Fig. 1. M. B. Sleeper, checking the voltage on the tubes with a Jewell tablemeter, before installing the set in the cabinet—Photographed in a corner of the library in the New York Laboratory

Non-Regenerative Browning-Drake
KB-8 Receiving Set

A set which will give you all that you can ask of a receiver—and results which can be obtained without recourse to controlled regeneration

WHEN a B.C.L. asks a dealer or set builder to construct a receiving set for him, he generally has uppermost in his mind one specification—the set must be satisfactory in operation and results. An experimenter, on the other hand, buying parts to make an outfit, generally wants something unusual in the way of operation or design.

The non-regenerative Browning-Drake receiver, type KB-8, was designed to meet the requirements of both the B.C.L. and the experimenter.

For the former, the KB-8 has been made irreproachable in operation; that is, there are two adjustments for tuning and that is all, once the rheostats and neutralizing condenser have been regulated. The set can be tuned quickly, for it requires only two hands, and there are no auxiliary controls to play with and which will cause the set to howl by throwing it into oscillation. Therefore, the set is not open to criticism for its bad manners, either by the operator or his next-door neighbor, who resents so strongly the presence of sets which are tuned by putting the set into oscillation in order to pick up squeals. The system of audio frequency amplification is equal to any

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other, and made doubly satisfactory because distortion cannot be introduced by putting the circuit into the unstable condition which is encountered just under the point of oscillation. The current consumption is extremely low, so that good B batteries will give such long life that no one can complain of expense or dissatisfaction from that source. The construction is rugged and permanent, precluding the development of loose parts and broken connections. The range is sufficient to bring in, at full volume, any broadcasting that can be received without distortion on a super-sensitive receiver.

ducing the Donle detector tube. This tube operates on a principle recently discovered by Mr. Donle, and in a recent series of tests demonstrated a degree of sensitiveness which has not been approached previously by any other tube. The electrical characteristics are somewhat similar to the D-21 Sodion. It does not require a potentiometer, it can be operated without a gridleak or grid condenser, and the plate impedance is very high. With 22 volts, the plate current is only 0.1 milliampere. The filament takes 0.25 ampere at 5 volts.

The sensitiveness of the detector is not only important in DX reception, but it

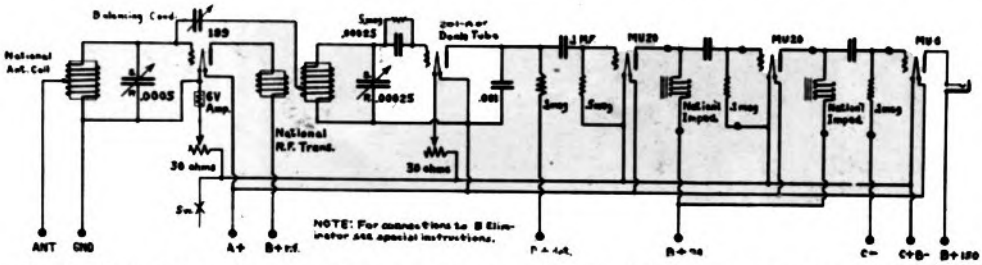

Fig. 2. Only two tuning controls are employed. The rheostats do not require readjustment, nor can they be used to put the circuit into oscillation. Sometimes tuning is sharper if the grid return to the first tube is put on the other side of the Amperite.

The experimenters will quickly recognize a number of innovations. The non-regenerative circuit, developed by RADIO ENGINEERING, is a conclusive demonstration of the fact that sensitiveness, sharpness, and quality are not confined to sets using regeneration control in one form or another. The National S.L.F. condensers, running over a compass of 270 degrees, are brand new, as are the National impedaformers which contain the chokes and stopping condensers, and mountings for the gridleaks. The Electrad rheostats, switch, and phone jack are just being put on the market, the Walbert neutralizing condenser is an innovation, and such mechanical features as the arrangement of the amplifying units and the pin-jack panel for voltage readings are shown for the first time.

Of special importance is the introduction of the new Donle detector tube. Harold P. Donle, formerly chief engineer of the Connecticut Telephone and Electric Company and inventor of the Sodion detector, the most sensitive type which has ever been made, is now pro-

has a marked effect upon the quality. When a fairly high minimum voltage must be applied to the grid in order to make it function, it is obvious that a part of the received speech must be lost. Increasing the sensitiveness of the detector reduces the amount of modulation which does not go into the A.F. amplifier.

Description of the KB-8 Set

In the description of the KB-8 receiver, the various units and features have been sub-divided so as to make them as understandable as possible. This is a most satisfactory way since the unusual features of this set can be best explained by discussing them individually. This set is entirely unlike any other that has been shown and the features are well worth careful consideration.

As to the actual construction details, blue prints are available which give the panel patterns and picture wiring diagram in full size, step-by-step assembly instructions with explanatory notes, terminal checking list by which the possibility of wrong or omitted connections is obviated, and a complete list of the

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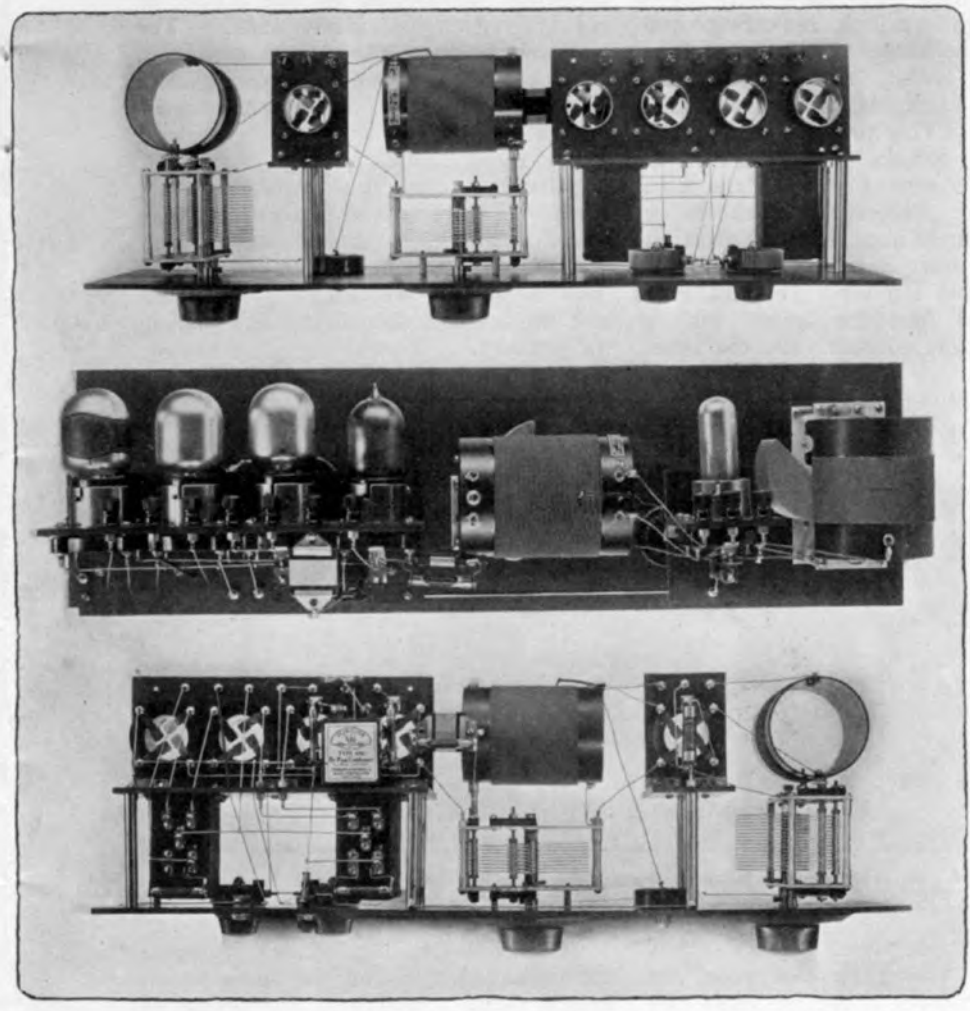

Fig. 3. Top, rear, and bottom views of the KB-8. Notice the beauty of the mechanical design, worked out in a way to make the leads of minimum lengths, with all terminals readily accessible

parts used in the original set, as well as the electrical constants.

This was done in order to devote the space in RADIO ENGINEERING to a complete discussion of the set, with the construction data available in blue print form to those who want to build it.

The R. F. Amplifier Unit In the circuit of the R.F. amplifier there is the left hand tuning unit, looking at the set from the front, R.F. tube panel, and neutralizing condenser.

The coil is identical in dimensions to that which has been furnished in the standard Browning-Drake units built by the National Company, but the 0.0005 mfd. variable condenser is of S.L.F. design, turning through 270 degrees. A Velvet vernier is employed, with a dial having 150 graduations. This gives an effective reduction ratio of 7 to 1.

Two panel support pillars, 3⅜-ins. long by ⅜-in. in diameter carrying a vertical panel 2½ by 3½ ins., 3/16-in. thick, to which another panel, of the same size, is secured with 1-in. angle brackets. An Amsco socket is mounted under the horizontal panel. Instead of fastening the socket with two screws as was originally intended, the socket is held to the panel by ⅝-in. 6–32 R.H. screws running through the panel, socket base,

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and into Lastites. The clips were taken from a single gridleak mounting, and fastened to the socket through the regular mounting holes. The clips are held by ½-in. 6–32 R. H. screws threaded into Lastites. This provides a convenient mounting for the 6V-199 Amperite.

If a UX199 tube is used for the R.F. amplifier, the Amperite, which is in series with the 30-ohm rheostat, makes it impossible to burn out the tube by turning the rheostat too far. The UX tube can be fitted into the socket with a Pacent Isolantite adapter. On the other hand, some people prefer the UV-201-A for an R.F. tube. In that case, the Amperite terminals must be short circuited. Then the rheostat gives the usual filament control.

A Walbert neutralizing condenser is mounted between the pillars which hold the R.F. tube panel. This is a very convenient type of neutralizing condenser for it can be adjusted from the front of the panel. However, since the adjusting screw is covered by a cap nut, there is no tendency to play with it, as is the case with types having a regulating knob. The connection of the neutralizing condenser is shown in Fig. 2.

Detector Tuning Circuit No change has been made in the inductance for the detector circuit. The standard regenaformer coil is employed, but the tickler is omitted, and a 0.00025 S.L.F. condenser substituted for the S.L.C. or S.L.W. types previously used. The mechanical details can be seen in Fig. 5.

It has been observed by some engineers that it is difficult to build a non-regenerative R.F. transformer which, without regeneration, gives a high degree of amplification over the entire broadcast range. Tests on the Browning-Drake transformer show that the loss at high wavelengths is practically negligible. This is due to the design of the coils and the method of winding and placing the primary.

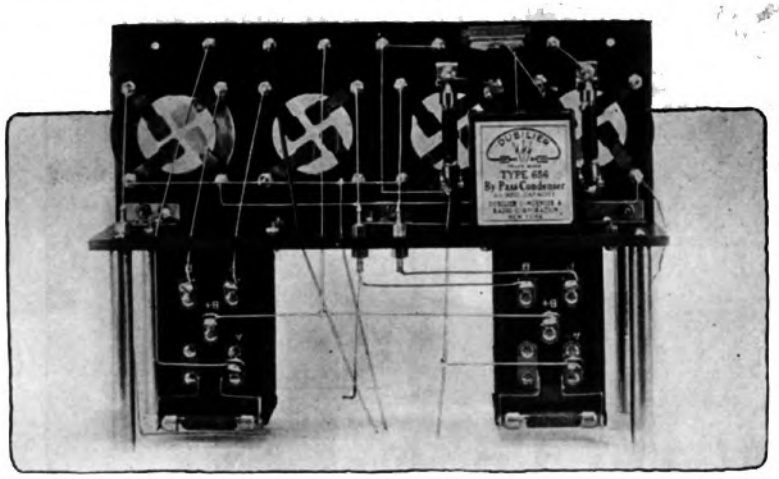

Fig. 4. Detector and amplifier unit removed from the set. The leads for the resistance stage are mounted on the two right hand sockets

In other words, regeneration increases the signal strength over the whole wavelength range. However, the design of this set is such that, even with a 201-A tube for a detector, a very high degree of sensitiveness is obtained. Using the Donle detector tube, the set showed a response equal to that of the Browning-Drake receiver equipped with a tickler. Instead of using transformer or impedance coupling after the detector, the coupling for the first stage is resistance. Results shown by hundreds of reports from RX-1 owners confirmed our judgment in deciding upon resistance for the first stage. Moreover, because of the high impedance of the Donle tube, greater amplification is obtained in the first stage with resistance than with either transformer or impedance coupling.

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Fig. 3 shows the Donle tube in the set, while Fig. 4 illustrates the method of mounting the plate resistor and grid-leak for the first stage. The 0.1 mfd. stopping condenser is fastened between the resistances on to the vertical panel. The clips were taken from two single resistor mountings, and fastened to the regular mounting holes of the sockets just as the clips for the Amperite were put in place. Additional details will be found in Fig. 6. The 0.001 mfd. by-pass condenser can be seen in Figs. 3 and 6. tites have been used for practically all of the connections. When a screw is too long to take a Lastite, put the screw in place and fasten it with an ordinary 6–32 nut instead of the Lastite. Then cut the screw off and remove the nut. That will leave the screw just long enough to go into the Lastite. A ¼-in. Spintite wrench makes this work a great deal easier. In two or three cases it is necessary to cut the head from a screw in order that one end can go into a Lastite or coil mounting pillar, with a Lastite

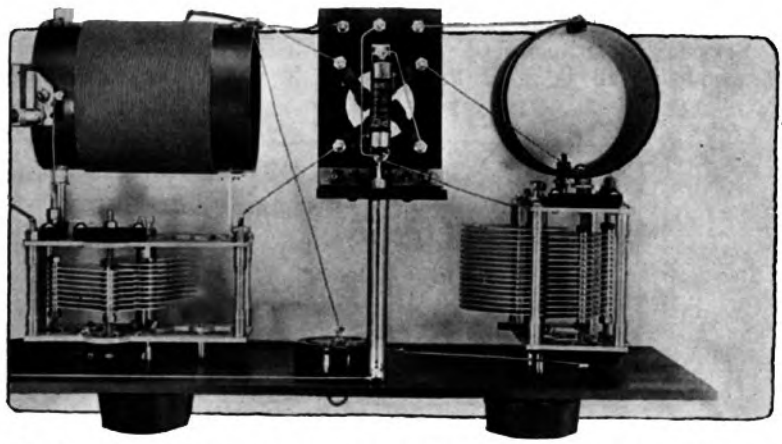

Fig. 5. The non-regenerative Browning-Drake coils mounted on the new National S. L. F. condensers. The R. F. tube, controlled by an Amperite, is located between them

Description of the A. F. Amplifier The two stages of impedance amplification are connected in the conventional manner, altho the combination of impedance or transformer amplification following a first stage of resistance coupling, first shown in the RX-1 receiver, was originated by RADIO ENGINEERING.

The impedaformers are fastened to the vertical panel. The outer mounting screws at the top, looking at the set from the front, also hold the angle brackets which fasten the horizontal panel to the vertical panel. This detail is explained in the blue prints. The photograph in Fig. 4 was taken of the amplifier unit removed from the front panel after it had been connected in the circuit. You can see that this unit can be entirely assembled and almost completely wired before it is put on the front panel. These pictures show the manner in which Las- on the other end. All these details are explained on the blue prints.

Fig. 7 illustrates the mounting of the rheostats, jack, and filament switch. These three items have just been developed by the Electrad Company and are of a type which will appeal strongly to those who look for mechanical excellence as well as convenience.

When the set is mounted in a cabinet, it may be well to arrange a small wooden block at the back of the cabinet so as to support the two corners of the large tube panel. The construction is very sturdy, however, for three angle brackets hold the horizontal panel in place. The vertical panel, in turn, is fastened to the front panel by four heavy panel support pillars.

Panels and Panel Material The front panel measures 7 by 24 ins. The original model was made with Celo-

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ron, 3/16-in. thick, altho the Crowe Name Plate Company is furnishing a metal panel, beautifully engraved and finished, which can be used in this set without any loss of efficiency.

In the rear there are two panels 2½ by 3½ ins. and two 9½ by 3½ ins. all of 3/16-in. Celoron.

The full size blue prints show the locations of the centers for the holes. Unless otherwise specified, the holes are made with a No. 18 drill. A double circle indicates countersinking. The necessary engraving is also indicated on the panel patterns. If you do not know where to have your panel engraved, the Service Department of RADIO ENGINEERING will be glad to tell you the location of the nearest concern that handles this work.

No engraving for the binding posts is called for, for Eby posts have been used throughout. If you can't get a binding post engraved B— C+, use a plain binding post and scratch the markings on it yourself, filling them in with white crayon.

Just to bring the binding post arrangement right up to the minute, we used a red Eby binding post for the 135 volts. As a matter of fact, it is well to be a little careful in handling that lead for, altho 135 volts is not dangerous, it is possible to get a slight kick from it.

Selection of the Tubes Either a UX-199 tube with a Pacent Isolantite adapter or a UV-201-A tube can be used in the R.F. stage.

We are inclined to prefer the UV-201-A as being more sensitive, altho it may be easier to neutralize the UX-199. We do not recommend the UV-199 with an adapter because adapters for UV-199's too often develop contact troubles.

The UV-201-A as a detector is entirely satisfactory in this set for all ordinary purposes but, as has been stated previously, the Donle tube gives a very definite increase in distance, volume, and quality, certainly more than enough improvement to justify the increased cost.

The first and second amplifying tubes should be Daven MU-20's, with a Daven MU-6 for the last stage. These tubes were chosen because they operate directly from 6 volts and do not require a rheostat. For this reason, it is well to watch the storage battery so that it will not drop appreciably below 6 volts.

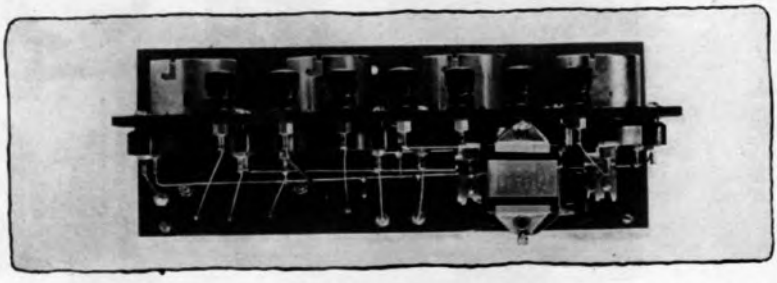

Fig. 6. Rear of the detector-amplifier unit. Note the simplified system of wiring made possible by the use of Lastites

Other types of amplifier tubes can be used provided they are the equivalent of the Daven tubes in their electrical characteristics.

A and B Battery Supply Binding posts on this set call for 22½, 67½, 90, and 135 volts. For B battery operation, the National Carbon Company recommends three No. 772 B batteries and two No. 771 C batteries.

The current drain on the set with 9 volts C battery for the last tube, with a UV-201-A for the R.F. amplifier, Donle detector tube, two MU-20's and one MU-6 is divided as follows. R. F. tube, 1.75 milliamperes, Donle detector tube, 0.1 M.A., first two A.F. tubes, 2.75 M.A., and the last power tube 5.25 M. A.

It is interesting to note that strong signals decrease the current in the last tube, instead of increasing it. Therefore, the total drain fluxuates between 7 and 10 M.A.

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The Acme B eliminator is quite satisfactory for this outfit. The low voltage binding post on the eliminator should go to the B+22 volts binding post on the set and the high voltage tap should be connected to the B+67½, B+90, and B+135 posts. That puts the full voltage on the R.F. and A.F. tubes.

Fig. 7 illustrates the power supply used in the permanent set-up for the KB-8 in the library of the New York laboratory. We have had excellent results with the 6-volt Gould Unipower A and it is most convenient to use for it requires practically no attention. Complete details on the Gould Unipower were given in RADIO ENGINEERING for December, 1925.

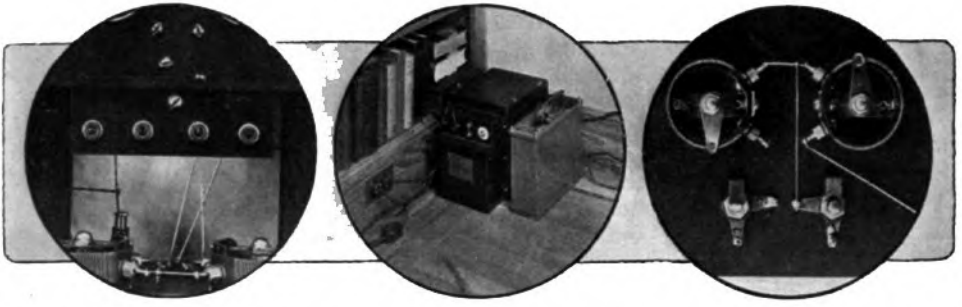

Fig. 7. Left, the tip jack panel, for voltmeter connections. Centre, the Gould Unipower A and Acme B eliminator for A. C. operation. Right, details of the Electrad rheostats, jack, and switch

Notes on the Installation

Thirty or forty miles from New York City, the KB-8 gives as sharp tuning as anyone can ask of a set, even when it is operated on a 100-ft. single wire antenna. This is a convenient size, not too big, but large enough for good pick-up. With a 75 or 100-ft. antenna the range is equal to any of the very best receivers.

In congested areas where there are a number of broadcasting stations operating simultaneously, it is necessary to reduce the antenna to 25 or 30 ft. The ground lead should not be more than 10 or 15 ft. If it is necessary to use a longer ground lead, reduce the length of the antenna accordingly. Then the tuning will be sharp enough to cut out local interference. The ability to use the KB-8 on such a short antenna makes it particularly well suited for installation in apartment houses where an outdoor antenna is not practical.

Any standard 7 by 24-in. cabinet can be used for the KB-8, allowance having been made around the edges of the panel so that the parts behind will not interfere. A depth of 7 1/6-ins. is required.

On general principles, we do not recommend a cabinet which has a loud speaker chamber built as a part of the cabinet. Often times mechanical vibration from the loud speaker causes the tubes to howl. However, a cabinet such as the Jewett Radio Highboy, which has a separate papier maché sound chamber mounted at the back of the cabinet, with the bell coming up to a screened opening, does not develop that trouble.

It is advisable to have the B battery eliminator mounted a slight distance from the set itself, and not directly behind it in the same compartment, altho we have not had any difficulty with the Acme eliminator in this respect.

Neutralizing and Tuning

When the set has been completely assembled, put in the tubes and adjust the rheostats so that the correct voltage is applied to the terminals of the R.F. and detector tubes. The voltage must be measured directly at the socket contacts and not at the binding posts. A UX-199 should have 3 volts at the socket, or 5 volts for a UV-201-A or Donle detector tube. As a matter of fact, the Donle detector tubes which we have tested generally operate well below their rated filament voltage, from 3½ to 4½ volts. This is an excellent feature about the

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tubes because it not only gives them unusually long life but also reduces the current drain on the A battery.

Test the voltage on the three A.F. tubes. This should be not less than 5½ or more than 6.1.

To neutralize the set, remove the cap nut from the Walbert neutralizing condenser on the front panel, tune in a station, and turn the left hand condenser dial back and forth, while you adjust the neutralizing condenser screw with a short stick sharpened at one end, until no whistle is heard while the condenser is varied. It is well to adjust the set on a fairly low wavelength. If you have a UX-199 tube for the R.F. amplifier, cut the R.F. tube rheostat out before you start neutralizing. Then you can reduce the volume by increasing the resistance in the rheostat. Once the set is adjusted, tighten up the cap-nut on the neutralizing condenser and leave it alone forever after. It may require readjusting if you change the antenna or the R.F. tube. Otherwise it should not be touched. The dial readings on the KB-8 run quite close together. On any set with conductive coupling to the antenna it is not possible to make them run perfectly true but the difference should not be appreciable.

Choosing the Loudspeaker In our installation we used an Amplion loud speaker type AR-19. Few set builders or engineers have considered the effect of the loudspeaker on the plate current consumption in the last tube. Quality being equal, it is wise to choose a loudspeaker which gives as low current consumption as possible. In the tests made on this set it was found that different types of loudspeakers varied the plate current as much as 4 M. A. The Amplion unit gave the lowest current consumption. This factor is well worth keeping in mind, for a difference of 4 mils in the plate current, if a set is run from B batteries, makes quite a little difference in the life of the batteries. The current of 5.25 M. A. previously noted for the power tube was obtained with the Amplion unit in the circuit.

Suggestions about the Assembly The non-regenerative Browning-Drake set has been designed with the utmost care, and every bit of useful information included in the dataprints. It is only fair, then, to expect the constructor to be just as careful in his workmanship when he assembles the set. It is not possible to make any design proof against carelessness. No set can be made successfully unless the instructions are followed accurately, the correct parts used, and real thought and care put into the work.

The original model has been wonderfully successful in its operation, even beyond our expectations, and these results can be duplicated by anyone who will follow the instructions. If, however, the parts are thrown together in an experimental set-up, it is not fair to complain if you are disappointed in the results.

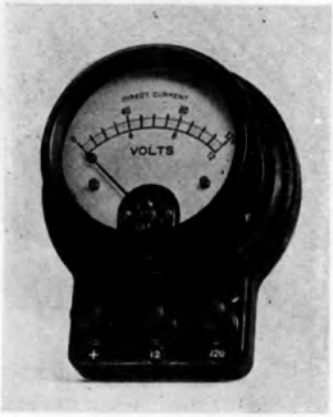

Fig. 8. Double-reading Jewell voltmeter for checking A and B batteries

The design of radio sets has become a real art, and we have done everything possible, at the same time, to present the designs in a way which anyone can copy if he will make the effort. Do not try to wire up the set from the schematic diagram. The picture wiring diagram has been made to protect you from mistakes. If you use the terminal checking list also, marking each terminal as you solder it, you will be able to tell when you finish the job if any wires have been omitted or if they have been connected in the wrong places.

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