctance is proportional to the length of the magnetic circuit and inversely proportional to its cross-section area. The *permeability* of the magnetic circuit is analogous to the *conductivity* of the electric circuit. The permeability of a given material is the reciprocal of the reluctance of a unit cube of this material. The unit of reluctance is the *Oersted.* For the magnetic circuit:

$$\text{flux } \Phi = \frac{\text{magnetomotive force}}{\text{reluctance}}$$

where Φ = flux in Maxwells per sq. cm.
the magnetomotive force in is Gilberts
the reluctance in is Oersteds

The magnetomotive force in Gilberts is:

$$\text{m.m.f.} = 1257 \times N \times I$$

where N = No. of turns of wire
I = current flowing through it (amperes)

The reluctance may be found from:

$$\text{Reluctance} = \frac{L}{\mu A}$$

where L = the length of the magnetic path in centimeters
μ = the permeability of the material at the particular flux density used
A = the cross-section area of the magnetic circuit. (sq. cm.)

Therefore the total flux is found from:

$$\text{Total flux } \Phi = \frac{1257 \times N \times I \times \mu A}{L}$$

$$\text{the flux density } B = \frac{\text{total flux}}{A}$$

$$= \frac{1257 \times N \times I \times \mu}{L} \text{ (Maxwells)}$$

The permeability of iron is not a fixed quantity, but depends upon the flux density at which the iron is operated. Figure 3 shows a set of curves which give the relation between the permeability and flux density of several magnetic materials. Notice that at low flux densities the permeability of the iron is fairly low, that there is a certain density at which maximum permeability is reached, and above this flux density the permeability decreases.

The curves in Figure 2 give the values of the flux density in kilolines per sq. inch produced by various magnetizing forces expressed in ampere-turns per inch length of magnetic path. On the same curves will be found corresponding values of flux density in gausses produced by the magnetizing forces H in C. G. S. units (gilberts per centimeter). The flux density in lines per square inch is equal to 6.45 times the density in gausses (since 6.45 sq. cm. = 1 sq. inch). The magnetizing force in gilberts per centimeter is 1257 times the ampere-turns per inch.

Servicing Receivers

(*Continued from page* 75)

All-Purpose Set Tester which is basic, compact, at the present time rather inexpensive and which was developed especially to meet the requirements mentioned above. Photos and a circuit diagram of this instrument are shown.

Next month Mr. Kaufman's discussion will be continued with a detailed description of the service testing routine which his wide experience indicates to be the most effective, combining speed, accuracy and thoroughness.—THE EDITORS.

3-Tube S.W. Set

(*Continued from page* 90)

To obtain best results from a short-wave receiver, some attention should be given to the antenna installation. Good insulation of the aerial is essential. The antenna length found to be desirable in most locations is 60 to 70 feet. The parts list is given below,

COIL DATA

COIL FORMS: 1¼-Inch diameter, 4 prong type.
ALL WINDINGS close wound except "A". Spacing on "A" equal to diameter of wire. ALL WINDINGS wound in same direction.

WAVELENGTH METERS	GRID		TICKLER		
	Type of wire	Turns	Type of Wire	Turns	Separation
"A" 14 TO 35	No. 20 Enam.	5	No. 28 SCC	3	5/32
"B" 34 TO 63	No. 20 Enam	11	No. 28 SCC	4	5/32
"C" 62 TO 112	No. 24 SCC	19	No. 28 SCC	5	1/8
"D" 110 TO 195	No. 26 SCC	48	No. 28 SCC	7	3/32

showing individual items, although a complete kit is available from the Alan Radio Corp.

List of Parts

C1—40 mmfd. midget condenser
C2—165 mmfd. variable condenser
C3—.0001 mfd. mica condenser
C4—.0002 mfd. mica condenser
C5—.5 mfd. condenser, pigtail type
C6, C7, C12—.01 mfd. condensers, pigtail type
C8—10 mfd. electrolytic condenser
C9, C10—8 mfd. each, electrolytic condenser
C11—16 mfd. electrolytic condenser
L1, L2—Plug-in coils (set of 4 coils)
L3—Audio impedance
L4—25-henry choke
L5—15-henry choke
R1—5-megohm resistor
R2—50,000-ohm potentiometer
R3—60,000-ohm resistor
R4—250,000-ohm resistor
R5—625-ohm resistor
R6—175-ohm resistor
SW—Power switch on R2
3 wafer sockets, 6-prong
1 wafer socket, 4-prong
1 vernier illuminated dial
1 stamped metal chassis
1 metal cabinet
1 terminal strip
1 dual antenna and ground binding-post strip

Backstage

(*Continued from page* 97)

and was previously heard on some CBS programs from the St. Moritz Hotel, where she sang during Harold Stern's broadcast periods. Her current radio programs mark her first featured network series.

NINO MARTINI, the young Italian operatic tenor heard on CBS programs, has been signed by the Metropolitan Opera Company for leading tenor rôles during the 1933-1934 season. Martini is said to be the first artist to be selected by the premier American opera company from the ranks of regular broadcast artists. The procedure has usually been the reverse, it being customary to seek radio recruits from the opera ranks. This award to Martini's efforts came as a result of less than five months broadcasting over the CBS. Although it was radio which brought Martini to the attention of large American audiences, he has previously appeared with the Philadelphia Grand Opera and two small Italian opera companies. CBS officials point out that Martini's voice covers more than two and a half octaves, extending up to F above High C. Martini is only twenty-eight years old.

Don Wallace Set

(*Continued from page* 78)

RFC—Hammarlund Isolantite r.f. choke*
SW1, SW2—Powertone sp.s.t. switches
T—Powertone audio transformer
3 Hammarlund Isolantite 4-prong sockets*
1 panel*
1 base*
1 vernier dial
1 triple binding-post strip
1 double binding-post strip
1 battery cable (special) with fuse
5 knobs
Other Bruno coils: 2A, 3A, 4A, if desired

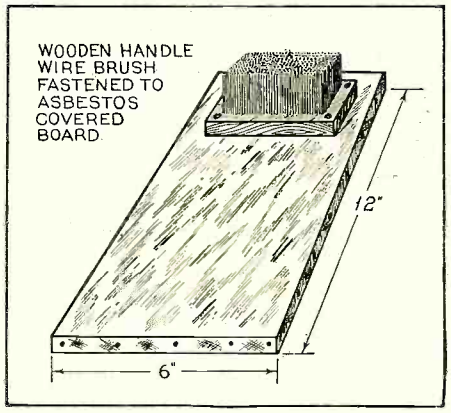
*NOTE: These items are included in the Powertone "Wallace" Foundation Kit.

With the Experimenters

(*Continued from page* 109)

nailed to the asbestos with the wire bristles upward.

This support is very handy on the work bench; for it is large enough to make it easy to find when laying the soldering iron down without removing attention from the work being done. The ordinary soldering iron holder is always getting tipped over or

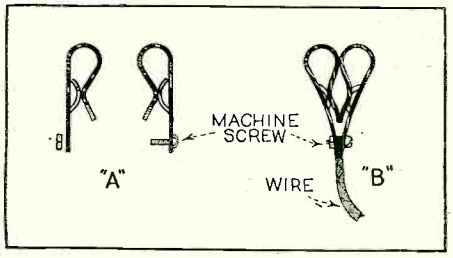


turned around when it is most needed. The broad asbestos surface of this support is hard to miss; and there is no danger of the hot iron burning through the layer of asbestos. The bristles of the wire brush are excellent for cleaning off the tip of the soldering iron. A wipe of the iron on the brush each time it is used will remove the corrosion and keep the point clean and shiny.

CHARLES FELSTEAD,
Los Angeles, Cal.

Simple Test Clips

After hunting all over town and not being able to find any but the usual iron or steel test clips, I decided to make my own. I



stripped two fahnestock clips from a discarded "B" battery, pressed the "faces" or spring sides together, as shown at "B" and held them in position by means of the machine screw.

HARRY D. HOOTEN,
Beech Hill, West Virginia.

Radio and Acoustics

(*Continued from page* 81)

important in industry in silencing apparatus so that it no longer produces noise. These measuring devices are becoming increasingly important where a machine contains many complicated parts, each producing its own particular frequency of sound. In this case the measurement of the various components gives a clue to the part or parts producing the individual sounds which go to make up

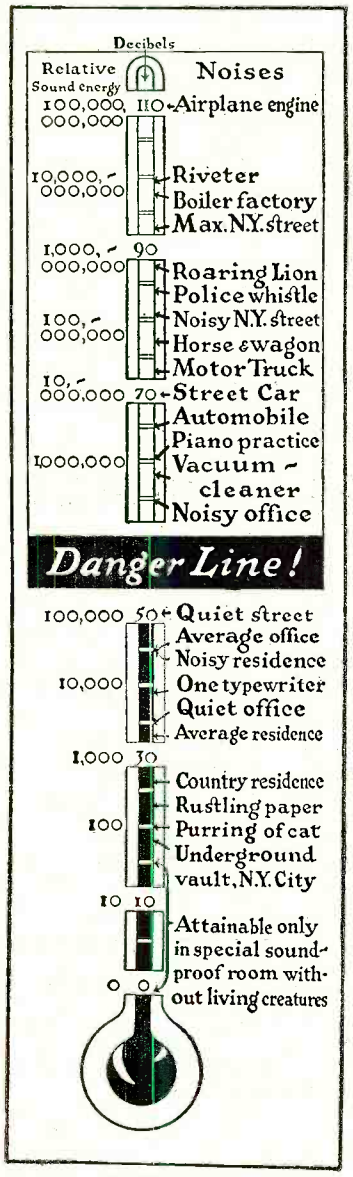


FIGURE 1

the whole noise. Acoustical engineers are finding, therefore, increasing use for such apparatus, as it opens out to them new opportunities for applying their knowledge in new fields of endeavor. For the benefit of of apparatus, the names of the leading makers of equipment of this type will be our readers who are interested in these types supplied on request.

*E. E. Free; Radio Lends a Hand in Fingerprinting Noise. RADIO NEWS, page 271, October, 1931.

DJC on 49.85 Meters

Mr. Howard Adams, Jr., of Baltimore, Maryland, reports the German station DJC broadcasting from 7 to 9 p.m. E.S.T. He says their signal is very good and usually stronger than the British station GSA, found immediately below it on the dial.

Multi-purpose Meter

(*Continued from page* 89)

such as switches, jacks, multiplier and shunt resistors complete the outfit. A simple circuit provides the serviceman with a complete analyzer that need never be obsolete. Even the finest factory-built single-meter set analyzers may be duplicated at less than one-third the cost by the ingenious serviceman, by applying the principles outlined above.

The next article will explain the actual construction of an ultra-modern set analyzer equipped with a single meter made suitable for a.c.-d.c. measurements through the use of a Taurex rectifier and calibrated for many different readings and ranges by means of a Masterdial.

The DX Corner

(*Continued from page* 100)

I2RO, HBI, DJA, DJC, RV59, VE9GW, VE9DR, W1XAZ, W8XK, W3XAL, W3XAU, W9XAA, W9XF, W2XE. He uses a Midwest four-tube converter ahead of a Gulbransen eight-tube receiver.

A New Mexican Station?

"There is a Mexican station broadcasting in the evenings between W1XAZ and W2XAF. I picked them up last night at 7:00 p.m., E.S.T., and they were still going strong at 12:20 midnight. I did not hear any English announcements until midnight and then could not catch the call letters. I believe I got the address correctly as follows: Box 1296, Mexico City. Reception was on the loudspeaker, using a five-tube Pilot Super-Wasp battery-operated set with two-volt tubes."—A. G. Taggart, International Short-Wave Club, Reedy Creek, Manitoba, Canada. (*Editor's Note:* If anyone verifies this reception, we would be glad to hear about it.)

A Report from California

I have had to date practically all of the American stations on the loudspeaker as well as VE9CS, VE9GW and VE9JR in Canada. I also get EAQ and VK2ME steadily. I have only been tuning on the high frequencies for a few months and use a home-built, five-tube, tuned-radio-frequency receiver.—Robert Schulz, Wilmar, California.

A Few Tips from Iowa

"GSB best received foreign station. EAQ next, I2RO very good, VK3ME is best here between 5 to 5:30 a.m., C.S.T. VK2ME is good, but not as good as VK3ME. League of Nations talks on HBL on 31.27 meters is best. XDA and XAM have another partner to help fill up the dials on 31.25 meters. I think the call is XEPC." *Editor's Note:* This may be the same station as spoken about in Mr. Taggart's letter.) "3XAU, LSX are also heard. The German stations are being received on all wavelengths and come in with a wallop. PRADO has developed an oral habit of verifying reception over the air."—C. R. Anderson, Mason City, Iowa.

From Holland to Florida

"In looking over the DX Corner, I notice that no one has yet logged PHI. Since April 9th he has been coming in here with good speaker volume from 8 to 10 a.m., E.S.T., Mondays, Thursdays, Fridays and Saturdays, on 16.88 meters. His programs are for Dutch, East and West Indians and announcements are in Dutch, English, French and Spanish. Between numbers he announces, "Hallo—hallo—hallo—PHI, Hol-

land. The station plays mostly American jazz. He signs off with the Dutch national anthem.—E. M. Law, Miami, Florida.

Best Bets in Pennsylvania

The following stations are reported by Mr. C .T. Sheaks, Turtle Creek, Pennsylvania: EAQ, GSA, GSB, W9XF, W9XAA, VE9DR, W8XK, W1XAZ, W2XAF, W2XE, GSC, HJ1ABB, HJ1ABE, HJ4ABA, FYA, I2RO, DJD, VE9JR, GSE. Mr. Sheaks forgot to mention what receiver he uses.

Readers Who Helped Log Stations for This Month's Report

We are indebted to the following readers of RADIO NEWS who sent in logs of reception this month: F. W. Graetz, Jr., West Lynn, Mass.; Arthur Hamilton, Somerville, Mass.; E. W. Turner, Culpepper, Va.; J. E. Brooks, Montgomery, Ala.; A. M. Troup, Lebanon, N. H.; James F. Dechert, Oxford, Md.; J. E. Dustin, Bradville, Mass.; C. H.. Skatzes, Delaware, O.; W. E. Gibbs, Camden, N. J.; Dr. Roger M. Burgoyne, Winchester, Mass.; C. H. Long, Winston, Mo.; C. Sargent, Dansville, N. Y.; D. Wood, Nixon, Ont., Can.; R. Peach, Canso, N. S., Can.; C. C. Rumsey, Sarasota, Fla:; Ray E. Everly, Newton, Ill.; M. P. Slade, Mount Kisco, N. Y.; C. M. Degree, Schenectady, N. Y.; M. Hill, San Francisco, Cal.; A. Smith, Dyersburg, Tenn; R. Grau, Arecibo, Puerto Rico; H. D. Smith, Warsaw, N. C.; S. M. Heape, Brisbane, Queensland, Australia; R. B. Edwards, Greenwich, Conn.; T. T. Tillotson, Rotan, Texas; D. Lehman, Bronx, N. Y.; H. S. Bradley, Hamilton, N. Y.; C. H. Canning, Los Angeles, Cal.; H. M. Gordon, Erie, Pa.; J. E. Woolley, Evansville, Ind.; George Liley, West Chester, Pa.; G. H. King, Pokwan, Ningpo, Shanghai, China; C. Brand, Brooklyn, N. Y.; Glenn Deater, McKees Rocks, Pa.; J. A. Leininger, Reading, Pa.; Leroy Fry, Venice, Cal.; C. W. Havlena, Washington, D. C.; H. E. Carse, Los Angeles, Cal.; H. A. Poole,; K. A. Bennett, Honolulu, T. H.; D. W. Swan, Jamestown, N. Y.; J. R. Pies, Terre Haute, Ind.; W. Prosser, Cleveland, O.; W. W. Winand, Mechanicsburg, Pa.; A. Brehm, Cincinnati, O.; H. Brown, Bulyea, Sask., Can.; M. Rosenberger, Elizabeth, N. J. The editors acknowledge, with thanks, the assistance of public-spirited readers who have thus cooperated to make these columns successful and helpful.

Heard Regularly in Portland, Oregon

W8XK, W3XAL, W2XAD, W3XAU, W1XAZ, W2XAF, W9XF, VE9JR, W2XE, VE9CS, YV1BC, EAQ, I2RO, FYA; these stations are heard by Mr. Philip E. Veek on a receiver of his own design.

Regular Reception in Columbia, S. C.

Mr. F. F. Pernell, using a Scott standard all-wave receiver two years old, logs the following:

On the 25-meter band, daily, I receive Pontoise from 11 a. m. until around 2:30 p. m. I2RO from about 6 to 7 p. m.

DJD has been coming through with exceptional volume.

HBP, the League of Nations station at Geneva, comes in very distinctly on Sunday afternoons from 5 to 5:45 p. m.

GSA is received daily with good volume and on several occasions Big Ben has been heard to strike, as far away as my neighbor's house across the street. YV1BC comes in excellently.

TI4NRH has been coming in with exceptional volume.

VK2ME and VK3ME are very much better within the last few weeks.

A Report from Shelburne, N. S.

My short-wave set is only the small but famous "Junk Box" built from RADIO NEWS. Later on I expect to get a Midwest or a McMurdo-Silver all waver. The following are some short-wave schedules that are regular and easy to get here: RV59, VE9GW, DJC, DJD, CT1AA, FYA and all the Americans. Philip H. Robinson, Shelburne, N. S.

Best Reception at Lima, Ohio

Mr. R. W. Evans reports the following list as coming in the best and steadiest: VK3ME, DJD, I2RO, RXC, EAQ, YV1BC, GSA, GSB, FYA, YVQ, HJB, VRT-ZFB, KKP, VK2ME, YV2AN, ICEJ (S. S. Rex) and VE9GW.

INDEX TO ADVERTISERS

The Service Bench

(*Continued from page* 107)

be observed in Figure 1 are attractively arranged.

The service shop shown in Figure 2 is a remarkable combination of display advertising and electrical efficiency. As will be observed, the proprietors of the Kronson Service Company, Buffalo, N. Y., have designed their service department in the form of a store within a store and have succeeded in demonstrating most effectively that a service department can be made a feature attraction of any establishment.

FIGURE 1

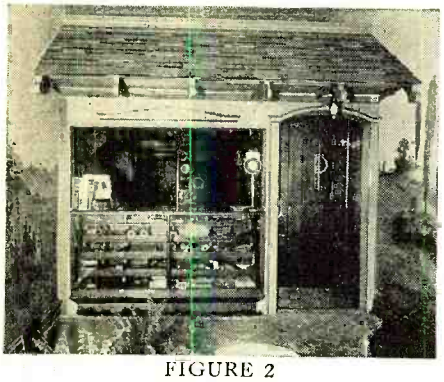


FIGURE 2

ALL IN THE DAY'S WORK

We had an idea that the -27 type of tube was rapidly becoming passé as a detector. However, the perennial suggestions on curing warming-up howl in this tube show it is still with us. C. A. Goditus, of the Paramount Radio Service, Wilkes-Barre, Pa., writes:

"This howl, which is an open-circuit howl, exists only while the type -27 detector is warming up, at which time there is no plate current flowing in the first audio primary. To eliminate this howl definitely, shunt the tube from plate to cathode with a resistance of about 40,000 ohms. This will provide a bleeder current of about 1 milliampere through the transformer primary during the warming-up period."

"Superhet" I.F. Adjustment

Mr. R. K. Wheeler, Indianapolis, Ind., points out a little suspected truth that the conventional use of a 175 kc. oscillator in lining up an intermediate-frequency amplifier often results in a super being operated at considerably below peak efficiency, in respect to both sensitivity and selectivity. This is due to the occasionally faulty premise that the oscillator and signal circuits are tracking with a frequency difference of exactly 175 kc.

Checks made by Mr. Wheeler on a number of supers operating unsatisfactorily with the i.f. circuits carefully peaked at 175 kc. showed, in every instance, that the frequency difference had crept above or below this value, due probably to minute variations in coil forms and condenser plate spacing over a period of time. The natural tendency in tuning such a receiver is to compromise between r.f. and i.f. resonance—i.e., detuning the r.f. circuit slightly to bring the difference between the oscillator frequency and the signal frequency somewhat closer to 175 kc. The natural result is loss in sensitivity and relatively broad tuning.

The logical cure, as Mr. Wheeler points out, is to tune the i.f. to the frequency difference, rather than try to compensate the rather complicated tracking circuits to conform with the altogether arbitrary 175 kc. intermediates. This is most easily accomplished by tuning in a station, or local r.f. oscillator, and adjusting the i.f. circuits as the tuning dial is wiggled back and forth. Adjust, of course, for greatest output.

Kit Kink

Frank W. Bentley, our official service cameraman of Missouri Valley, Iowa, observes:

"A small roll of battery or connection wire is an aggravating thing around the bench or in the kit. One or both ends are usually twisted around the roll to keep it from unwinding, and a portion of the roll is always spreading and catching on everything. When you want a piece of it, you have to unwind several inches, get the sharp kinks out or cut it off to get smooth wire to work with. Cut a band from an old tire inner tube (or use a large rubber band) and place it around the roll as shown in Figure 3. Make the draw loop to cover and hold the wire ends and snap the remainder of the band around the lower half of the roll. The ends are always straight and ready to get at, while the roll is neat, solid and compact. The band is easy to put on and remove."

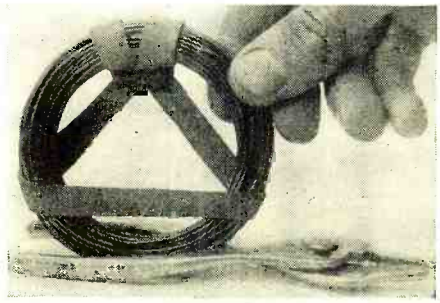


FIGURE 3

Condenser Speaker Repair

"A common fault of the Kylectron condenser speaker is an annoying spitting or arcing over which occurs more or less periodically at low volume, and at high volumes on overload peaks. This is caused by a lack of leakage path. I find a simple remedy is to shunt the speaker terminals with a 3 to 5-megohm carbon 1-watt resistor. There is no change in volume or quality.

"If there are holes in the diaphragm of any section, it is not necessary to disconnect that section, due to the shorting of the metallic covering to the back electrode. Scrape a clean circular path, with a knife, around the hole. Scrape all the metallic covering off, to the rubber, and wipe clean. This prevents a short-circuit even if the edges of the hole touch the back electrode."—C. R. Cantonwine, Rockford Radio Laboratory, Rockford, Ill.

Hum in a Crosley

"I have had several Crosleys brought to my attention with the complaint of hum—usually of gradual appearance, building up to an annoying degree in the course of months. By a process of elimination, the trouble was located in the mershon condenser

"Replacement of this unit is costly, and the expense can almost always be avoided by drilling a small hole in the hard rubber top and filling with *distilled* water to within ¼ inch of the top. In drilling the hole, caution should be observed not to damage the electrodes within. The condenser should be fully discharged when refilling, and the hole plugged with sealing wax." W. J. Golson, Dothan, Alabama.

How to Sell P. A. Installations

D. H. Wright, president of Wright-DeCoster, makes the following observations on the technique of merchandising P. A. equipment.

"Demonstrations are usually necessary before any large public-address sale can be closed. This is especially true of out-of-door installations. Yet I cannot advise too strongly against putting in a complete installation on approval, gratis. If such a demonstration is to be made, a rental charge should be agreed on before the equipment is installed.

"It is always best to give the demonstration in the location where the installation is to be made. If the installation is going to be made in a stadium, install one horn of the type that is going to be used. After connecting the speaker to the microphone and turntable, see that the horn is covering the most difficult spot, and then, when you are convinced that the results are going to be good, make your demonstration.

"Explain that the complete installation will cover the whole stadium as well as the particular spot chosen is being covered where you and the customer are standing.

"It is an excellent plan to talk about the merits of your equipment during the playing of a good record—but don't talk too much. The music lends a background and tends to prove what you are saying.

"There are two good reasons why a partial sound installation is better for a demonstration than a complete one. First, you give only an idea of what the complete job is going to sound like. This has the effect of making one anxious to hear the complete installation. 'A taste whets the appetite more than a full meal.' Second, it stops the competitors, who are inclined to be derogatory in their criticism, from doing their best to poison the purchaser against your installation."

Radio News Technical Information Service

The Technical Information Service has been carried on for many years by the technical staff of RADIO NEWS. Its primary purpose is to give helpful information to those readers who run across technical problems in their work or hobby which they are not able to solve without assistance. The service has grown to such large proportions that it is now advisable to outline and regulate activities so that information desired may come to our readers accurately, adequately and promptly.

Long, rambling letters containing requests that are vague or on a subject that is unanswerable take up so large a portion of the staff's working time that legitimate questions may pile up in such quantities as to cause a delay that seriously hinders the promptness of reply. To eliminate this waste of time and the period of waiting, that sometimes occurs to our readers as a consequence, the following list of simple rules *must* be observed in making requests for information. Readers will help themselves by abiding by these rules.

Preparation of Requests

1. Limit each request for information to a single subject.
2. In a request for information, include any data that will aid us in assisting in answering. If the request relates to apparatus described in RADIO NEWS, state the issue, page number, title of article and the name of the device or apparatus.
3. Write only on one side of your paper.
4. Pin the coupon to your request.

The service is directed specifically at the problems of the radio serviceman, engineer, mechanic, experimenter, set builder, student and amateur, but is open to all classes of readers as well.

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Complete information about sets described in other publications cannot be given, although readers will be referred to other sources of information whenever possible. The staff cannot undertake to design special circuits, receivers, equipment or installations. The staff cannot service receivers or test any radio apparatus. Wiring diagrams of commercial receivers cannot be supplied, but where we have published them in RADIO NEWS, a reference will be given to past issues. Comparisons between various kinds of receivers or manufactured apparatus cannot be made.

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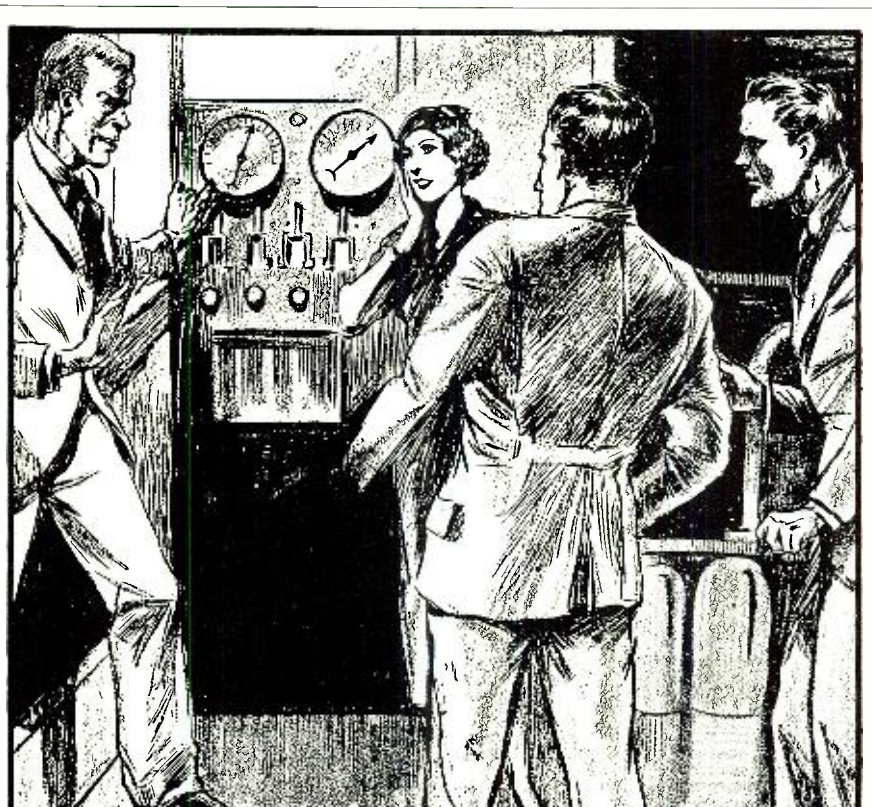

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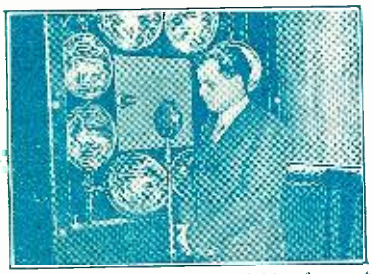

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