July 11, 1961 L. J. ROBSON 2,991,935

ELECTRICAL TRAFFIC ANALYSERS

Filed March 4, 1958 8 Sheets-Sheet 1

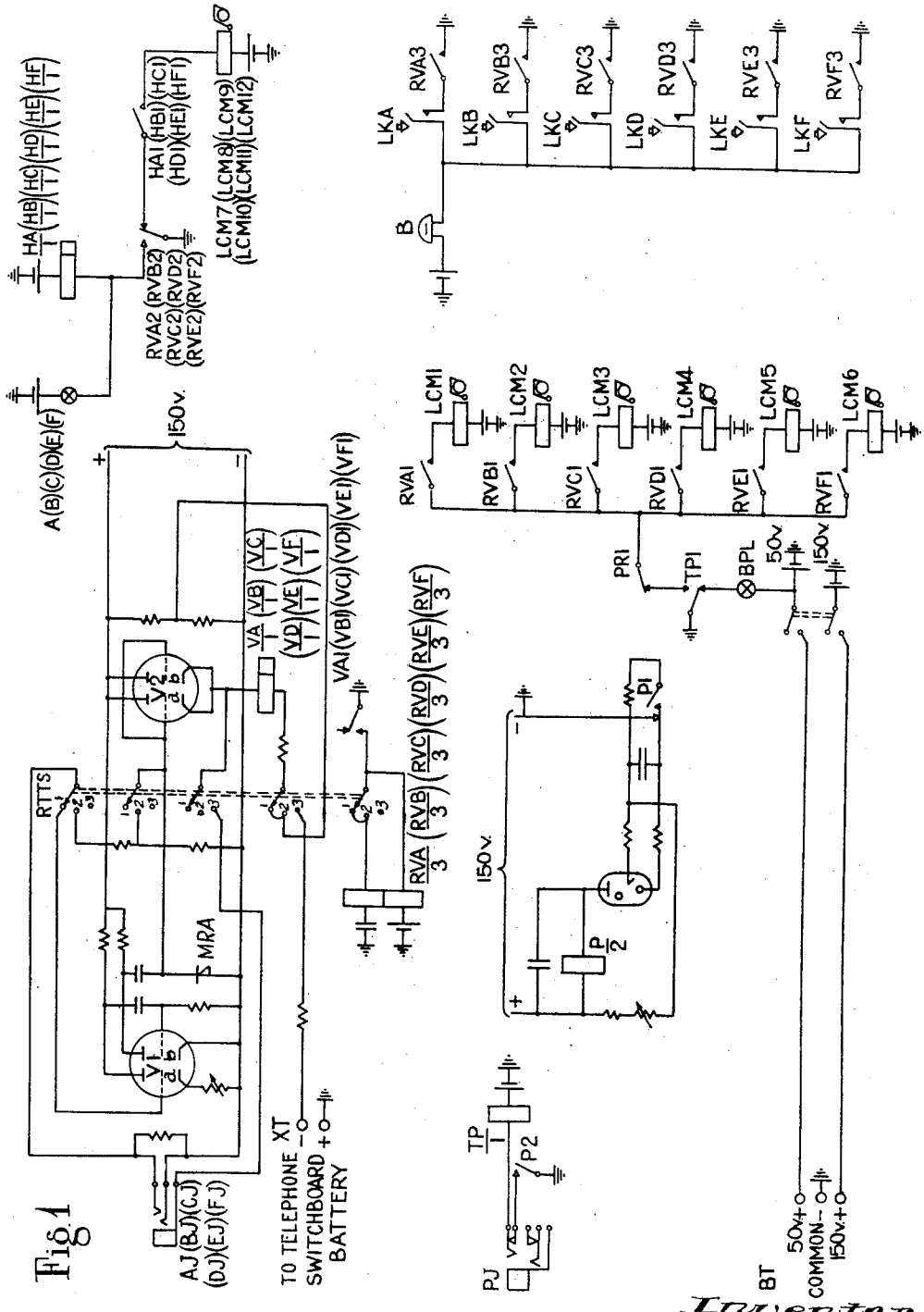


Fig. 1

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8 Sheets-Sheet 2

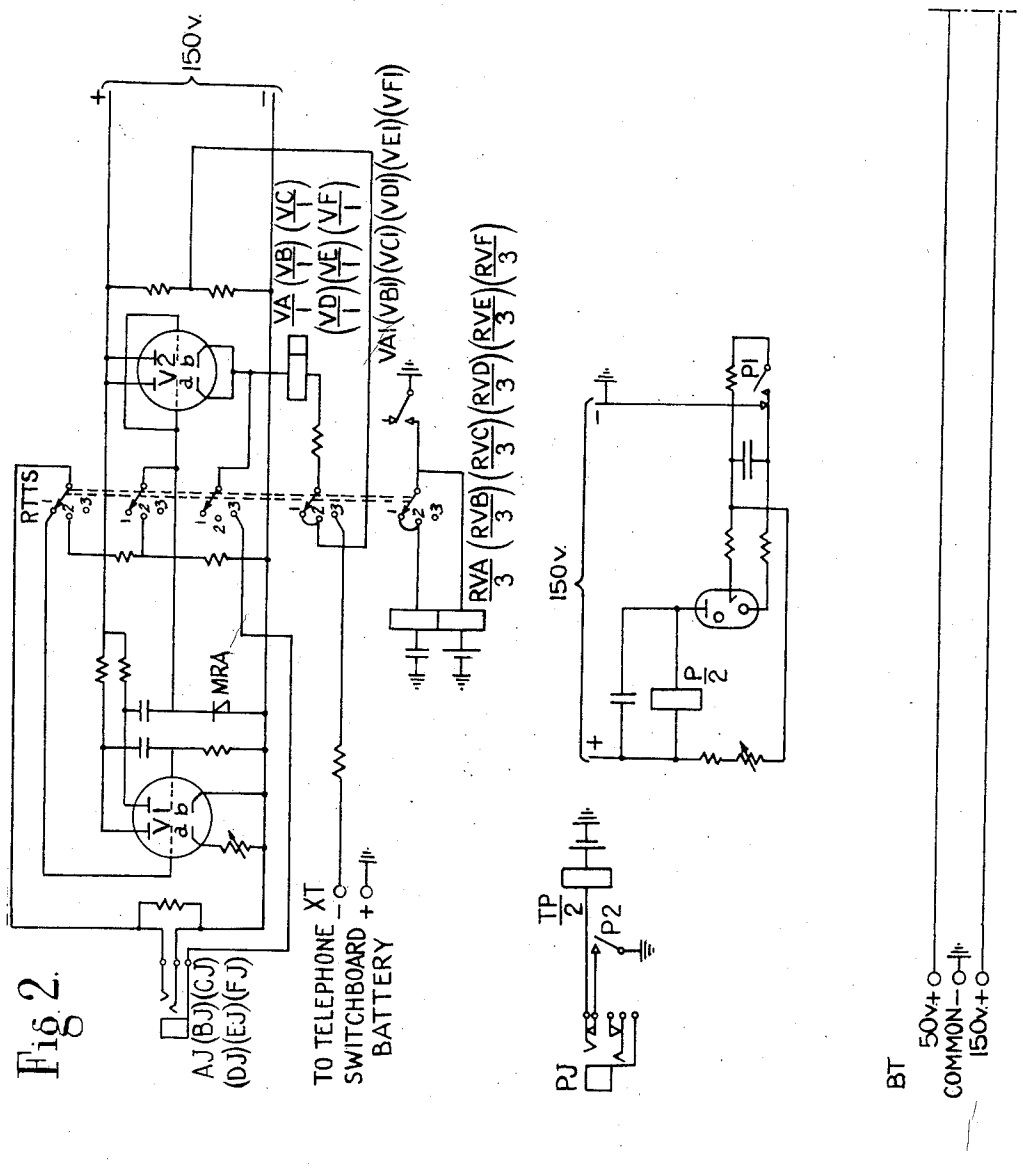


Fig. 2.

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ELECTRICAL TRAFFIC ANALYSERS

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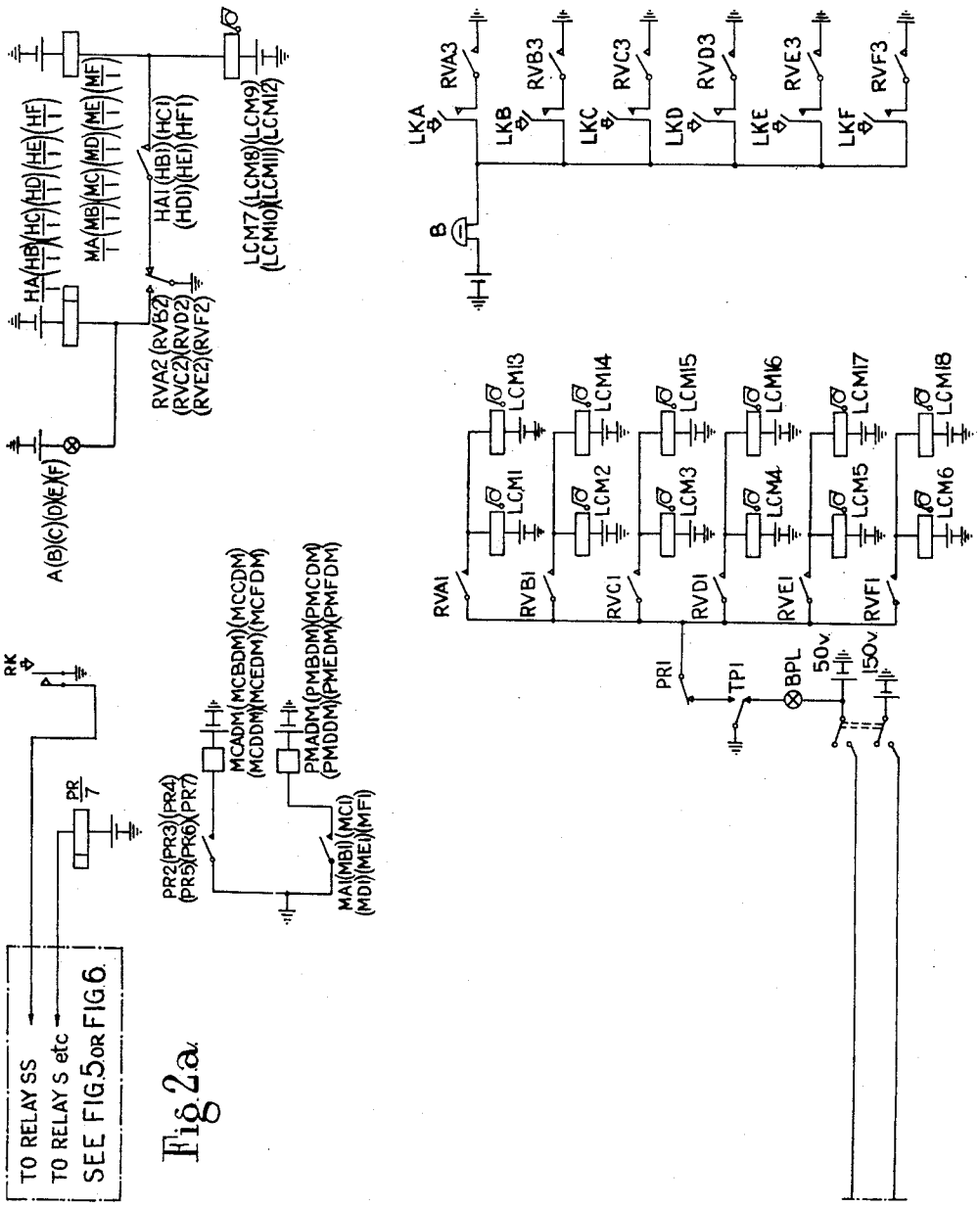


Fig. 2a

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ELECTRICAL TRAFFIC ANALYSERS

Filed March 4, 1958 8 Sheets-Sheet 4

Fig. 3

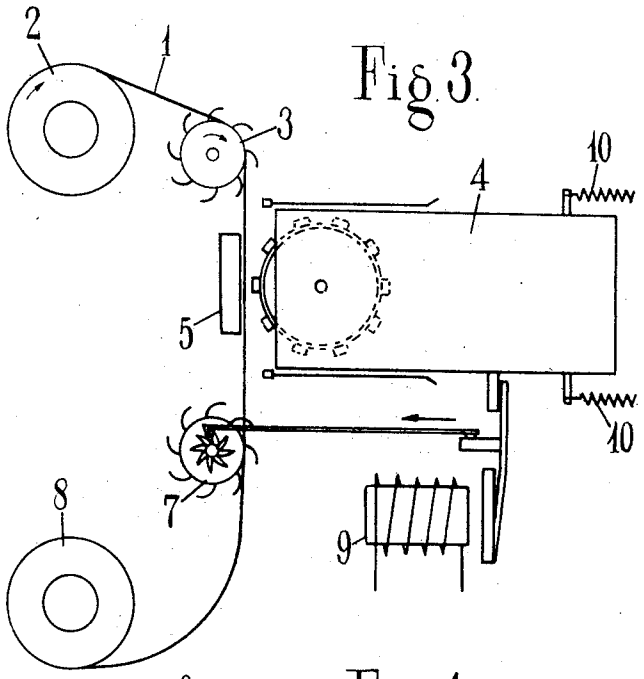
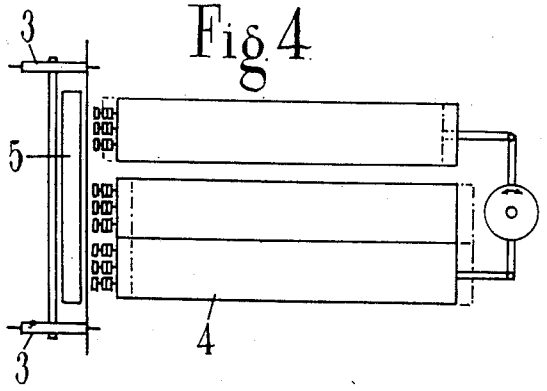


Fig. 4



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ELECTRICAL TRAFFIC ANALYSERS

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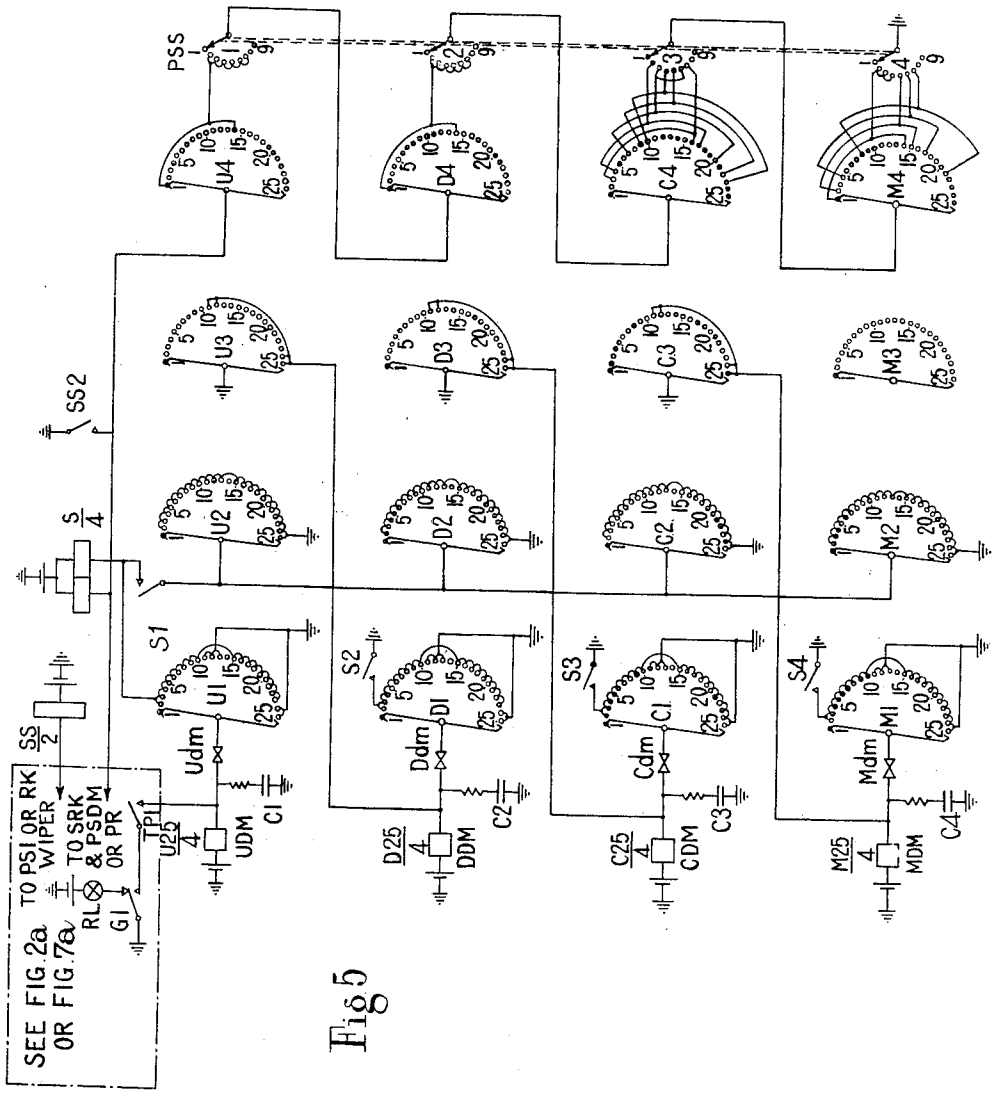


Fig 5

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ELECTRICAL TRAFFIC ANALYSERS

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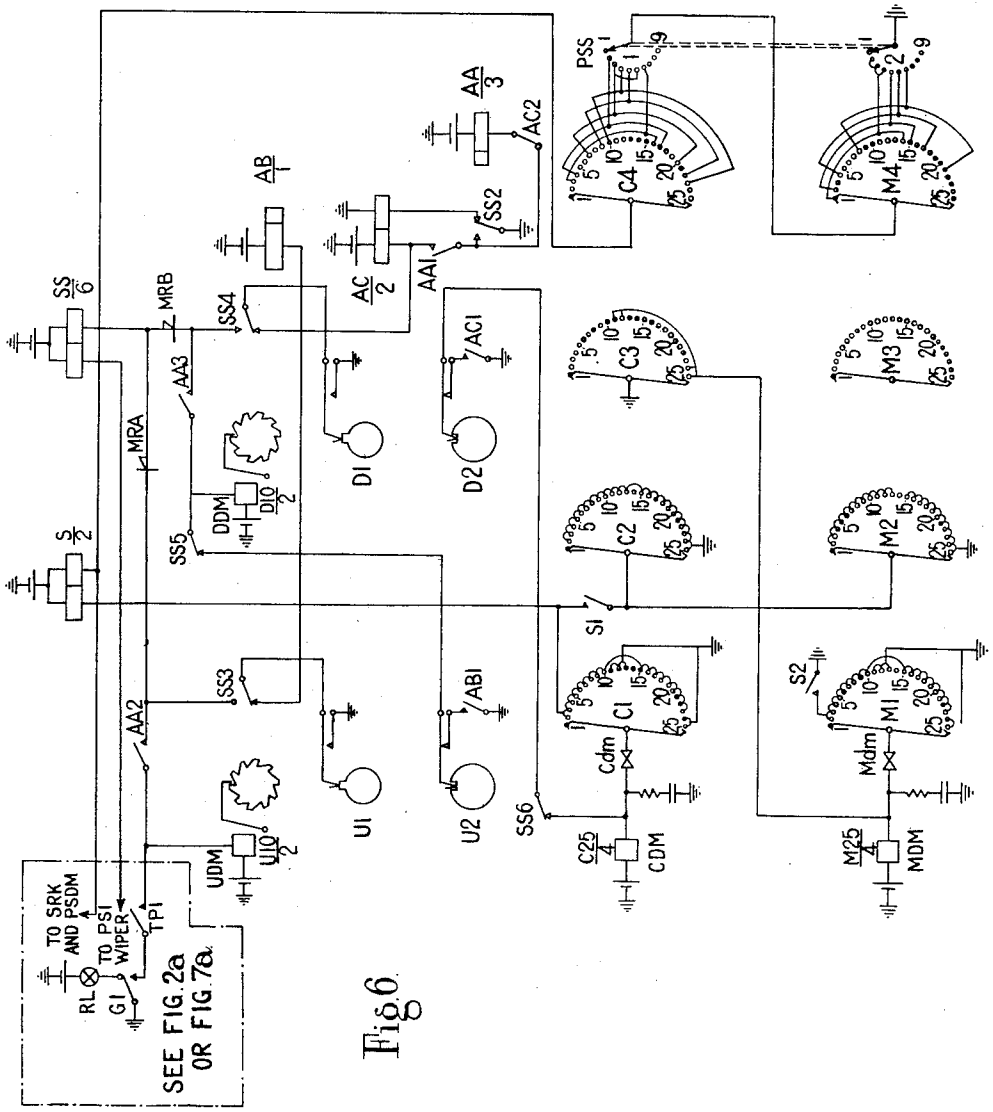


Fig. 6

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ELECTRICAL TRAFFIC ANALYSERS

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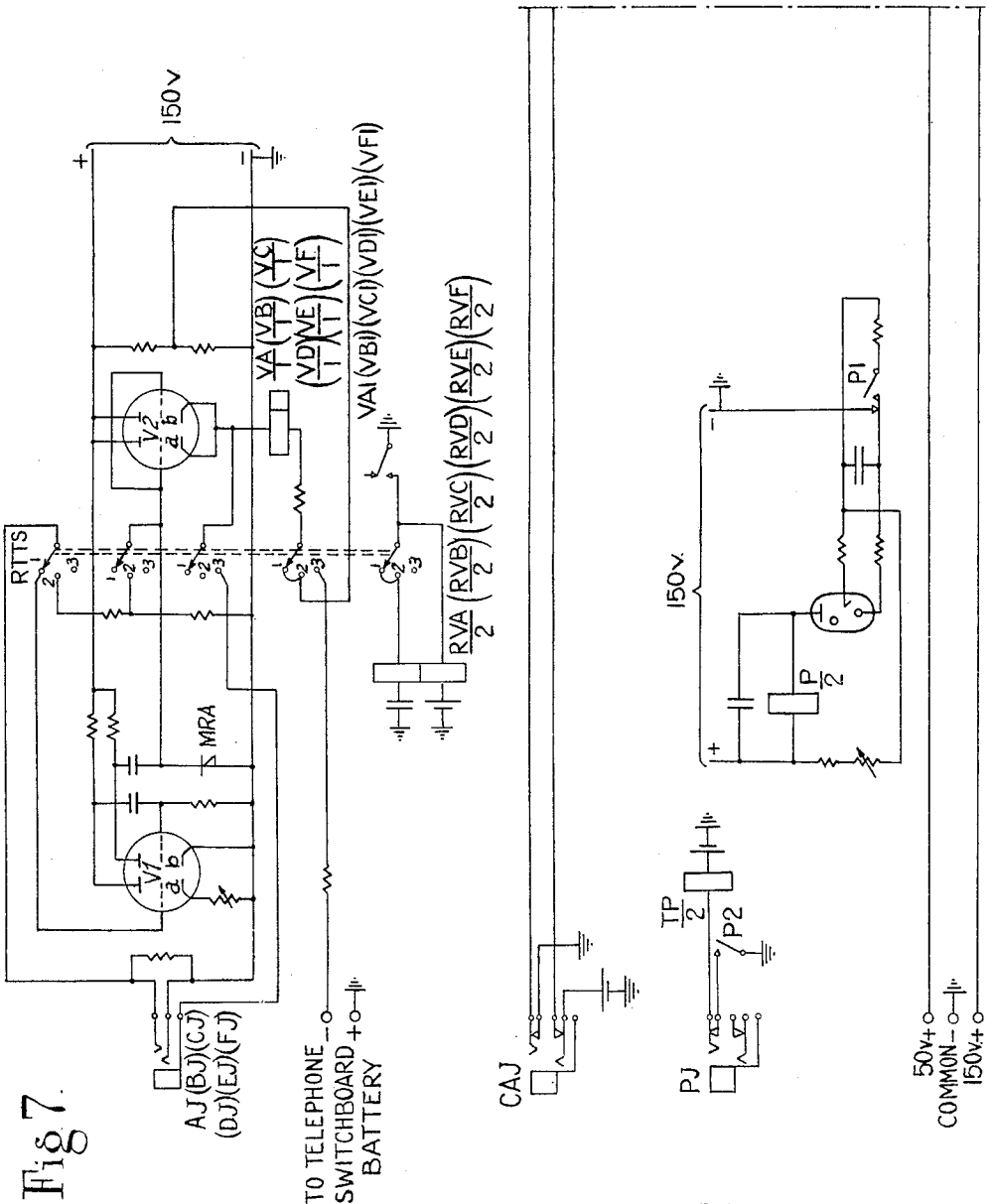


Fig. 7.

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ELECTRICAL TRAFFIC ANALYSERS

Filed March 4, 1958 8 Sheets-Sheet 8

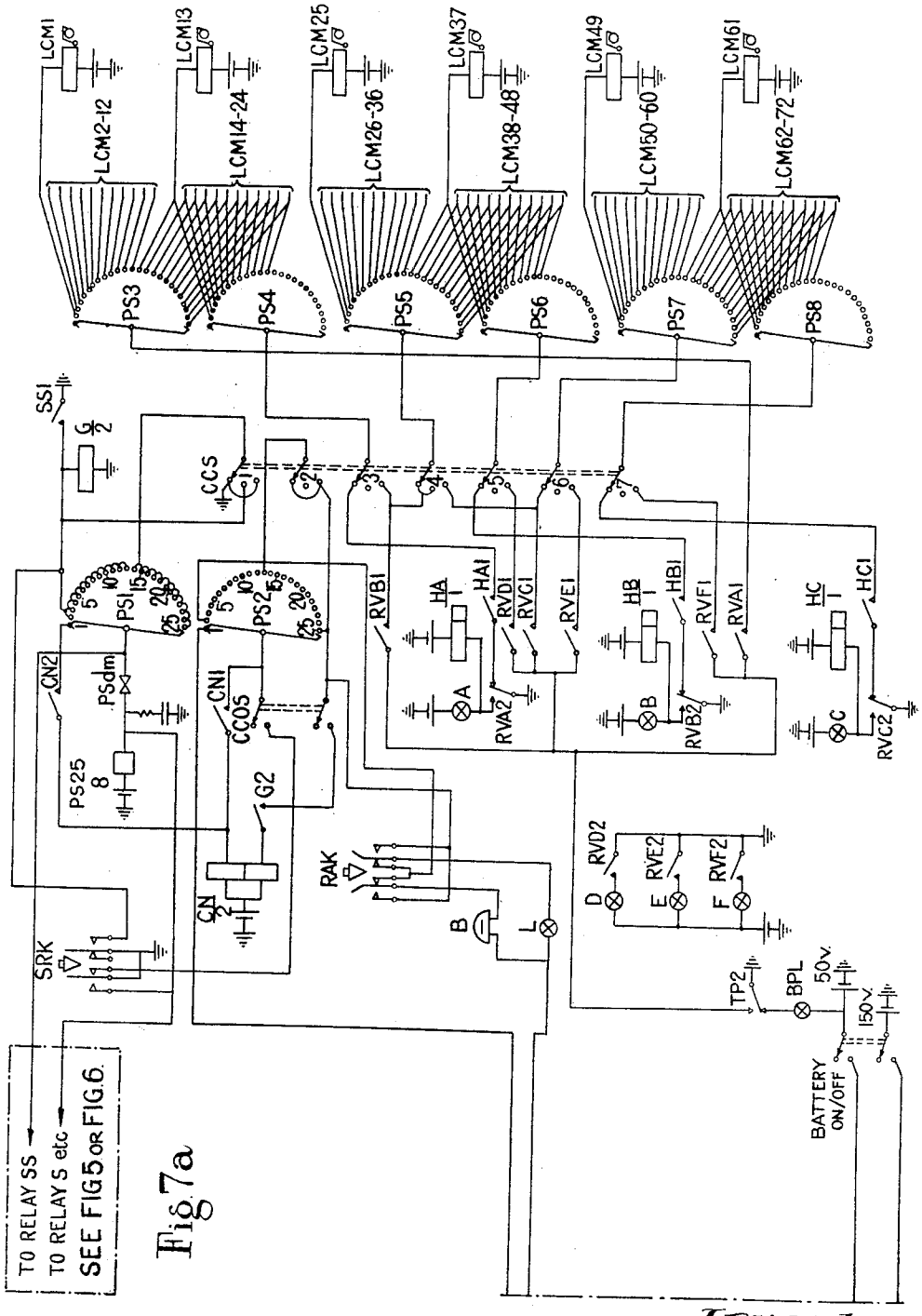


Fig 7a

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2,991,935

ELECTRICAL TRAFFIC ANALYSERS

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Filed Mar. 4, 1958, Ser. No. 719,052
Claims priority, application Great Britain Mar. 8, 1957
2 Claims. (Cl. 235—92)

The present invention relates to a circuit arrangement suitable for the automatic recording of utilization e.g. the total circuit utilization time and the number of messages completed in specific selected periods of time simultaneously over two or more radio, telegraph or telephone circuits.

The invention consists of an arrangement for recording the utilization e.g. of a signal channel comprising an electrical pulse drive, a pulse counter and means for connecting the pulse drive to operate or not to operate the counter in accordance with the utilization condition.

The invention further consists of an arrangement for recording utilization e.g. of a signal channel by means of an electrical pulse drive, comprising a plurality of pulse counters, a sequence switch adapted to be connected in succession to individual counters, means to detect the particular utilization, means for connecting the pulse drive to the sequence switch to operate or not to operate the counter connected thereto for each pulse of the drive in accordance with the utilization indication detected and a counting unit connected to step the sequence switch to its next position after a predetermined number of pulses have been counted.

Conveniently, the utilization of a plurality of signal channels can be simultaneously recorded.

By utilization of a channel is meant the period during which a channel is in use or operative or the number of times in which the channel is in use or operative in a given period and possibly the length of each period of use or operation or both.

Means may be provided whereby the period between successive steps of the sequence switch may be varied.

Pulses may also be extended to operate a camera to photograph the electro-magnetic counter readings at intervals of time.

The arrangement may then be adapted for continuous recording i.e. without the need for periodic reading of the counters and manual resetting.

Alternatively recording may be effected by printing.

The arrangement will be further described with reference to embodiments for recording the circuit utilization time and/or message count of the radio, telegraph or telephone traffic shown in the accompanying drawings.

FIGURE 1 shows the circuit diagram for a circuit utilization unit with circuit utilization and/or message count displayed on counters requiring manual transcription.

FIGURES 2 and 2*a* show the circuit diagram of an alternative circuit utilization unit recording the utilization and/or message count and/or the total length of each message transcribed automatically on to a continuous printed paper roll, tape or other means of permanent record.

FIGURE 3 is a side elevation and

FIGURE 4 is a plan of three of the meters of FIGURES 2 and 2*a*.

FIGURE 5 shows the circuit diagram of a period selection and counter unit.

FIGURE 6 shows the circut diagram of an alternative part sectional counter unit.

FIGURES 7 and 7*a* show the circuit diagram of a further circuit utilization unit.

In the embodiment to be described the circuit utilization time would normally be recorded in seconds derived

from an inherent one-second pulse circuit or from an external impulse or master clock system. Other timing intervals, however, may be used.

The facilities provided by the equipment are as follows.

(1) The recording in seconds (or any other unit of time) of the circuit utilization time of each of one or more radio, telegraph or telephone circuits.

(2) The recording in seconds (or any other unit of time) of the circuit utilization time of each of one or more radio, telegraph or telephone circuits plus the number of messages completed of each.

(3) The recording in seconds (or any other unit of time) of the circuit utilization time of each of one or more radio, telegraph or telephone circuits plus the number of messages completed plus the utilization time of each message.

In the following the designations P, TP, VA, RVA etc. are referred to in the specification with the prefix "relay." The drawing shows such elements as

$$\frac{P}{2};\ \frac{TP}{1};\ \frac{VA}{1};\ \frac{RVA}{3}\ \text{or}\ \frac{RVA}{2}$$

These symbols denote the number of contacts associated with each of these relays.

Uniselectors are similarly designated in the general description as M or C but are amplified again in the circuit diagram as

$$\frac{M25}{4}\ \text{or}\ \frac{C25}{4}$$

as the case may be. These additional symbols denote the number of bank contacts successively stepped by the uniselectors as the wipers traverse the banks (i.e. in the cases quoted 25) and denote also that each has four such rows of bank contacts.

The wipers traversing each row of bank contacts are thereby shown to total 4 also and step simultaneously from contact to contact i.e. when the wiper of one bank contact is on contact **11**, the other three wipers are likewise also on their bank contact **11**.

In FIGURE 1 there is shown terminals BT designated Battery Terminal to which connection is made by plug and cord connection to a 50 volt and 150 volt D.C. source of supply, the negative terminals of which are commoned to earth.

A jack PJ designated one-second pulse jack to which connection is made by plug and cord to a one-second D.C. pulse source of supply if derived from an external source.

The inherent one-second pulse circuit comprising the cold cathode tube and pulsing relay P may be used, in which case operation of the battery on/off switch to the "On" position will extend an earth condition at one second intervals via P2 contact PJ (with no plug inserted) to pulse relay TP at one-second intervals. This condition is referred to as a pulsing earth.

A lamp jack BPL designated battery and pulse lamp to indicate that the battery is connected and that the equipment is receiving the train of incoming one-second pulses. This condition will be indicated by relay TP pulsing at one-second intervals and flashing lamp BPL via its pulsing contact TP1.

Six jacks AJ, BJ, CJ, DJ, EJ and FJ (with associated lamp jacks A, B, C, D, E and F) designated circuit jacks to which connection is made by plug and cord to the equipment monitor jacks of the circuits under investigation. Each of these circuit jacks is connected via an amplifier detector circuit (valves V1, V2, V3, V4, V5, V6, V7, V8, V9, V10, V11, V12 respectively) to an individual line sensing relay (VA, VB, VC, VD, VE or VF respectively) which will operate in dependence upon whether the radio, telegraph or telephone circuits con-

nected are in use and which will in turn operate the appropriate integrating relay RVA, RVB, RVC, RVD, RVE or RVF respectively as follows: The ganged 5-pole 3-position switch designated RTTS is rotated to the required position depending upon the type of circuit sensing required for a particular analysis. This position 1 provides for radio (speech) sensing, position 2 for telegraph circuit sensing and position 3 for telephone circuit (P.B.X terminated) sensing.

A typical operation on circuit A only of this sensing unit under the three conditions referred to above is as follows:

POSITION 1—RADIO

Audio voltage applied across the tip and ring connections of the appropriate circuit jacks AJ is applied to the grid of valve V1*a*. The amplified output of V1*a* is then applied to the grid of V1*b* and further amplified.

The output of V1*b* is then applied across the metal rectifier MRA and the resultant D.C. applied to the paralleled grids of V2 thus operating the sensing relay VA, which in turn will operate its integrating relay RVA.

The integrating relays have a slow to release feature of 2 or 3 seconds so that momentary pauses in speech do not cause it to release and register a false message count.

Thus the extension of speech transmitted or received over a particular radio circuit connected via the radio equipment monitor jack, plug and cord connected to the appropriate circuit jack AJ, BJ, CJ, DJ, EJ, on FJ of this unit, will operate the appropriate line sensing relay VA, VB, VC, VD, VE or VF in the amplifier detector circuit and this will in turn operate the corresponding integrating relay. Alternatively, the appropriate integrating relay can be operated directly by D.C. techniques, i.e. earth being extended to it from a relay already having a function in the radio line termination equipment such as from the operation of a "channel call" light.

POSITION 2—TELEGRAPH

Upon receipt of the voltage signal elements via the tip connection of the appropriate circuit jack AJ, the grids of valve V2 are driven positive above cut-off and thus operate the sensing relay VA, which in turn via VA1 will operate its integrating relay RVA. As in the case of radio sensing relay RVA has a slow to release feature such that momentary pausing in the telegraph message transmission does not cause it to release and register a false message count.

Thus the normal condition of a telegraph circuit which is not in use is a negative potential applied to the grid of V2 (V4, V6, V8, V10, V12 as appropriate) this biassing the valve to cut-off, hence relay VA (or VB, VC, VD, VE or VF as appropriate), does not operate. However, one or more positive elements will occur with each character transmitted or received when the circuit is in use and this condition will operate in the amplifier detector circuit the appropriate line sensing relay VA, VB, VC, VD, VE, or VF which may conveniently be of the polarised type and which in turn operates the corresponding integrating relay which will remain operated for as long as characters are being transmitted, i.e. for as long as the circuit is in use, and for a further short period, if desired, to ensure continuity of record of each message. It will be noted that under telegraph conditions valves V2, V4, V6, V8, V10 and V12 only are used.

POSITION 3—TELEPHONE

Under free line conditions P.B.X battery negative potential exists on the sleeve connection of the circuit jack AJ this effectively short circuits the sensing relay VA and thus the integrating relay RVA remains unoperated.

However, when the circuit under analysis is engaged the sensing relay VA operates to the resistance earth extended via the sleeve connection of the P.B.X operators card circuit used to establish the engaged condition and to the negative terminal of the telephone switchboard battery connection shown in FIGURE 7. Relay RVA hence operates via VA1 but in this case the integrating relay RVA has no slow to release feature since it operates as a single coil relay, its secondary winding being open circuit.

Thus the insertion of a plug having sleeve connection only and being physically devoid of tip and ring connections in a circuit appearance jack of the switchboard multiple of the line of the telephone circuit under investigation will, when that circuit is brought into use, i.e. when it has a cord circuit plug connection at any of its other parallel jack appearances on the switchboard, extend a different potential from its idle condition over the sleeve connection of the cord connection AJ, BJ, CJ, DJ, EJ or FJ of this equipment (FIGURE 1) to operate the appropriate line sensing relay VA, VB, VC, VD, VE or VF in the amplifier detector circuit which will operate the appropriate integrating relay of RVA to RVF which will remain operated for as long as the circuit is in use, i.e. has a plug inserted in one of its parallel appearance jacks of the switchboard. It may be convenient in checking the utilization in P.B.X telephone circuits to use the same battery for sensing purposes as that from which the P.B.X itself derives its power. FIGURE 1 shows connection to the P.B.X battery via exchange terminal XT.

Six counters which may conveniently have five digits, designated LCM1–LCM6 will record the circuit utilization time in seconds for the period under investigation.

Six counters which may conveniently be of four digits, designated LCM7–LCM12 will record the total number of messages or continuous periods of utilization completed over each signal channel during the period of investigation.

A D.C. buzzer designated B which may be brought into operation upon the recording of circuit utilization of any of the circuits under investigation.

Six locking plunger-type keys designated LKA to LKF when depressed manually permit buzzer B to sound when the appropriate circuit is in use.

Six lamp jacks designated A to F which will indicate which circuit is in use.

Circuit description

If the electromagnetic counters LCM are not of the reset digit pattern it will be necessary to note the number registered on each counter before their commencement of operation.

The line sensing relay associated with the amplifier detector circuit of the jack designated circuit jack AJ is itself designated relay VA, likewise circuit jacks BJ, CJ, DJ, EJ and FJ have line sensing relays VB, VC, VD, VE, VF connected via their corresponding amplifier detector circuits.

To describe a typical circuit operation on circuit A only: The operation of the battery on/off switch to the "On" position completes the inherent one-second pulse circuit of relay TP and causes relay TP to pulse operate at one-second intervals via earth extended from P2 via pulse pack PJ, without a plug inserted. Battery pulse lamp BPL will also pulse operate in sympathy with it at TP1 in its non-operated position.

Conversely, in its operated position TP1 extends pulsing earth at one-second intervals via RVA1 which is operated only when the circuit connected to circuit jack AJ is in use, and pulse operates the five digit counter LCM1 to register the circuit utilization in seconds. Earth from RVA2 also operates circuit A lamp to indicate that the circuit is busy. Relay HA is slow to release and thus upon the release of relay RVA, i.e. upon the termination of circuit use, permits earth via RVA2, HA1 to step counter LCM7 one digit to register the completion of the message.

(Similarly the message count feature using circuit B

is effected with the slow release feature of relay HB which operates from earth extended from RVB2 and so on.)

It follows that when relay VA is released i.e. when the circuit is not utilised, no further count will be registered on LCM1 counter.

The pulsing contact TP1 on the other hand is pulsing irrespective of whether the circuit is being utilised or not.

When it is desired to terminate the utilization and/or message count check the operation of the battery on/off switch to the "off" position will prevent further counting and the counter registrations may then be transcribed.

UTILIZATION ALARM

Depression of the locking type plunger key LKA when circuit A is being monitored permits the operation of the buzzer to be effected via RVA3 when the circuit is in use. The buzzer may be silenced by operating the key LKA to its extended position. Similarly operation of LKB to LKF will control the alarm of circuits B to F respectively.

In FIGURES 2 and 2*a* six counters, which may conveniently be of the five-digit type, designated LCM1 to LCM6 adapted to have type head or embossed figure characters which will record the circuit utilization time in seconds (or any other desired period of time).

Six counters, which may conveniently be of the four-digit type, designated LCM7 to LCM12 which will record the total number of messages completed over each signal channel during the period of investigation.

Six counters, which may conveniently be of the four-digit type capable of being electromagnetically reset, designated LCM13–LCM18 which will record the length of time in seconds (or any other desired period of time) of each message.

Six ratchet or other drive-operated rolls of paper or other means of permanent record which are positioned to traverse the surface of each group of three counters (for example in the case of circuit A the three counters would be LCM1, LCM7, LCM13).

Six drive magnets designated MCADM, MCBDM, MCCDM, MCDDM, MCEDM and MCFDM which will operate simultaneously via contacts of PR relay (PR2 to PR7) which is operated when the period count, as determined by the position of PSS (FIGURE 5 or 6) has been completed. MCADM to MCFDM depress the type head or embossed figure characters of the paper roll passing over the faces of the (four-digit) counters LCM7 to LCM12 and the (five-digit) counters LCM1 to LCM6 to record the circuit utilization time of each of the six (five-digit) counters and the total number of messages received on each of the six (flow-digit) counters associated with the six circuits A to F in specific intervals of time as determined by the setting of switch PSS (FIGURE 3 or 4).

Six drive magnets PMADM, PMBDM, PMCDM, PMDDM, PMEDM and PMGDM which when operated depress the type head or embossed figure characters of the paper roll passing over the face of the (four digit resettable) counters LCM13 to LCM18 to record the length of each message. These drive magnets are operated via MA1, MB1, MC1, MD1, ME1, and MF1 respectively at the completion of each message via the slow release of relay HA to HF respectively as previously described.

The release of each of these twelve drive magnets causes the paper or other material line feed to be advanced one step ready for the next printing or record.

The additional third utilization (four-digit) resettable counters LCM13 to LCM18 may conveniently be arranged to reset after each recording at the end of each message. This counter reset mechanism would be electromagnetic and would derive operation on the release of relays HA to HF.

Six relays designated MA to MF are operated simultaneously with the operation of the message counters LCM7–LCM12 which in turn, via their contacts MA1 to MF1 operate drive magnets PMADM to PMFDM respectively.

Non-locking plunger type key RK may be depressed when it is desired to reset the counting unit of FIGURE 5 or 6.

A typical printed record of the meters LCM1, LCM7 and LCM13 is given in the following table:

Occurrence	A (on LCM1)	B (on LCM7)	C (on LCM13)
Analysis check commences at 0800 hrs. (A and B would not normally be at zero, i.e. not being resettable from previous operation)	00,000	0,000	0,000
Message occurs. 18 secs			18
Message occurs. 36 secs			36
Message occurs. 1 min. 24 secs			84
X. First count period ends. (0805 hrs.)	138	3	
Message occurs 2 min. 54 secs			174
Message occurs 1 min. 33 secs			93
Message occurs 3 mins. 10 secs. starting 30 seconds before end of second count period			
X. Second count period ends (0810 hrs.)	435	5	
Message ends			190
Message occurs 1 min. 57 secs			117
Message occurs 24 secs			24
X. Third count period ends (0815 hrs.)	736	8	
Message commences 1 min. after start of fourth count period for 12 min. 10 secs.			
X. Fourth count period ends (0820 hrs.)	976	8	
X. Fifth count period ends (0825 hrs.)	1,276	8	
Long message ends (3 min. 10 secs. after start of period)			730
X. Sixth count period ends (0830 hrs.)	1,466	9	
X. Seventh count period ends no messages (0835 hrs.)	1,466	9	

and so on.

The actual mounting of these three meters in a suitable installation will be apparent from FIGURES 3 and 4. Thus sprocket hole edged paper from a roll **2** is fed over sprocket **3** and down in front of the three meters **4** between a pressure pad **5** and the printing wheels **6** of the meters. Then the paper passes over a lower sprocket **7** and away to a wind-up roll **8**.

The three meters **4** are mounted side by side in dependent reciprocation in the direction of their lengths by solenoids **9** and restoring springs **10**. The solenoids **9** also advance the sprockets **7** in their operation.

Each meter when it is operated by its associated solenoid pulls its printing wheels **6** up to the pressure pad **5** and thereby prints the figures to be recorded on to the paper.

In FIGURE 5 there is shown four cycling selector switches M, C, D, and U which with suitable strapping of their bank contacts M4, C4, D4 and U4 to particular outlets of a Period Selection Switch PSS1 to PSS4 permit the counting of any successive series of one-second pulses before the operation of relay PR (FIGURE 2*a*).

The nine-position switch PSS designated period selection switch has four poles designated PSS1 to PSS4 each having six pre-set count periods of five minutes, ten minutes, fifteen minutes, thirty minutes, one hourly and two hourly periods with the addition of three further positions to which any particular count period may be pre-set to meet particular requirements.

The pulsing contact TP1 is pulsing drive magnet UDM irrespective of whether the circuit is being utilized or not.

When uniselector U steps to bank contact **11**, i.e. upon completion of the tenth one-second pulse, earth is extended from the wipers of arc U3 to give a single earth pulse to operate drive magnet DDM. Uniselector U self-drives via its own interrupter springs U*dm* to earth from bank contacts **11**, **12** and **13** of arc U1 to bank contact **14**.

Drive magnet DDM remains operated whilst uniselector U steps over bank contacts **11** and **12** since the wipers of uniselector U are of the bridging type and contact two adjacent bank contacts simultaneously.

When the wipers of uniselector U reach bank contact

13, drive magnet DDM is de-energised and hence the wipers of uniselector D step to bank contact 2.

Uniselector U steps to bank contact 14 which in common with its bank contact 1 is a home position due to the strapping of bank contacts in groups such that every half revolution of its wipers will permit twenty seconds to be counted. The cycle of events is then repeated. A further ten one-second pulses are then received and counted.

Uniselector D is stepped to bank contact 3 to indicate a count of twenty seconds. This progression of events will continue until ninety-nine seconds have been counted.

Upon completion of the hundredth one-second pulse, however, uniselector U will operate, as previously described, and uniselector D will step to its eleventh bank contact when an earth pulse will be extended via the wipers of arc D3 bank contact 11 to energise drive magnet CDM.

Uniselector D self-drives via its own interrupter springs D*dm* to earth from bank contacts 11, 12 and 13 of arc D1 to bank contact 14. When the wipers of uniselector D reach bank contact 13, drive magnet CDM will be de-energised to step uniselector C to bank contact 2.

The progression of events continues until nine hundred and ninety-nine seconds have been counted.

Upon completion of the thousandth one-second pulse, however, the wipers of uniselector C will step to their eleventh bank contact and will extend an earth pulse to energize drive magnet MDM. When the wipers of uniselector C reach bank contact 13, drive magnet MDM will be de-energised thus permitting the wipers of uniselector

$$\frac{M25}{4}$$

to step to bank contact 2, i.e. one thousand one-second pulses have been counted.

If, for example, the period sequence time interval is hourly, i.e. three thousand six hundred seconds are required to be counted, the progression of count proceeds as described.

On completion of the three thousand six hundredth one-second pulse, however, earth is extended via the period selection switch PSS4 pre-set to position 6, the one hourly count period, the wiper of arc M4 bank contact 4 via the period selection switch PSS3 preset to position 6, the wiper of uniselector

$$\frac{C25}{4}$$

arc C4 bank contact 7 via period selection switch PSS2 preset to position 6 to the wiper of arc D4 bank contact 1 to PSS1 preset to position 6, to the wiper of arc U4 bank contact 1 to operate relay S via its operate coil and also extends earth to operate relay PR (FIGURE 2*a*). S1 holds relay S via earth extended from arcs U2, D2, C2 and M2 in parallel and also completes the circuit for the self-drive of uniselector U via arc U1 to step it to its home contact (bank contact 1 or 14 as appropriate). Likewise, earth extended via S2, S3 and S4 permits uniselectors D, C and M respectively to self-drive to their home contacts 1 or 14 as appropriate.

The earth extended via the period selection switch PSS1–PSS4 preset to position 6 via arcs M4, C4, D4 and U4 is removed and permits relay PR to release. Immediately these uniselectors commence to home. Simultaneously earth is removed from the operate coil of relay S which releases when uniselectors U, D, C and M have reached their home contacts 1 or 14 as appropriate. Contacts PR2 to PR7 (FIGURE 2*a*) operate the appropriate drive magnet of MCADM to MCFDM to depress the paper roll or other means of record on to LCM1 to LCM6 and LCM7 to LCM12 counters to record their registrations. The circuit utilization count for the second count period, i.e. of the second hour of the example being described, then proceeds in similar fashion to operate the electromagnetic printing control at the end of the next hourly count period (i.e. a further 3,600 seconds).

The speed with which uniselectiors U, D, C and M self-drive to their home contacts will ensure that they are reached before the initial one-second pulse of the second count period is effected.

The counter unit (FIGURE 3) proceeds to count three thousand six hundred seconds as before.

This hourly cycle of events continues indefinitely.

In FIGURE 6 there is shown two ten-step ratchet relays

$$\frac{U10}{2}$$

and

$$\frac{D10}{2}$$

which are of the forward action type, i.e. the cams rotate one ratchet tooth upon the energising of the drive magnets. Ratchet relay

$$\frac{U}{10}$$

steps one ratchet tooth for each one-second pulse and ratchet relay

$$\frac{D10}{2}$$

steps one ratchet tooth every tenth one-second pulse received. Each of the ratchet relays has two cams actuating spring sets designated U1, U2, and D1, D2.

Two cycling selector switches C and M which with suitable strapping of their bank contacts to particular outlets of the period selection switch PSS1 and PSS2 permit the counting of any successive series of hundreds and thousands one-second pulses up to nine thousand nine hundred before operation of relay PR (FIGURE 2*a*).

A two-pole nine position switch PSS1 to PSS2 designed period selection switch having six pre-set count periods of five minutes, ten minutes, fifteen minutes, thirty minutes, one hourly and two hourly periods with the addition of three further positions to which any particular count period may be pre-set to meet particular requirements.

A typical operation on the circuit connected to circuit jack AJ of FIGURE 2 only and using the period selection unit and counter of FIGURE 5 will be described:

The one-second pulse relay TP (FIGURE 2) is pulsing at one-second intervals ineffectively at this stage apart from indicating that it is receiving the incoming pulses from the inherent one-second pulse circuit or from an external pulse connected by plug and cord connection to the one-second pulse jack PJ. It will be noted that if the latter source of pulse is used the insertion of the plug will disconnect the inherent pulsing circuit and render it ineffective.

The battery pulse lamp BPL is pulse operating at one-second intervals via earth from the pulsing contact TP2 in its released position.

Upon receipt of the first one-second pulse, relay AB will operate via earth extended from U1 cam springset operated, SS3 normal and will remain operated until receipt of the tenth one-second pulse.

AB1 prepares the circuit for the extension of earth via U2 cam springset via SS5 to operate the ten-step ratchet relay

$$\frac{D10}{10}$$

drive magnet DDM on receipt of the tenth one-second pulse effected upon the slow release of relay AB.

Relay AC operates upon receipt of the tenth one-second pulse via earth extended from D1 cam springset operated, SS4 normal and will remain operated until receipt of the one hundredth one-second pulse. AC1 prepares the

circuit for extension of earth via D2 cam springset operated, SS6 normal to operate uniselector

C25/4

drive magnet CDM which will step its wipers on to their second bank contact upon the release of relay AC which is effected by the D1 cam springset operating on its tenth step i.e. on receipt of the hundredth one-second pulse.

It will be appreciated that relay AC has a slow to release feature only when relay SS is normal since earth via SS2 short circuits its subsidiary coils. Under reset conditions to be described later the very much shorter release lag of this relay when SS2 is operated effects the homing of the

U10/2

and

D10/2

drive magnets in as short a time as possible.

The slow to release feature of relays AB and AC also permit adequate length of pulse to be extended to

D10/2

drive magnet DDM and

C25/4

drive magnet CDM respectively every time a tenth and/or hundredth pulse is registered.

This progression of events will continue until nine hundred and ninety-nine seconds have been counted. Upon completion of the thousandth one-second pulse, however, drive magnet CDM is pulse operated and extends earth via C3 wiper bank contact 11 to energize drive magnet MDM which will permit uniselector

M25/4

wipers to step to their second bank contacts when the wipers of uniselector

C25/4

have stepped to their thirteenth bank contact.

Uniselector

C25/4

will self-drive to bank contact 14 via its own interrupter springs C*dm* and C1 wipers to earth via bank contacts 11, 12 and 13.

As, in the example taken, the count period is hourly, i.e. three thousands six hundred seconds require to be counted, the progression of count proceeds as previously described. On completion of the three thousandth one-second pulse, however, earth is extended via the period selection switch PSS2 preset to position 6, i.e. the one-hourly count period, arc M4 bank contact 4 via the period selection switch. PSS1, position 6, to await the stepping of uniselector

C25/4

wipers to their seventh bank contact (upon completion of the three thousand six hundredth one-second pulse).

Earth is then extended to operate relay S.

It will be noted that no units or tens digits are to be counted and at this particular moment both the ratchet relays

U10/2

and

D10/2

are in their home position.

Earth is also extended to operate relay PR which via its contacts PR2 to PR7 (FIGURE 2*a*) operate the appropriate drive magnet of MCADM to MCFDM to depress the type head or embossed figures or actuate the other means of record to register the count of LCM1 to LCM6 and LCM7 to LCM12.

S1 holds relay S via earth extended from arc C2 and arc M2 in parallel.

S1 also completes the circuit for the self-drive of uniselector C via arc C1 to step to its home contact (bank contact 1 or 14 as appropriate). Likewise earths are extended via S2 to home uniselector M to its home circuit 1 or 14 as appropriate.

The homing of uniselectors C and M removes the earth via the period selection switch 1, position 6, from the initial operate coil of relay S.

When uniselectors C and M are on their home contact 1 or 14, as appropriate, earth is removed from arc C2 and arc M2 respectively thus permitting the relay S to release.

All other facilities are identical with those previously described.

The circuit facilities above described have taken as the example a one hour count period, i.e. three thousand six hundred seconds have been counted, before the uniselector steps to its next bank contact to commence the second count period. However, it will be seen that the period selection switch PSS (FIGURES 4 and 5) is of nine positions and that any of the following six count periods may be selected.

Position 2—five minute periods (three hundred seconds)
Position 3—ten minute periods (six hundred seconds)
Position 4—fifteen minute periods (nine hundred seconds)
Position 5—thirty minute periods (eighteen hundred seconds)
Position 6—one hour periods (three thousand six hundred seconds)
Position 7—two hour periods (seven thousand two hundred seconds)

Positions 1, 8 and 9 have not been wired and will permit a choice of any three additional count periods to be effected by simple wiring on the banks of the counting unit uniselectors (FIGURES 5 and 6 as appropriate).

It should be noted that whilst the foregoing description has assumed the use of a counting circuit employing uniselectors from which the period pulse from five minutes to two hours or any other period of time is derived, this may also be achieved conveniently from a synchronous motor operated from an A.C. mains supply having cam operated spring sets which could be selected or preset to operate at any desired period. Likewise, the one-second pulse source could be derived from a synchronous motor controlling a cam operated springset.

In FIGURES 7 and 7*a* there is shown a cycling selector switch PS designated period sequence switch connected to a total number of seventy-two four-digit electromagnetic counters designated LCM1 and LCM72.

Terminals BT are designated battery terminals and to these connection is made by plug and cord connection to a fifty volt and 150 volt D.C. source of supply, the negative terminals of which are commoned to earth.

A jack PJ is designated one-second pulse jack to which connection is made by plug and cord connection to a second D.C. pulse source of supply if derived from a master clock system.

The lamp BPL is designated battery and pulse lamp to indicate that the battery is connected and that the equipment is receiving the train of incoming one-second

pulses. This condition will be indicated by the lamp flashing at one second intervals.

Six jacks AJ, BJ, CJ, DJ, EJ and FJ (with associated lamp jacks) designated circuit jacks to which connection is made by plug and cord connection to the equipment monitor jacks of the circuts under investigation. Each of these circuit jacks is connected via an amplifier detector circuit to an individual line sensing relay (VA, VB, VC, VD, VE, or VF respectively), which will operate in dependence upon whether radio, telegraph or telephone circuits are to be monitored and which will in turn operate the appropriate integrating relay RVA, RVB, RVC, RVD, RVE or RVF respectively as follows.

The ganged 5-pole 3-position switch designated RTTS is rotated to the required position depending upon the type of circuit sensing required for a particular analysis. This position 1 provides for radio (speech) sensing, position 2 for telegraph (circuit) sensing and position 3 for telephone circuit (P.B.X terminated) sensing.

A typical operation on circuit A only of this sensing unit under the three conditions referred to above is as follows:

POSITION 1—RADIO

Audio voltage applied across the tip and ring connections of the appropriate circuit jacks AJ is applied to the grid of valve V1*a*. The amplified output of V1*a* is then applied to the grid of V1*b* and further amplified.

The output of V1*b* is then applied across the metal rectifier MRA and the resultant D.C. applied to the paralleled grids of V2 thus operating the sensing relay VA which in turn will operate its integrating relay RVA.

The integrating relays have a slow to release feature of 2 or 3 seconds so that momentary pauses in speech do not cause it to release and register a false message count.

Thus the extension of speech transmitted or received over a particular radio circuit connected via the radio equipment monitor jack, plug and cord connected to the appropriate circuit jack AJ, BJ, CJ, DJ, EJ or FJ of this unit will operate the appropriate line sensing relay VA, VB, VC, VD, VE or VF in the amplifier detector circuit and this will in turn operate the corresponding integrating relay which will remain operated for as long as speech is maintained and for a short period, approximately two to three seconds after speech is terminated which will ensure that short pauses in speech are recorded as continuous utilisation. Alternatively, the appropriate integrating relay can be operated directly by D.C. techniques, i.e. earth being extended to it from a relay already having a function in the radio line termination equipment such as from the operation of a "channel call" light.

POSITION 2—TELEGRAPH

Upon receipt of the voltage signal elements via the tip connection of the appropriate circuit jack AJ, the grids of valve V2 are driven positive above cut-off and thus operate the sensing relay VA, which in turn via VA1 will operate its integrating relay RVA. As in the case of radio sensing relay RVA has a slow to release feature such that momentary pausing in the telegraph message transmission does not cause it to release and register a false message count.

Thus the normal condition to the line sensing relay when the circuit is not in use is a negative eighty volts condition. However, one or more positive elements (positive eighty volts) will occur with each character transmitted or received when the circuit is in use and this condition will operate in the amplifier detector circuit the appropriate line sensing relay VA, VB, VC, VD, VE or VF which may conveniently be of the polarised type and which in turn operates the corresponding integrating relay which will remain operated for as long as characters are being transmitted i.e. for as long as the circuit is in use, and for a further short period, if desired, to ensure continuity of record of each message, it will be noted that under telegraph conditions valves V2, V4, V6, V8, V10 and V12 only are used.

POSITION 3—TELEPHONE

Under free line conditions P.B.X battery negative potential exists on the sleeve connection of the circuit jack AJ, this effectively short circuits the sensing relay VA and thus the integrating relay RVA remains unoperated.

However, when the circuit under analysis is engaged the sensing relay VA operates on the resistance earth extended via the sleeve connection of the P.B.X operators card circuit used to establish the engaged condition, and to the negative terminal of the telephone switchboard battery connection shown in FIGURE 7. Relay RVA hence operates via VA1 but in this case the integrating relay RVA has no slow to release feature since it operates as a single coil relay, its secondary winding being open circuit.

Thus the insertion of a plug having sleeve connection only and being physically devoid of tip and ring connections in a circuit appearance jack of the switchboard of the line of the telephone circuit under investigation will, when that circuit is brought into use, i.e. when it has a plug and cord connection at any of its other parallel jack appearances on the switchboard, extend a different potential from its idle condition over the sleeve connection of the cord connection AJ, BJ, CJ, DJ, EJ or FJ of this equipment (FIGURE 1) to operate the appropriate integrating relay RVA, RVB, RVC, RVD, RVE or RVF in the amplifier detector circuit which will remain operated for as long as the circuit is in use, i.e. has a plug inserted in one of its parallel appearance jacks of the switchboard.

A three position switch CCS designated circuit selection switch having seven poles designated CCS1 to CCS7 will give the following facilities:

Position 1.—Three circuits monitored

(Normally the circuits connected via plug and cord connections to circuit jacks A, B and C). This will permit a circuit utilisation count and number of messages count over twelve periods simultaneously for each circuit connected.

Position 2.—Three circuits monitored

(Normally the circuits connected via plug and cord connections to circuit jacks A, B and C). This will permit a circuit utilization count over twenty-four periods simultaneously for each circuit connected.

Position 3.—Six circuits monitored

Connected via plug and cord connections to circuit jacks A, B, C, D, E and F). This will permit a circuit utilization count over twelve periods simultaneously for each circuit.

A jack CAJ designated camera jack, if desired, may be connected via plug and cord connection to an electrically actuated shutter mechanism of a camera to photograph the counter registration at the completion of a particular count period cycle. This would be of particular use under continuous operation conditions.

A two position switch CCOS designated 12/24 count/continuous operation which is operated depending on whether (*a*) a specific period count of twelve or twenty-four count periods is required or (*b*) it is required to effect a continuous monitoring of the circuits in question indefinitely until manually stopped.

An alarm circuit designated record alarm consisting of a lamp L and buzzer B which will be brought into operation under continuous operation conditions and which will, on the commencement of the twelfth and twenty-fourth count period as appropriate, operate the lamp L

and buzzer B to draw attention to the fact that the first eleven or twenty-three counts, as appropriate, as registered on the counters should now be noted. It will similarly operate on the completion of the twelfth and twenty-fourth count period as appropriate to ensure that the counts on the twelfth or twenty-fourth counters are then noted.

A locking plunger type key designated record alarm key RAK which when extended will extinguish the record alarm lamp L and silence the buzzer B under the first conditions as in the preceding paragraph i.e. at the commencement of the twelfth or twenty-fourth count period, as appropriate. When the twelfth or twenty-fourth count period, as appropriate, has been completed the period sequence switch PS will step automatically (under continuous operation conditions) to the first set of counters connected again the record alarm lamp L and buzzer B will operate to indicate that the twelfth and twenty-fourth count period, as appropraite, has been completed and that the count as indicated on the twelfth or twenty-fourth counters should now be noted. The operation of the record alarm key RAK depressed to its original postion will extinguish the lamp L and silence the buzzer B and will be ready to operate upon the commencement of the twenty-fourth or forty-eighth count period, as appropriate. This cycle of events will continue until manually stopped either by the operation of the continuous operation switch CCOS to the 12/24 count position or by operation of the battery switch to its "Off" position.

A lamp jack RL designated reset lamp (FIGURE 5) which will indicate that the cycling selector switch period sequence switch PS is on its home contact and is ready to start sequence of count periods.

A non-locking plunger type key SRK designated start/reset key which when momentarily depressed with the reset lamp RL operated starts the period count cycle. If the reset lamp RL is not operated, momentary depression of this key will return the cycling selector switch period sequence switch PS to its first contact to permit the reset lamp RL to operate.

CIRCUIT DESCRIPTION

NOTE.—If the seventy-two four-digit electromagnetic counters LCM are not of the reset digit pattern it will be necessary to note the number registered on each counter before their commencement of operation.

The line sensing relay associated with the amplifier detector circuit of the jack designated circuit jack AJ is itself designated relay VA, likewise circuit jacks BJ, CJ, DJ, EJ and FJ have line sensing relays VB, VC, VD, VE, VF connected via their own amplifier detector circuits.

(1) *Three circuits monitored.*—I.e. plug and cord connection to circuit jacks AJ, BJ and CJ for a period count of twelve count periods on each, i.e. the period selection switch PSS of FIGURE 5 preset to the desired count period and the circuit selection switch CCS preset to position 1 and the 12/24/continuous operation CCOS preset to 12/24.

This will permit a circuit utilization count and number of messages count to be taken over twelve count periods for each of the three circuits connected to the circuit jacks AJ, BJ and CJ.

To describe a typical circuit operation on circuit A only with the period selection switch preset to position 6, i.e. the hourly count period. The one-second pulse relay TP is pulsing at one-second intervals ineffectively at this stage apart from indicating that it is receiving the incoming pulses from the inherent one-second pulse circuit or from an external master clock connection i.e. the battery and pulse lamp BPL is pulse operating at one second intervals via earth and the pulsing contact TP2 is in its unoperated normal position.

Momentary depression of the non-locking type plunger key start/reset key SRK (FIGURE 7) will extend earth momentarily to operate the period sequence switch

$$PS\ \frac{25}{8}$$

drive magnet PSDM which will cause its associated wipers to step to their bank contacts 2 upon release of the key.

Relay G operates via arc PS1 to battery via drive magnet PSDM and relay SS in parallel, neither of these operates in series with relay G since this latter is of higher resistance.

G1 (FIGURE 5) operates and extinguishes the reset lamp RL and completes the circuit for the extension of earth condition via TP1 (the one-second pulsing contact) to pulse the units uniselector

$$U\ \frac{25}{4}$$

drive magnet UDM, the wipers of which will traverse their bank contacts one contact per second.

TP2 (FIGURE 7*a*) extends pulsing earth at one-second intervals via RVA1 which is operated only when the circuit connected to circuit jack AJ is in use and pulse operates the four-digit counter LCM1 via arc PS5 bank contact 2 to register the circuit utilization in seconds during the first hourly count period. Earth from RVA2 also operates circuit A lamp to indicate that the circuit is busy. Relay HA is slow to release and thus upon the release of relay RVA, viz, upon the termination of conversation, permits earth via RVA1, HA1, position 1 of CCS4, arc PS4 bank contact 2 to step counter LCM13 one digit to register the completion of one message during the first hourly count period. (Similarly the message count feature using circuit B is effected with the slow release feature of relay HB which operates from earth extended from RVB2.)

It follows that when relay VA is released, i.e. when the circuit is not utilized no further count will be registered on LCM1 counter.

The pulsing contact TP1 on the other hand is pulsing drive magnet UDM irrespective of whether the circuit is being utilized or not.

When uniselector U steps to bank contact 11, i.e. upon completion of the tenth one-second pulse, earth is extended from the wipers of arc U3 to give a single earth pulse to operate drive magnet DDM. Uniselector U self-drives via its own interrupter springs U*dm* to earth from bank contacts 11, 12 and 13 of arc U1 to bank contact 14.

Drive magnet DDM remains operated whilst uniselector U steps over bank contacts 11 and 12 since the wipers of uniselector U are of the bridging type and contact two adjacent bank contacts simultaneously.

When the wipers of uniselector U reach bank contact 13, drive magnet DDM is de-energised and hence the wipers of uniselector D step to bank contact 2.

Uniselector U steps to bank contact 14 which in common with its bank contact 1 is a home position due to the strapping of bank contacts in groups such that every half revolution of its wipers will permit twenty seconds to be counted. The cycle of events is then repeated. A further ten one-second pulses are then received and counted.

Uniselector D is stepped to bank contact 3 to indicate a count of twenty seconds. This progression of events will continue until ninety-nine seconds have been counted.

Upon completion of the hundredth one-second pulse, however, uniselector U will operate, as previously described and uniselector D will step to its eleventh bank contact when an earth pulse will be extended via the wipers of arc D3 bank contact 11 to energise drive magnet CDM.

Uniselector D self-drives via its own interrupter springs D*dm* to earth from bank contacts 11, 12 and 13 of arc D1 to bank contact 14. When the wipers of uniselector

D reach bank contact 13, drive magnet CDM will be de-energised to step uniselector C to bank contact 2.

The progression of events continues until nine hundred and ninety-nine seconds have been counted.

Upon completion of the thousandth one-second pulse, however, the wipers of uniselector C will step to their eleventh bank contact and will extend an earth pulse to energise drive magnet MDM. When the wipers of uniselector C reach bank contact 13, drive magnet MDM will be deenergised thus permitting the wipers of uniselector

$$\frac{M25}{4}$$

to step to bank contact 2, i.e. one thousand one-second pulses have been counted.

In the example taken the period sequence time interval is hourly, i.e. three thousand six hundred seconds are required to be counted. The progression of count proceeds as previously described.

On completion of the three thousand six hundredth one-second pulse, however, earth is extended via the period selection Switch PSS4 preset to position 6, the one hourly count period, the wiper of arc M4 bank contact 4 via the period selection switch PSS3 preset to position 6, the wiper of uniselector

$$\frac{C25}{4}$$

arc C4 bank contact 7 via period selection switch PSS2 preset to position 6 to the wiper of arc D4 bank contact 1 to PSS1 preset to position 6, to the wiper of arc U4 bank contact 1 to operate relay S via its operate coil and also extends earth to energise drive magnet PSDM (FIGURE 5*a*). S1 holds relay S via earth extended from arcs U2, D2, C2 and M2 in parallel and also completes the circuit for the self-drive of uniselector U via arc U1 to step it to its home contact (bank contact 1 or 14 as appropriate). Likewise, earth extended via S2, S3 and S4 permits uniselectors D, C and M respectively to self-drive to their home contacts 1 or 14 as appropriate.

The earth extended via the period selection switch PSS1–PSS4, preset to position 6, via arcs M4, C4, D4, and U4 is removed from drive magnet PSDM (FIGURE 7*a*) immediately these uniselectors commence to home thereby de-energising drive magnet PSDM and stepping the wipers of arcs PS1 to PS8 to their third bank contacts. Simultaneously earth is removed from the operate coil of relay S which releases when uniselectors U, D, C and M have reached their home contacts 1 or 14 as appropriate.

The circuit utilization count for the second count period, i.e. of the second hour of the example being described, then proceeds in similar fashion to operate counter LCM2.

The speed with which uniselectors U, D, C and M self-drive to their home contacts will ensure that they are reached before the initial one-second pulse of the second count period is effected.

The counter unit (FIGURE 5) proceeds to count three thousand six hundred seconds as before.

This hourly cycle of events continues throughout the twelve hour period count. Upon completion of the twelfth hourly count period, earth is extended as before to operate drive magnet PSDM via arcs M4, C4, D4, and U4 in series via earth extended from the period selection switch PSS4, preset to position 6, which on the homing of the counting uniselectors M, C, D and U will step

$$\frac{PS25}{8}$$

wipers to their fourteenth bank contact. Earth is then extended via PS1 bank contacts 14 to 25 strapped from CCS preset to position 1, to self-drive uniselector

$$\frac{PS25}{8}$$

drive magnet PSDM to its home contact, bank contact 1.

Relay G will then release and in releasing will disconnect the pulsing earth from drive magnet UDM (FIGURE 5) and will also operate the reset lamp RL.

The circuit analysis in the example taken has now been completed and the counter readings may now be taken. If non-resettable counters are in use then the respective differences between the totals now registered and those previously noted for each counter will represent respectively the circuit utilization in seconds during the hourly count periods and the total number of messages for the message count during the hourly count periods and these recordings may be then graphically represented if desired.

Further facilities which in no way alter the mode of operation of the circuit utilization counts are later described.

(2) *Three circuits monitored—circuit utilization only for twenty-four count periods on each circuit.*—The circuit description is identical with that already described except that since the circuit selection switch CCS is now preset on position 2 it permits a circuit utilization count in seconds of the circuits connected via plug and cord connection normally to circuit jacks AJ, BJ and CJ.

(3) *Up to six circuits monitored—circuit utilization on each for twelve count periods.*—The circuit selection switch CCS is on position 3. The circuit description is identical with the utilization feature first described except that pulsing earth is now extended from TP2 via RVA1, RVB1, RBC1, RVD1, RVE1 and RVF1 via position 3 of the circuit selection switch CCS to register the circuit utilization count in seconds of the six circuits to operate successively counters LCM1 to LCM12; LCM13 to LCM24; LCM25 to LCM36; LCM37 to LCM48; LCM49 to LCM60; and LCM61 to LCM72 for the circuit utilization of each respectively.

CONTINUOUS OPERATION

It will be appreciated that if a total period count cycle in excess of twelve or twenty-four count periods is required, additional counters would be necessary, their number being dependent upon the total period count. In such circumstances it is desirable that the counters which had registered the first twelve or twenty-four count periods would also register the second cycle of twelve/twenty-four count periods and so on.

This requires an alarm circuit to sound upon the completion of each period count cycle so that the number registered on the counters may then be recorded. The alarm operates upon the completion of each cycle. The unit would also be required to start the second and subsequent count period cycles immediately upon the completion of the twelfth or twenty-fourth count period of each period count.

The unit has been designed with this facility using the 12/24 count/continuous operation switch CCOS thrown to the continuous operation position. Where, for example, the twenty-four period count has been selected on CCS preset to position 2 to be repeated indefinitely the circuit description is as follows:

The period count proceeds as described previously until arcs PS1 to PS8 wipers step to the twenty-fifth bank contact i.e. for the commencement of the twenty-fourth count period. Earth is then extended from the start reset key SRK normal via the continuous operation switch CCOS, arc PS2 wiper, bank contact 25, via a second contact of the continuous operation switch CCOS, G2 to operate relay CN.

This earth is also extended via the plunger type locking key record alarm key RAK (in its depressed position) to operate the record alarm lamp L and buzzer B to battery via the camera jack CAJ to warn that the record of the counters, in this instance LCM1 to LCM23 and LCM25 to LCM47 and LCM49 to LCM71.

The record alarm lamp L and buzzer B, may be extinguished and silenced respectively by the extension of

the record alarm key RAK which, as previously stated, is of the locking type.

CN1 holds relay CN to earth extended from the continuous operation switch CCOS and the start/reset key SRK normal. CN2 is not effective at this stage. Upon completion of the twenty-fourth count period uniselector

$$PS\ \frac{25}{8}$$

wipers step to their home contact, bank contact 1. CN2 then extends earth via PS1 bank contact 1 to step the wipers of uniselector

$$PS\ \frac{25}{8}$$

to their second bank contacts to commence the circuit utilization count over the second twenty-four count periods.

Earth is then extended from the continuous operation switch CCOS via arc PS2 bank contact 2 again to operate the record alarm lamp L and buzzer B via the record alarm key RAK (in its extended position) to battery from the camera jack CAJ. This will warn that the count of the twenty-fourth count period should now be noted from counter LCM24, LCM48 and LCM72.

The record alarm lamp L and buzzer B may be extinguished and silenced respectively upon the depression of the record alarm key RAK.

The alarm circuit is now ready to be brought into operation upon the completion of the second twenty-third count period. This cycle of events is repeated indefinitely.

When it is required to terminate the progression of events the operation of the start/reset key SRK will remove the earth from the hold circuit of relay CN which will then release.

Depression of the start/reset key SRK will also operate relay SS which will hold from earth extended from SS1 via the bank commoning of arc PS1.

SS1 short circuits relay G which then releases. SS1 permits uniselector PS to self-drive via arc PS1 bank commoning and its interrupter springs PS*dm* to its home bank contact (contact 1).

SS2 (FIGURE 5) extends earth to operate relay S over its operate coil. S1 holds relay S via earth extended from arc U2, arc C2, arc D2, and arc M2 in parallel and also with S2, S3 and S4 permit uniselectors U, C, D and M respectively of the counter unit to self-drive to their home contacts to resume the count when desired.

Under continuous operation conditions, G2 in releasing prevents the re-operation of relay CN over its operate coil when uniselector PS wipers are traversing their twenty-fifth bank contact of arc PS2. When PS wipers reach bank contact 1 relay SS releases SS2 and removes the earth from the operate coil of relay SS thus permitting relay S to release when uniselectors U, C, D and M have self-driven to their home contact 1 or 14 as appropriate.

I claim:

1. An arrangement for recording utilization by means of an electrical pulse drive, comprising two groups of counters, a sequence switch adapted to be connected in succession to pairs of counters simultaneously, one from each of the two groups, means to detect a particular utilization, means for connecting the pulse drive to the sequence switch to operate or not to operate one of the pair of counters connected thereto once for each pulse of the drive, in accordance with the utilization indication detected, further means adapted to detect each uninterrupted period of utilization, means for connecting the pulse drive to the sequence switch to operate the other of the pair of counters connected thereto once for each uninterrupted period of utilization indication detected and a counting unit connected to step the sequence switch to the next pair of counters after a predetermined number of pulses have been counted.

2. An arrangement for recording simultaneously a plurality of utilizations by means of an electrical pulse drive comprising a plurality of pairs of groups of counters, the individual counters in each group each corresponding with a separate particular utilization, a sequence switch adapted to be connected in succession to each pair of groups of electromagnetic counters simultaneously, a plurality of means each adapted to detect a separate one of the particular utilizations, means for connecting the pulse drive to the sequence switch to operate or not to operate each of the counters of one of the groups of the pair of groups connected to the sequence switch in accordance with the utilization indication detected, once for each successive interval of time determined by the pulse drive, a plurality of further means adapted to detect each uniterrupted period of one of the particular utilizations, means for connecting the pulse drive to the sequence switch to operate each of the counters of the other group of the pair of groups connected to the sequence switch once for each uninterrupted period of utilization indication detected and a counting unit connected to step the sequence switch to the next pair of groups of counters after a predetermined number of pulses of the pulse drive have been counted thereby.

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