

The Wireless World

THE
PRACTICAL RADIO
JOURNAL
24th Year of Publication

No. 770.

FRIDAY, JUNE 1ST, 1934.

VOL. XXXIV. No. 22.

Proprietors: ILIFFE & SONS LTD.

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Advertising and Publishing Offices:
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LONDON, S.E.1.

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MANCHESTER: 260, Deansgate, 3.

Telegrams: "Iliffe, Manchester." Telephone: Blackfriars 4412 (4 lines).

GLASGOW: 26B, Renfield Street, C.2.

Telegrams: "Iliffe, Glasgow." Telephone: Central 4857.

PUBLISHED WEEKLY. ENTERED AS SECOND CLASS MATTER AT NEW YORK, N.Y.

Subscription Rates:

Home, £1 1s. 8d.; Canada, £1 1s. 8d.; other countries, £1 3s. 10d. per annum.

As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

No Compromise with Quality!

But the B.B.C. Thinks Otherwise

SHOULD we compromise with quality of broadcast reproduction, or should our aim be to attain the most faithful reproduction which the skill of the manufacturers can achieve?

One would have expected that the answer of the B.B.C. and the whole industry would have been that they were prepared to co-operate to give reproduction as good as the transmissions permit. But we have been rudely startled recently to discover that the B.B.C. holds no such view and that a compromise with quality is regarded as justifiable, and even to be encouraged.

For some while past we have felt that it would be a useful service if the B.B.C. were to transmit from time to time standard frequencies so as to enable the owner of a receiver to judge the performance which he is getting from his set, and recently there has been correspondence on this subject which has once more brought it to the public notice. The result of this renewed demand for such a service from the B.B.C. has been the disclosure of an attitude on the part of the Corporation which is, at the very least, disturbing in relation to its possible effect on the future of quality reception.

We are well aware that, because of the present congested state of the ether in Europe, highly selective receivers are necessary. But on account of this need for selectivity the B.B.C. adopts the view that the manufacturer is justified in limiting the frequency response of his receiver, and that if standard frequencies were radiated the

more selective receivers of the manufacturers would be penalised in comparison with those designed mainly for local reception.

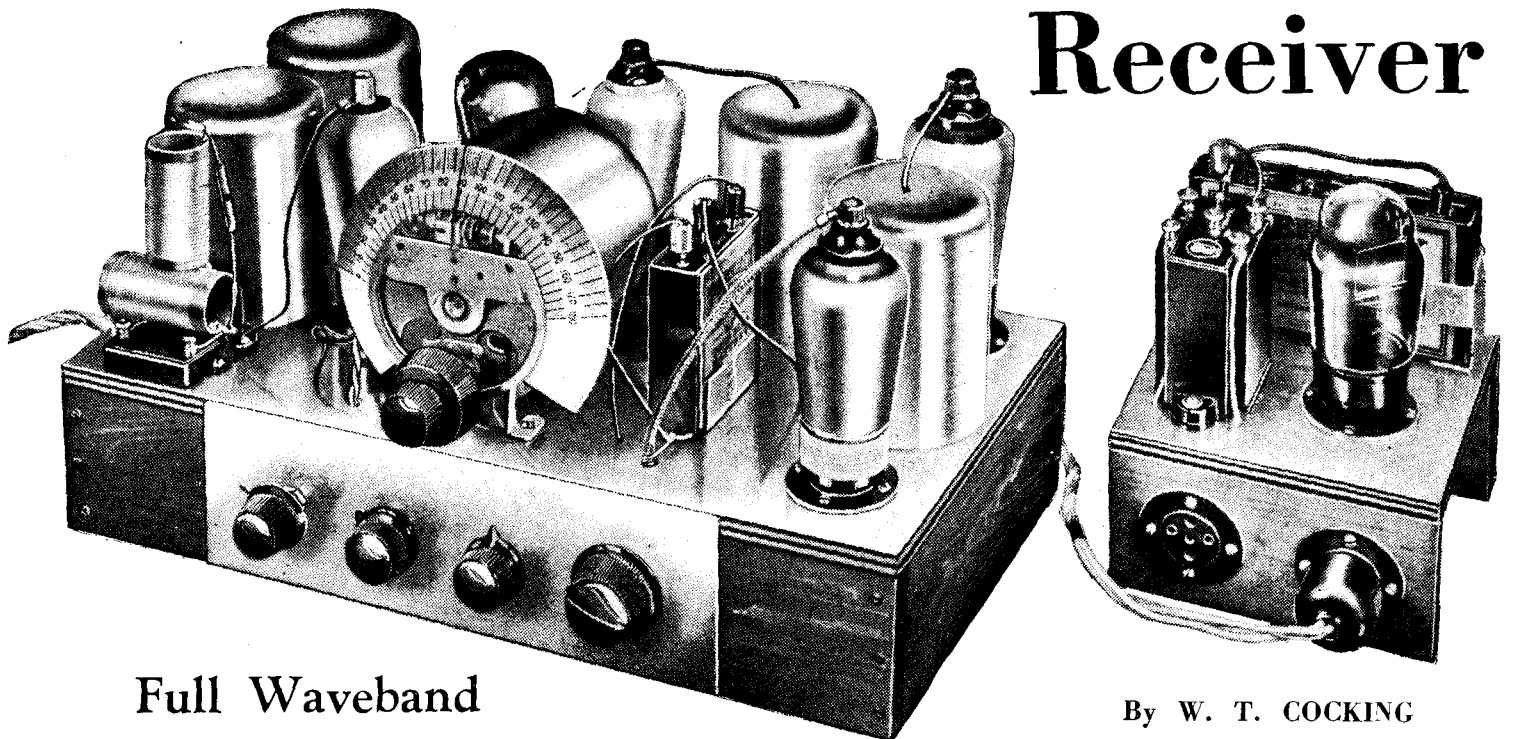
In our view the B.B.C. should do everything possible to help the public to appreciate the high standard of quality of which broadcasting is capable, and we deplore anything in the nature of a conspiracy, however well intentioned it may be, between the B.B.C. and manufacturers which has for its effect a sacrifice of quality merely in order to simplify the task of the designer and producer of sets.

No Compromise Necessary

There is no reason why receivers should not be designed for the highest possible quality reception from nearby stations, or any station not suffering from adjacent-channel interference, yet capable of giving very high selectivity when required to do so. It is quite unnecessary in these days to assume that receivers must be designed to meet exacting requirements of selectivity to avoid adjacent-channel interference, and that all other reception must fall into line with an equally narrow frequency band. If the B.B.C. persist in this retrograde policy as regards quality, it would be equally logical for them to limit the frequency band of the transmissions.

If set manufacturers must not be penalised by making a comparison in quality possible, then surely a restriction in the transmitted frequency band is the simplest way to put all types of sets on the same footing and end the pursuit of the ideal in reproduction by thus making it impossible of achievement. This would make sure that the public would always recognise "wireless" as distinct from anything better.

The Battery Single-Span Receiver



Full Waveband Coverage Without Ganging or Switching

By W. T. COCKING

SINGLE-SPAN tuning represents one of the most interesting receiver developments of recent years, and the principles underlying its operation were fully described in recent issues of *The Wireless World*.¹ The outstanding advantages of the new system are the absence of any ganging and the possibility of obtaining a tuning range wide enough to cover the 200-2,000 metres band in a single sweep of the variable condenser and without any necessity for coil changing. In addition, the absence of second channel interference and other forms of whistle generation render the system particularly adaptable to modern broadcasting conditions, while the introduction of variable selectivity leads to a further improvement in the performance obtainable.

The wide tuning range and absence of ganging are achieved by a modification of the now familiar superheterodyne. The use of an intermediate frequency higher than that of any received signal, together with an oscillator working on a frequency higher than the intermediate frequency, permits all frequencies lower than the intermediate frequency to be received with a single small coil and variable condenser in the oscillator circuit. In the Single-Span Receiver, for example, the intermediate frequency is 1,600 kc/s and the oscillator functions over a range of 3,100 kc/s to 1,750 kc/s, thus permitting signals between 1,500 kc/s (200 metres) and 150 kc/s (2,000 metres) to be received. This

alone would not give single-span tuning, for normal superheterodyne practice dictates that certain circuits must be tuned to the signal itself. The difficulty is overcome by the use of signal-frequency circuits so designed that they are responsive to all signals within the 150-1,500 kc/s range, but attenuate signals outside that range, and so prevent second channel interference.

The use of a high intermediate frequency is not in itself new, and it was used many years ago in the Infradyne receiver. For the process of frequency changing, however, this type of set aimed at using the sum of the signal and oscillator frequencies rather than the difference, with the result that a wide tuning range with a given coil and condenser was hardly possible, and signal frequency tuning was still necessary. As a result, the system offered little or no advantage over the ordinary superheterodyne and soon fell into disuse.

Advantages of a High I.F.

It is interesting to find, however, that a system employing an aperiodic aerial circuit and, therefore, more nearly akin to single-span tuning, was developed by von Kramolin as early as 1927, although he envisages the use of a fairly low intermediate frequency. In an example, he suggests the use of a frequency of some 500 kc/s for the I.F. circuits, with which reception can be obtained over a band of 1,500-550 kc/s, (200-550 metres) with an oscillator circuit tuning between 2,000 and

1,050 kc/s as the sole tuning control. Since the second channel range in 2,500-1,550 kc/s, it is theoretically possible to employ aperiodic signal frequency circuits and obtain freedom from second channel interference. The design of a suitable filter, however, would be a matter of considerable practical difficulty on account of the proximity of the receiving and second channel ranges.

The high intermediate frequency employed in Single-Span Receivers avoids difficulties of this nature and permits a tuning range covering both medium and

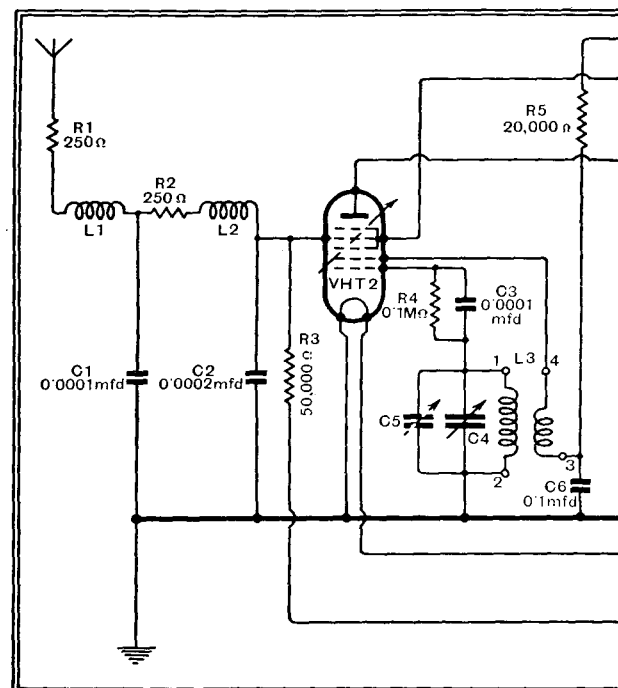


Fig. 1.—The complete circuit diagram of the receiver

¹ March 23rd, 30th, and April 6th, 1934.

long waves to be obtained. This alone, however, would not be sufficient to produce a successful receiver, and special design, not only of the aerial filter, but also of the I.F. circuits is essential to a satisfactory performance. The aerial filter must be as efficient as possible and give a substantially even response over the receiving range, but yet give a high degree of attenuation in the second channel region. In the I.F. circuits, the tuning coils and condensers must be designed for minimum losses and the ratio of inductance to capacity chosen for maximum selectivity rather than for optimum amplification. Furthermore, to obtain adequate selectivity for modern conditions it is necessary to employ reaction. By combining reaction with a special circuit arrangement and automatic volume control, it becomes almost entirely a selectivity control and has comparatively little effect upon the amplification.

Requirements for Battery Operation

The Single-Span Receiver² was built upon these lines and its performance well bore out the expectations based upon a study of the theoretical considerations. Single-span tuning, however, is by no means confined to a mains-operated set, and the principle is equally applicable to a battery receiver. The receiver described in this article is essentially the same as the earlier mains model, and the alterations which have been made are only those necessary for the different types of valves and those needed to preserve economy of anode current consumption, for no others have been deemed necessary or advisable.

The circuit diagram of the receiver appears in Fig. 1, and it will be seen that the first valve in the set is a heptode frequency-changer. The aerial filter, which permits all signals between 200 and 2,000

² *The Wireless World*, April 13th, 20th, 27th, 1934.

metres to be simultaneously applied to the control grid of the tetrode section of this valve while attenuating all signals outside this range, consists of the two coils L1 and L2 with the resistances R1 and R2 and condensers C1 and C2. The oscillator section, with which all tuning is carried out, comprises the coil assembly L3 with the tuning condenser C4 and the padding condenser C5.

THE principle of single-span tuning, in so far as it permits single-control operation without the use of ganged condensers, is a radical departure from accepted methods. Its further advantages of providing a very wide tuning range without the need for wave-band switching and of eliminating second channel whistles make it ideal for modern conditions. The principle is by no means confined to mains operated sets, and in this article will be found constructional details of a battery operated receiver capable of giving an outstanding performance

The intermediate frequency first appears in the tetrode anode circuit of this valve and preliminary selection is afforded by the pair of coupled tuned circuits L4 and L5, to the latter of which reaction is applied. The potentials developed across the trimming condenser C9 are applied to the grid of a triode valve which serves the dual purpose of providing reaction and of isolating the circuit to which reaction is

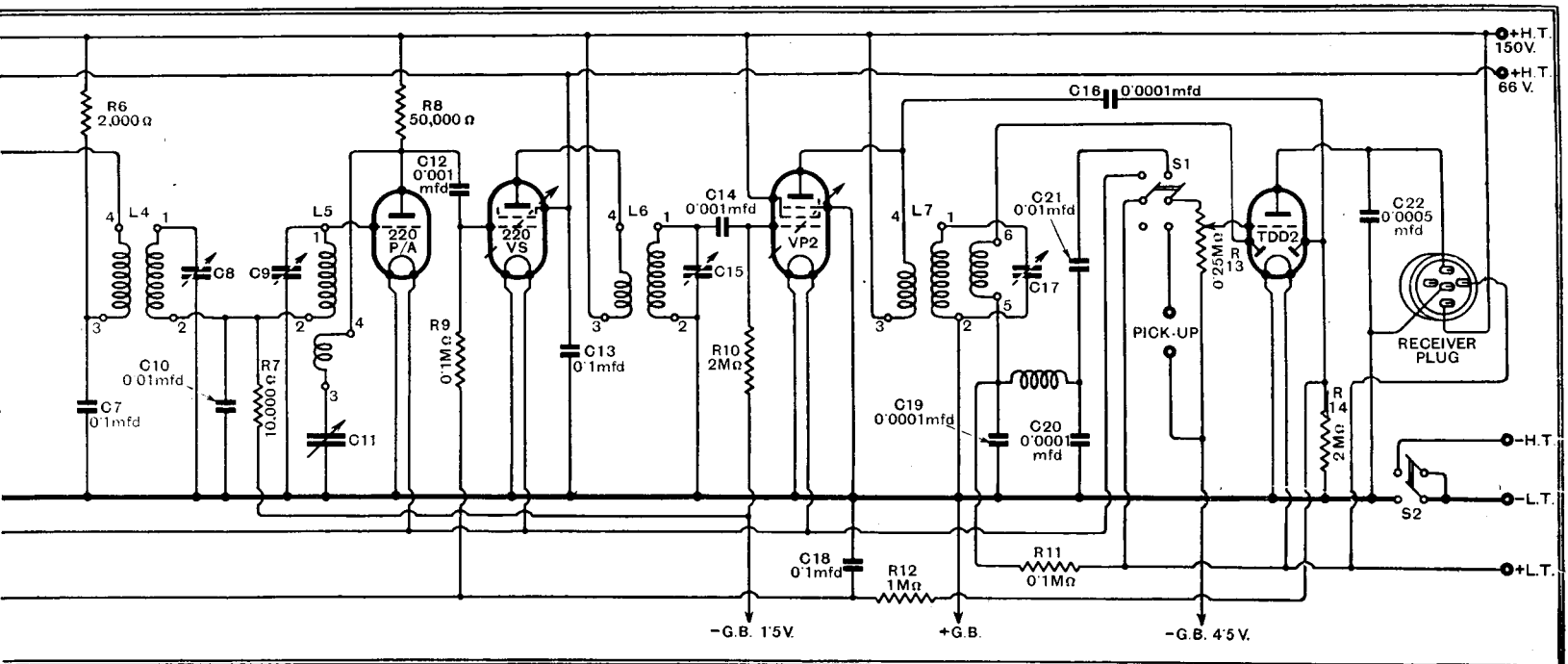
applied from the I.F. amplifier proper.³ If such isolation were not obtained it would be difficult to make any effective use of reaction.

This buffer valve is coupled to the first I.F. valve by a resistance-capacity coupling, and this I.F. valve, of the screen-grid type, is coupled to the second stage of amplification by a tuned transformer of 1-2 ratio. An H.F. pentode is used in the second stage and feeds another tuned transformer carrying three windings. The primary is connected in the I.F. valve anode circuit, the secondary is tuned, and the tertiary feeds the diode detector. This last valve in the receiver unit is a duo-diode-triode, and it is worthy of note that the two diodes have different characteristics. The detector diode is mounted round the negative limb of the filament, and functions normally, but the A.V.C. diode is mounted round the positive limb. This diode is fed by the 0.0001 mfd. condenser C16, and its load resistance R14 is returned to -L.T. As a result, the voltage drop along the detector diode and triode portions of the filament appears as a delay voltage in this diode circuit, and sufficient delay on A.V.C. is obtained without additional biasing.

The L.F. Circuits

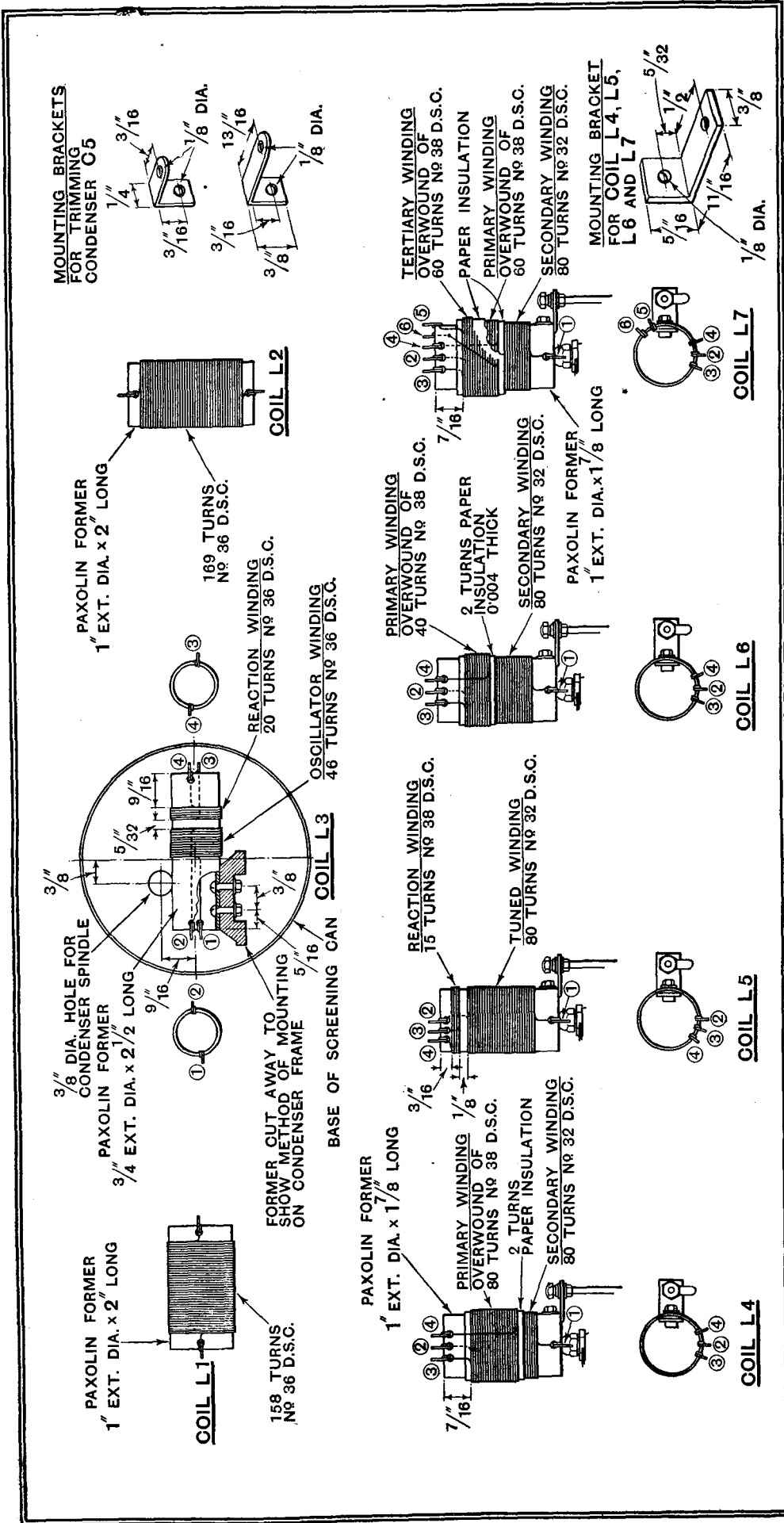
A.V.C. is applied through the usual filter R12 and C18 to the control grids of the frequency changer and the first I.F. valves, which in the absence of any A.V.C. bias are operated at zero grid potential. This is permissible, since with the particular valves selected grid current does not start until the grid reaches an appreciably posi-

³ The use of a buffer valve is dealt with by F. M. Colebrook, B.Sc., in a paper entitled "A Study of the Possibilities of Radio-Frequency Voltage Amplification with Screen-grid and with Triode Valves," which appeared in *The Journal of the Institution of Electrical Engineers* for February, 1934.



unit of the Battery Single-Span Receiver. A heptode frequency-changer is employed, and a duo-diode-triode second detector valve provides delayed A.V.C.

HOW TO MAKE SINGLE-SPAN COILS



These drawings show the constructional details of the various coils, and it should be noted that all windings must be in the same direction.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

RECEIVER.

- 1 Variable condenser, 0.00016 mfd., C4 Polar Type "E"
 - 1 Dial, slow motion type
 - 2 Bulbs, 2 volts 0.06 amp. Polar Micro-drive semi-circular Bulgin Type "H"
 - 1 Slow motion reaction condenser, 0.0002 mfd., C11 (Polar) Eddystone 957
 - 1 Tapered volume control, 250,000 ohms and knob, R123 Rothermel Type 72-121 (Ferranti, Claude Lyons, Magnum)
 - 1 Rotary O.M.B. D.P.D.T. switch, S1 Claude Lyons 2163
 - 1 Rotary O.M.B. D.P.S.T. switch, S2 Claude Lyons 2161
 - 3 Valve holders, 5-pin Clix Chassis Mounting Standard Type
 - 2 Valve holders, 7-pin Clix Chassis Mounting Type
 - 1 Compression condenser, 100 mmfds., C5 Colvern
 - 4 Microdensers, 100 mmfds., C8, C9, C15, C17 Eddystone 900
 - 1 Fixed condenser, 0.0001 mfd., C1 Graham-Farish Bakelite Case Type
 - 1 Fixed condenser, 0.0002 mfd., C2 Graham-Farish Bakelite Case Type
 - 4 Fixed condensers, 0.1 mfd., C6, C7, C13, C18 Graham-Farish Tubular Type
 - 2 Fixed condensers, 0.01 mfd., C10, C21 Graham-Farish Tubular Type
 - 2 Fixed condensers, 0.001 mfd., C12, C14 Graham-Farish Tubular Type
 - 1 Fixed condenser, 0.0005 mfd., C22 Graham-Farish Tubular Type
 - 4 Fixed condensers, 0.0001 mfd., C3, C16, C19, C20 Graham-Farish Tubular Type (Dubilier, Peak, T.C.C., Telsen)
 - 2 Resistances, 250 ohms 1/2 watt, R1, R2 Ferranti G.5
 - 1 Resistance, 2,000 ohms 1/2 watt, R6 Ferranti G.5
 - 1 Resistance, 10,000 ohms 1/2 watt, R7 Ferranti G.5
 - 1 Resistance, 20,000 ohms 1/2 watt, R5 Ferranti G.5
 - 2 Resistances, 50,000 ohms 1/2 watt, R3, R8 Ferranti G.5
 - 3 Resistances, 100,000 ohms 1/2 watt, R4, R9, R11 Ferranti G.5
 - 1 Resistance, 1 megohm 1/2 watt, R12 Ferranti G.1
 - 2 Resistances, 2 megohms 1/2 watt, R10, R14 Ferranti G.1 (Dubilier, Erie, Graham-Farish, Claude Lyons, Seradex, Watmel)
 - 1 Screened H.F. choke Wearite Type HFP (Bulgin, Kinva)
 - 1 10-way connector Bryce
 - 1 5-pin plug Bulgin P.3 (British Radio Gramophone Co.)
 - 1 4-way battery cable Bulgin B.C.2
 - 1 5-way battery cable Bulgin B.C.3 (Belling-Lee, Goltone, Harbros)
 - 6 Knobs Bulgin K.6
 - 4 Ebonite shrouded terminals A. E. Pick-up (2) Belling-Lee Type "B"
 - 4 Coil screens, 3 1/2 x 2 1/2 in. diam. Mains Power Radio, Ltd. Broadway Works, Eastern Road, Romford, Essex. Colvern
 - 1 Coil screen, 4 x 3 1/2 in. diam. Materials for coils: 1 1/2 in. Paxolin tube, 1 in. diam. Wright & Weaire 2 1/2 in. Paxolin tube, 3/4 in. diam Wright & Weaire Quantity No. 32, 36 and 38 D.S.C. wire. or 1 set of coils
 - 2 Lengths of screened sleeving Harbros (Goltone)
 - 1 G.B. battery, 4 1/2 volts
 - 1 G.B. battery clip Bulgin No. 2
 - 6 Wander plugs Clix No. 12B (Ealex)
 - 2 Spade ends Clix No. 3
 - 2oz. No. 20 tinned copper wire, 6 lengths Systoflex, wood, etc.
 - Plymax baseboard, 15 x 5 x 1/2 in. Peto-Scott
 - Screws: 24 1/4 in. No. 4 R/hd.; 6 1/2 in. No. 4 R/hd. All with nuts and washers. 2 1/2 in. No. 6BA with metal threads and nuts and washers.
 - Valves: 1 Ferranti VHT2, 1 Cossor 220P/A, 1 Cossor 220VS, 1 Mullard VP2, 1 Mullard TDD2.
- OUTPUT UNIT.**
- 1 Q.P.P. transformer, 1:8 R.I. (Varley)
 - 2 Fixed condensers, 0.005 mfd., C23, C24 Graham-Farish Tubular Type (Dubilier, Peak, T.C.C., Telsen)
 - 1 Resistance, 150,000 ohms 1/2 watt, R15, Ferranti G.5 (Dubilier, Erie, Graham-Farish, Claude Lyons, Seradex, Watmel)
 - 2 Valve holders, 5-pin Clix Chassis Mounting Standard Type
 - 1 Valve holder, 7-pin Clix Chassis Mounting Type
 - 1 5-pin plug Bulgin P.3 (British Radio Gramophone Co.)
 - 1 G.B. battery, 9 volts
 - 1 pr. G.B. battery clips Bulgin No. 1
 - 2 Wander plugs Clix No. 12B (Ealex)
 - 1 Loud speaker, permanent-magnet moving coil Blue Spot "Star"
 - Quantity No. 22 tinned copper wire, 2 lengths Systoflex, wood, etc.
 - Plymax baseboard, 5 x 5 1/2 in. x 1/2 in. Peto-Scott
 - Screws: 14 1/4 in. No. 4 R/hd.; 2 1/2 in. No. 4 R/hd. All with nuts and washers. 1 1/2 in. No. 6BA with metal thread and nut and washer.
 - Valves: 1 Marconi or Osram QP.21.

The Battery Single-Span Receiver—
tive potential. The second I.F. valve is not controlled for A.V.C. purposes, and is given a fixed bias of -1.5 volts. It should be noted that this valve is designed to operate with a screen potential equal to the anode voltage.

tuning condenser, and care should be taken to see that both windings on this coil are in the same direction and that the connections are made correctly. If the winding direction of one coil, or the connections to one coil, be reversed, the heptode will not oscillate and no signals will be obtainable.

run on to the paper covering for the start of the primary. At this point it should be secured to the paper by a small blob of sealing wax. The primary may then be wound and the end again secured with sealing wax, the wire then being looped back to the appropriate lug.

These four I.F. coils are mounted on the trimming condensers by small brackets. The brackets are carried by the condenser terminals for the moving plates, and it will be found that the coil lug No. 1 in every case comes close to one of the terminals for the fixed plates, to which it should be joined by a stout wire, so giving additional rigidity. The condensers themselves are mounted on the screen bases by their one-hole fixing bushes. Care should be taken to see that the coils are correctly mounted on the condensers and that their terminal lugs are not too large, otherwise the lugs may foul the top of the screening can. Such a short-circuit would probably prevent reception, but it might only lead to a poor performance. It may, however, short-circuit the H.T. supply and damage the transformer primary concerned.

The remainder of the construction is straightforward and follows normal practice; it will be dealt with next week, therefore, together with the initial adjustments and some notes on the performance to be expected from the receiver.



A rear view of the receiver unit with the coil screens removed to show the internal arrangement of the transformers.

The output stage, the circuit of which appears in Fig. 2, is built as a separate unit, since this facilitates the employment of alternative equipment. The triode section of the duo-diode-triode in the receiver acts as the first stage L.F. amplifier both on radio and gramophone, and is coupled to the output valve by a 1-8 ratio push-pull transformer. The output valve is a double-pentode of the quiescent push-pull type, and gives an output adequate for most purposes when used with a sensitive type of loud speaker.

Constructing the Coils

In the interests of economy the apparatus has been designed for use with an H.T. supply of 150 volts, and it consumes a total current with no-signal of only 17 mA., an average of slightly under 3 mA. per valve. The same performance could only have been secured at a lower H.T. voltage by increasing the current consumption, with the inevitable result of a larger bill for H.T. battery replacements. In the interests of maximum economy the radio-gramophone switch is arranged to break the L.T. supply to the four early valves on gramophone, so that the total current consumption, both L.T. and H.T., is much less on gramophone than on radio.

The coils employed are identical with those used in the A.C. set, and the drawings given in this article need little amplification. L1 and L2 are both single layer coils and are supported by the wiring. L3 is bolted to the frame of the oscillator

The basis of the other coils is the same, and is a single layer winding on a piece of 1in. diameter tubing; the differences between L4, L5, L6, and L7 are only in the primaries. L4 carries an overwound primary of 80 turns of wire, but L5 has no primary, although there are 15 turns of wire, wound on the main former at the end of the tuned winding, for reaction purposes. L6 is similar to L4, but the primary has only 40 turns. L7 carries an overwound primary of 60 turns, and a tertiary of the same number of turns wound over the primary. In every case adequate insulation between the windings is obtained by wrapping two layers of a fairly thin and hard paper round the previous winding.

The tuned winding can in every case be secured by soldering the ends to tags fastened to the former; two layers of paper should then be wrapped round the coil at the low potential end, and the outer turn secured by a tiny blob of sealing wax at its two corners. One end of the wire for the primary should then be soldered to its appropriate tag and loosely

The Radio Industry

AERIALITE, LTD., of Junction Mills, Whittington Street, Ashton-under-Lyne, are manufacturing several different types of aerial for fitting on cars, including models for the running board and the hood lining.

A very neat and compact Kabi "hum-balancing" potentiometer, no greater than a sixpence in diameter, has been introduced by F. W. Lechner and Co., Ltd., 61, Spencer Street, Clerkenwell, London, E.C.1.

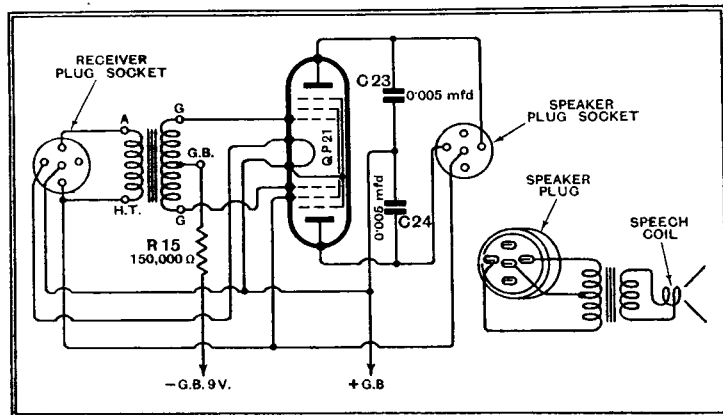


Fig. 2.—The circuit diagram of the output equipment which is built as a separate unit to facilitate modifications for special circumstances.

Steady progress is being made in the building of the new Cossor factory (the fifth), which will give employment to a thousand workers.

A new Hivac 2-volt battery H.F. pentode valve is described in a leaflet issued by the makers, the High Vacuum Valve Co., Ltd., 113-117, Farringdon Road, London, E.C.1.

A correction: Vortexion, 182, Broadway, Wimbledon, London, S.W.19. Style and address given last week was incorrect.

Modern Sound Film Technique

The British Acoustic Full-Range System

By A. L. M. DOUGLAS

CONSTANT improvements in sound gear make the task of the studio recordist less arduous and anxious than in the early days of the talkies. This article describes the latest apparatus in use in the British Gainsborough Studios.

ONE factor there is which never troubles the broadcasting engineer but which the sound film recordist must always take into consideration, namely, the casting of shadows. Bulky recording gear is anathema in the film studios. In the British Acoustic Full-Range Recording System the small tubular local amplifier is of negligible bulk to allow rapid operation in the studio and the reduction of shadows which a large microphone assembly is always prone to set up.

The system is of the variable area split track type, and is characterised by several

unique features combined with flexibility in operation.

The microphone is of the magnetic type in which a light corrugated strip or ribbon of a non-ferrous alloy is freely suspended in a powerful magnetic field. In the latest pattern the ribbon is open to attack by the air pressure waves front and rear, after the manner of the microphone used for some years by R.C.A. Photophone.

H.T. and L.T. are fed along the same multiple cable as the speech lines, and are derived from local batteries housed in the soundproof monitoring booths. It has been found from long experience that a mobile booth, which can be wheeled about the studio floor, greatly facilitates correct monitoring; the microphone boom operators and local conditions are under direct observation, and close contact with the producing staff is possible.

The booth contains a mixing panel with three microphone inputs and gain controls. In addition, there is a main gain control operating on the combined output of all

three faders, and an adjustable direct reading volume indicator, which is a speech potential meter with a Westinghouse metal rectifier. This is arranged to float on the end of a cord, so that the recordist may place it directly in his line of sight to the scene. There is also an intercommunication telephone for speaking to any of the recording rooms; and

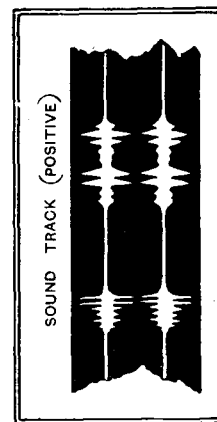


Fig. 1.—A section of magnified positive film as it appears in recording of the variable area split track type.

a plug connected with a pair of headphones, which may be worn by a musical director or other person, enabling him to hear directly from the mixed microphone output.

Other equipment includes a check loud speaker, a standard lamp, and an A.C.-operated buzzer for signalling.

The booths are very light and free running, and all batteries may immediately be withdrawn *en bloc* from the rear. H.T. and L.T. check meters are fitted to the mixing panel. The emission of the microphone amplifier may thus always be observed.

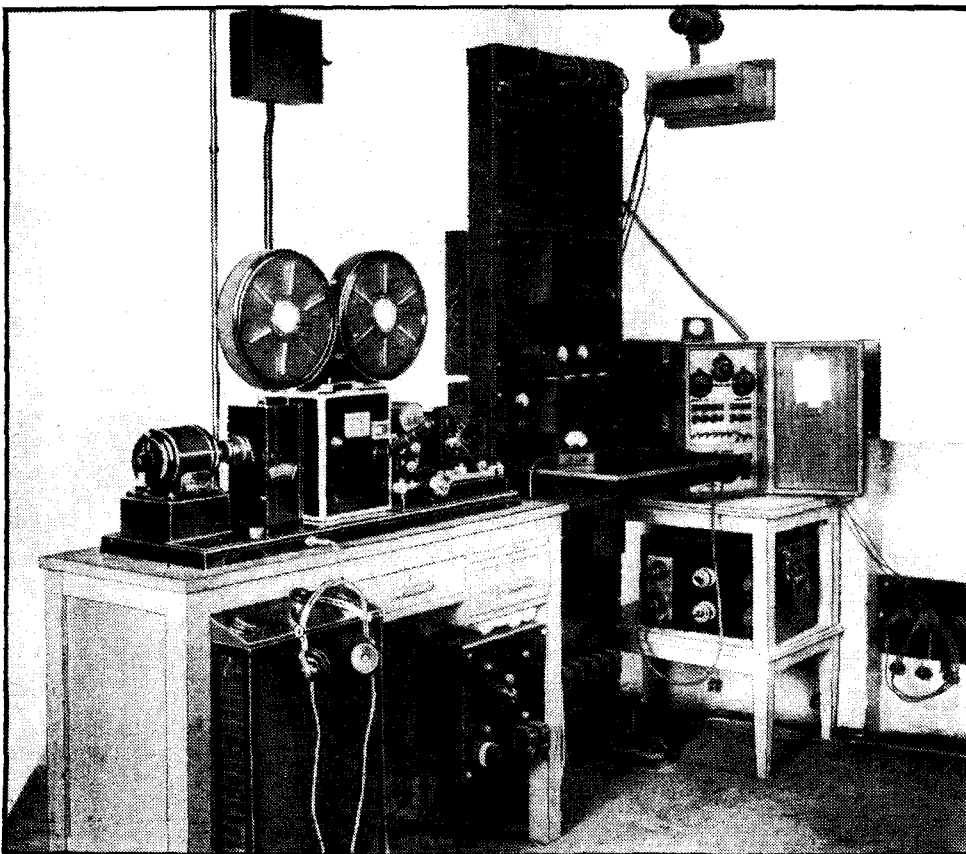
Connection is made with the booths by a flexible cable, sufficiently long to reach to any part of the studio and plugging into a wall distribution board. Each circuit is, of course, carefully screened, thus allowing the A.C. supply to be carried in the same cable without ill-effect.

Reducing Ground Noise

From the wall board, permanent shielded lines run to the main amplifying equipment. This is housed in a warm room with the recording camera.

The amplifier is constructed in rack form, and can be clearly seen in the photograph. The circuit arrangement is given in Fig. 2, from which it will be observed that there are two stages of voltage amplification following the microphone amplifier, and a current stage driving the string galvanometer.

Following this is another valve feeding



The sound camera and amplifier assembly.

Modern Sound Film Technique—

into a split input, part going to a two-stage amplifier driving the main Voigt loud speaker and the booth speaker, also the volume indicator; and part going to the polarising or ground noise reduction amplifier. Here it is rectified and applied to the galvanometer as D.C. varying in intensity with the speech potentials. When no modulation takes place, the D.C. deflects the strings and mirror to the top of the mask, thus photographing only a narrow double line of light on the track. The whole of the remainder is therefore black in the print, so that dirt, emulsion granularity and small abrasions do not influence the reproducing cell.

The applied D.C. varies inversely as the amplitude of the speech currents, thus the greatest deflection of the strings is obtained for a small sound and vice versa.

At the foot of the rack is the main switch and fuse panel. Power is derived from accumulators for H.T. and L.T. of 240-v. and 8-v. respectively.

The type S sound camera is characterised by extremely even running. It is practically impossible to get a "wow." The mechanical filter system is shown diagrammatically in Fig. 3. The film is accurately aligned by the drum D, which has a very slight taper leading up to the rear flange. The film is so positioned that it runs up the taper and abuts on the flange, and so is kept absolutely parallel, since the drum flange runs dead true. Recording is carried out on the opposite side, the film standing just off the front edge of the drum.

The galvanometer is horizontal and projects a split image through a special mask on to the film, photographing a double track. By this means the actual mirror excursion for a given amplitude is halved, inertia is greatly reduced, and in consequence the high-note response is very strong. The appearance of the track is shown in Fig. 1. The mirror and strings are oil damped, and, being a preadjusted unit, can be rapidly changed in the event

of a fault developing during operation. The useful working range of the system is from approximately 40 to 12,000 cycles

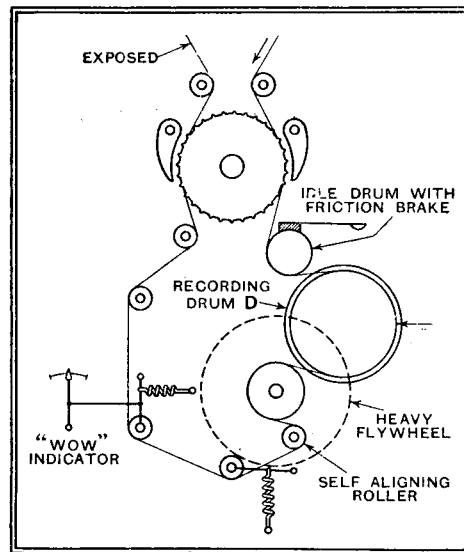


Fig. 3.—The mechanical filter system in the sound camera.

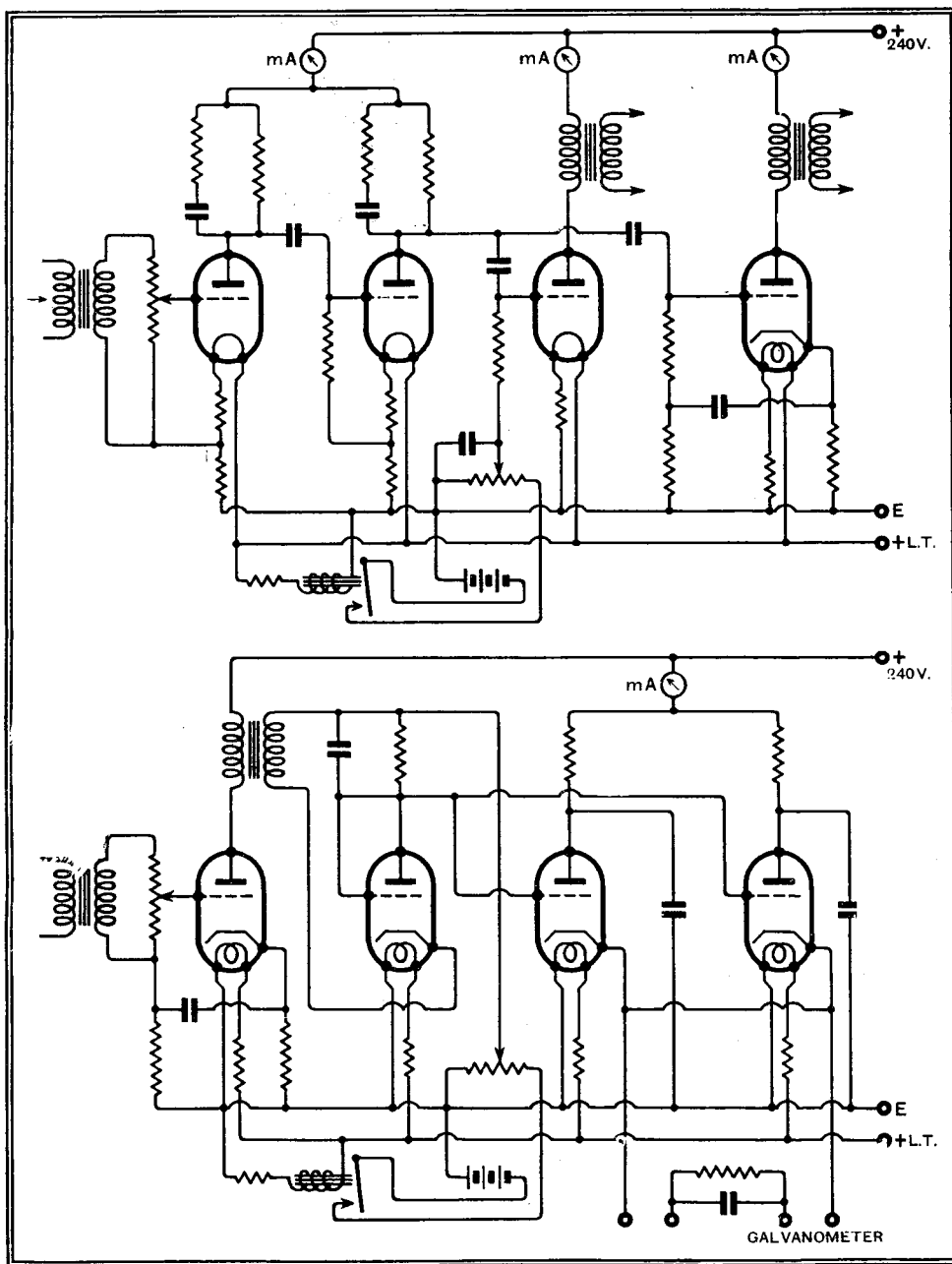


Fig. 2.—Diagrams showing the general circuit arrangement in (above) the main amplifier and (below) the polarising or ground noise reduction amplifier.

per second, but galvanometers are adjusted to have a response to 15,000 cycles.

Current for the camera exciter lamp is drawn from the A.C. mains through a metal rectifier and smoothing circuit, as also is the galvanometer field current.

The camera is driven by a three-phase synchronous motor, as is all the other equipment in the studio. The starter is mounted on the camera table.

Rapid "Mixing"

A Marconi oscillator, adjustable from zero to 10,000 cycles, is used for daily checking of the oscillograph and to set recording levels, and is indispensable for checking resonant peaks.

Other apparatus associated with the recording gear includes re-recording heads and interlocking gear for ensuring perfect synchronism between these and the picture projectors. Each sound head has a two-stage local amplifier attached, thus bringing the output to a similar level to that from the microphone. Disc re-recording gear is also available.

A novel mixing panel is installed in the orchestration theatre control room, in which the fader knobs describe an arc of a circle rather in the manner of a "beer engine." This enables an extremely rapid movement to be given, and is of great value in the mixing of sound effects, etc., into a finished film. Short-circuiting switches are fitted to these faders.

The complete studio channel is also available built into a light six-cylinder truck, thus providing recording of equal fidelity for exterior or location work. By careful design, every component on these trucks is interchangeable with the corresponding studio equipment. Provision is made for charging the batteries on the road, as, of course, the A.C. for picture and sound cameras has to be derived from a rotary converter operated from accumulators. An accurate frequency meter enables synchronism to be maintained.

UNBIASED

BY FREE GRID

My Light-controlled Clock

AS Shakespeare once remarked, some people are born dense, some suffer from the effects of our modern educational system, while others are unfortunate enough to have been dropped on their heads during babyhood.

I am moved to this quotation by the persistence of elementary enquiries which I continue to receive concerning the precise working of my light-controlled clock which I described in the March 30th issue of this journal. Here is a typical letter which I have received from Worthing, a seaside resort of which I have very vivid recollections, having been unfortunate enough to be marooned on the end of the pier while undertaking some scientific research work one Easter many years ago at a time when the middle portion got washed away.

"In order that this clock business may be satisfactorily and finally settled," writes this correspondent, "perhaps you will of your goodness in some future issue insert answers to the following further queries on this intensely fascinating subject:—

"(a) How do you manage if, upon arrival at the boarding-house, apartment house, or hotel, you find the mains are:—

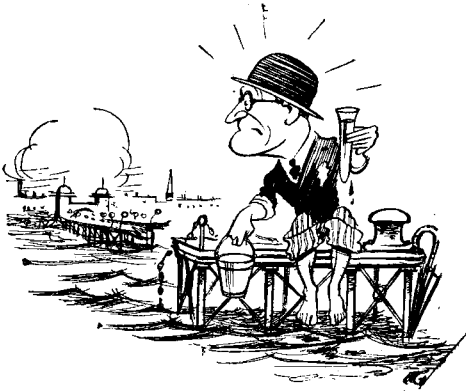
"(1) A.C. at some frequency other than 50 cycles?

"(2) D.C.?

"(3) Gas and water only?

"(b) How do you compensate for the clock being out of action whilst changing the 'ordinary gas-filled bulb' for 'the one filled with fog'?

"(c) At what class of shop are electric bulbs filled with fog obtainable, or, alternatively, can you explain in simple language how to convert a gas-filled bulb to a fog-filled one? Would it be any use taking an ordinary bulb into the Houses of Parliament during a debate?"



Vivid recollections.

With regard to question (a) (1) it should, of course, be obvious that in such a case the clock would receive its "correcting" impulses at a greater or lesser number of times per second, according to the fre-

quency of the mains. With regard to questions (a) (2) and (a) (3) I would point out that in my original article I explained that this clock was designed to meet a particular case only, namely, one in which it so happened that A.C. mains were present; therefore, these two questions do not arise.

With regard to question (b) it is perfectly obvious that my correspondent has failed to read my original article correctly. The clock is not a synchronous motor arrangement, but merely a high-grade "clockwork" clock in which the escapement is monitored by regular electrical impulses.

Question (c) is all-important, and very easily dealt with. A fog-filled bulb is, of course, made very simply by coating the inside of it with a photographic emulsion during manufacture. The fogging is then produced automatically when the light is switched on. So far as I know, these bulbs cannot at present be obtained commercially, but doubtless a lamp manufacturer and a manufacturer of photographic goods will eventually co-operate in this matter, just as they have done in the production of special photographic floodlighting bulbs.

Ye Olde Raylwaye

I MUST utter a word of protest at the complete lack of initiative which seems to permeate the traffic manager's department of some of our railways.

I was inveigled the other day into taking a Sunday rail trip to one of our old Cathedral cities. The railway authorities had spared no efforts, so far as their limited imaginations permitted them, to make the trip a success. A special train, equipped with "observation coaches," had been provided, and it had been arranged that the train should slow down when passing the most interesting parts of the countryside.

The *pièce de résistance* of the whole trip was the presentation to each passenger of a printed list indicating all the various factories, cemeteries, and other places of interest which the train would pass. I found this quite successful in the case of those objects of interest close to the line.

But, dealing with places and objects some little distance away, the whole thing was absurd. I found it extremely fatiguing to the eyes after the first few miles to have to keep dodging from printed sheet to window, and I could not help thinking how much more enterprising it would have been to make use of wireless, or, rather, of a simple public-address system with the microphone presided over by some knowledgeable official.

Such a procedure would have enabled us all to lounge back comfortably in our seats and yet to miss nothing. As it was, I soon had a crick in the neck, and my fellow sightseers seemed to be in no better plight.

There are, of course, always women, and even certain men, who will seize any and every occasion to exercise their jaws, and this trip was no exception. I presume, therefore, that, so far as these cretinous creatures are concerned, loud speakers would be an abhorred interruption. There is no real reason, however, why the various coaches should not be wired up so that each passenger could have a pair of 'phones which he could don or otherwise as fancy dictated.

For females and others who might find the wearing of 'phones uncomfortable, I would suggest that earpieces be sewn into the headrests after the manner of the pillow-'phones with which some hospitals



Fatiguing to the eyes.

are equipped. At any rate, I offer the suggestion to the railway companies concerned without the least hope that they will take the slightest notice.

Give Us the Earth

BUILDERS on the estates which are springing up like mushrooms around our large cities are vying mightily with each other in their attempts to attract Mr. Everyman.

Their latest idea is to equip each house with a wireless aerial in the loft. I cannot help thinking that they would do a better service to their customers if they installed a really efficient earth. This should definitely *not* consist of a metal plate buried in the garden with a long trailing lead to the room in which the set is to be used. The earth-plate should be buried deep down in the earth under the room in which it can be expected that the set will be used.

The connecting wire would be led up through the concrete and the floor boards to a suitable connection on the skirting board. For purposes of moisture, a pipe could also be let down through the concrete, its upper end terminating in a funnel. Access to this would be via a small trap-door in one of the floor boards, although there is usually quite enough moisture under these dwellings (save the mark!) without the necessity for this refinement.

HINTS and TIPS

Practical Aids to Better Reception

INTERACTION between the H.T. supply system and the L.F. coupling transformer is one of the commonest causes of hum in an A.C. mains set. It is not generally realised that a very simple test as to whether this is really responsible for a noisy background can be carried out in a few minutes.

Testing for Interaction

A procedure that gives conclusive results is as follows: The transformer is dismantled and connected in circuit in the usual way (electrically speaking) by means of leads not less than a foot in length. The transformer is then moved as far away as possible from the power supply equipment, and if the noise ceases it can be assumed quite definitely that interaction was responsible for it. If this conclusion is reached, the next step is to find the position for the transformer which corresponds to minimum hum.

IT has already been stated briefly that one of the many advantages of the Single-Span method of reception is that it allows tuning of the receiver to be controlled from outside the set in a way that is quite out of the question with any other circuit arrangement. For the benefit of those who are interested in the subject it will be opportune to give some practical details as to how the principle of remote control may be applied.

Single-Span Remote Control

In ordinary receivers it is usual to go to great pains to reduce the value of stray capacity across the tuned circuits to the lowest possible figure. Not so in the Single-Span set as recently described in these pages; instead, a relatively large trimming condenser is deliberately shunted across the oscillator circuit, which, it will be recalled, forms the sole tuning adjustment. It therefore follows that the oscillator condenser may be mounted at an appreciable distance from the receiver; the capacity of the screened connecting lead which must necessarily be used for this condenser will take the place of that of the trimming condenser.

Actually the trimming condenser is normally set to a capacity of some 60 or 70 micro-microfarads, and so the capacity of the extension lead must not exceed that figure. This means that low-capacity cable of the type sold for screened aerial downloads must be used, and that the limit of length must be set to some 5 or 6 feet—quite enough for a "chair-side" control. When necessary, however, a screened cable of lower self-capacity might be devised, thus allowing remote control from a more distant point.

The connections of the remote condenser are shown diagrammatically in Fig. 1, from which it will be seen that the metal screening of the cable forms the "return" electrical connection. It is desirable to mount the remote tuning condenser in a small metal box, which may be fitted with spring clips for mounting on the arm of a chair or in any other way that may be convenient for the user. When the self-capacity of the extension cable is low the trimming condenser C5 must be retained, but it will be set at a lower capacity value than usual, in order to compensate for the added stray capacity.

EVERYONE knows by now that for best quality the modern superheterodyne must be accurately tuned to the wavelength of the incoming signal. Very slight detuning, even to the extent of 2 or 3 kilocycles, can, and often does, introduce an unpleasant form of distortion. But it is less generally known that detuning of the oscillator circuit (which generally "takes charge" of the tuning of the receiver as a whole) may be produced by fluctuations in mains voltage. A case was recently investigated where the quality of reproduction of a well-designed

Wandering Mains Voltage

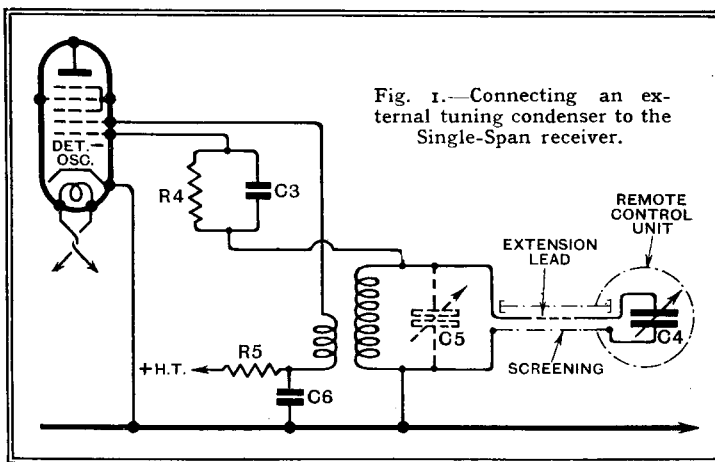


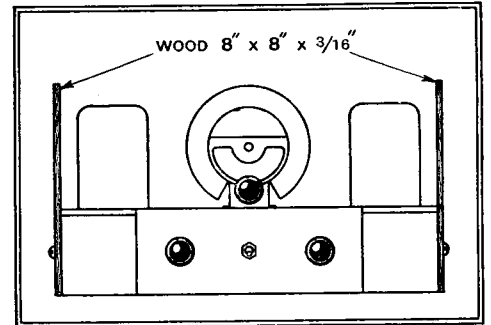
Fig. 1.—Connecting an external tuning condenser to the Single-Span receiver.

superheterodyne was found to change appreciably from minute to minute; it was ultimately found that the mains voltage was varying to such an extent that the wandering oscillator frequency was producing the distortion.

IT is a great help when wiring a receiver, or even when carrying out subsequent tests and adjustments for which access to the underside of the chassis is required, if a pair of temporary supports be arranged in the manner indicated in the accompanying sketch. These supports, which are screwed to the ends of the base compartment, may consist of strips of plywood about 8 in. square.

Wiring and Adjusting

This hint will be found particularly useful by builders of the Single-Span receiver; it is understood that the Peto-Scott Com-



Temporary wooden supports which facilitate access to the underside of a receiver chassis.

pany are supplying supports of this kind with all kits of parts supplied for the new receiver.

WE are often inclined to forget, when planning a mains-operated receiver, that the voltage required for grid bias purposes must be subtracted from the total delivered by the rectifier and smoothing unit before arriving at the voltage available for the anode circuits. In ordinary practice an extra voltage of anything between 10 and 40 volts over and above the anode rating of the output valve must be provided if the set is to be operated at full power.

A Reminder

THE Single-Span system of tuning helps to bring home to us the fact that the adjacent-channel selectivity of a superheterodyne depends largely on the intermediate frequency circuits. In receivers planned on the new principle all selectivity comes from the I.F. amplifier. Accordingly, if interference from the "next-door neighbours" (on the tuning scale) is encountered, it is to these circuits that attention should especially be paid when dealing with any type of superheterodyne. Mistuning of the I.F. transformers, excessively close coupling between circuits, or even definite faults such as leakage or broken connections, should be suspected when this form of interference is encountered.

Interference from the Next Channel