UDC 654. 94 : 621. 317. 083. 7

WHOLLY ELECTRONIC ANALOG TELEMETERING EQUIPMENT

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I. FOREWORD

Wholly electronic analog telemetering equipment has been developed to replace the torque balance type analog telemetering equipment heretofore in extensive use.

The sender is divided into a primary converter and a secondary converter which, through the absence of moving parts, are completely static.

As for the receiver, the conventional model has been modified to suit the construction of the bay. *Fig. 1* shows a diagram for the signal transmission system.

The bay equipping this device is a new model of bay constructed so as to be suitable for a back-to-back setting system.

Fig. 1 Signal transmission system diagram

II. BAY

Fig. 2 represents an outer view of the bay of the sender. This bay is called a "T" bay which conforms to the standard of the Nippon Telegraph & Telephone Corporation calling for height 2750 mm, width 520 mm and thickness 225 mm. Full provisions are made for installation of this equipment in the communications machinery room along with other communications apparatus.

In equipping the bay with a wholly electronic telemeter, the following points were considered:

1) What is commonly called a back-to-back system is employed. This makes possible daily maintenance, check-up, addition or alteration of meter elements from the front side of the bay. The equipment consists of plug-in construction as much as possible in respect of cost. Bunched wiring on the rear uses a standardized connection to suit any meter elements, and slight rewiring that may be necessitated by different elements may be carried out through strap wiring at the front.

2) The number of meter elements or so-called channels is 8 when only this telemetering equipment is mounted on the bay as the present example and 6 when the bay is shared by a signal transmission device. The signal transmission device referred to above signifies Fujitsu transmitter, model TL 18.

3) The front covers open together on hinges as illustrated or may be of a fastener system with each unit of equipment divided by a front cover and fastened togeter by a fastener. The latter is our standard and the former may be furnished upon request.

4) The setting position of the equipment is fixed and standardized.

5) Fuses, instead of being concentrated as done heretofore, will be distributed where needed to

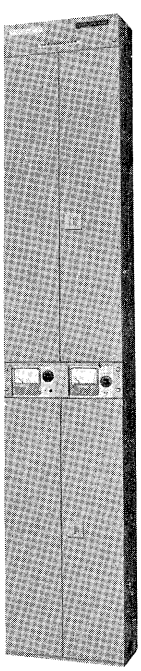


Fig. 2 External view of the bay of sender

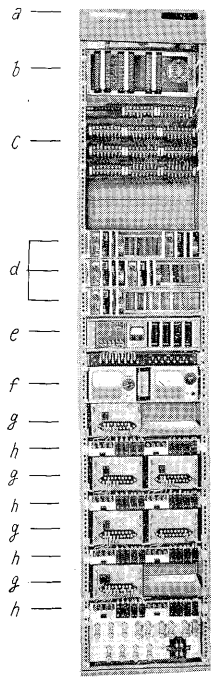


Fig. 3 Inner view of the bay of sender

economize space and simplify wiring. This distribution of fuses may take more time than the concentrated system in locating fuse breakage but this fear may be negligible.

Fig. 3 illustrates an inner view of the bay of the sender with 8-channel capacity arranged for 7-chaneels.

(a) Signal lamp
Left side (white color): Power source lamp
Right side (red color): Alarm lamp

(b) Terminal block of tele-communication type (including buzzer)

This is where the output terminal of the secondary converter or, in other words, the connecting terminal with the signal transmission device is connected to the output of primary and secondary converters by an anchor strap.

(c) Terminal block of strong current type

This is for input of the primary converter. The number of terminals per channel being a maximum of 7 on power and reactive power, this block is capable of handling 56 pieces for 8 channels. The size of outside lead cord at maximum is 8 mm^2.

(d) Secondary converter (explanation in following paragraph)

This consists of three boxes of printed circuit plates, and each box comprises 3 channels.

(e) Power source device (explanation follows)

(f) Meter board (explanation follows)

(g) Primary converter (explanation follows)

(h) Testing terminals for primary converter (explanation follows)

III. CONVERTERS AND OTHER DEVICES

1. Primary Converter

This is to convert measured input to d-c voltage (50 mv full scale). Measured values include power, reactive power, voltage, current and water level and the primary converter to convert these factors is housed in the same case, of which the outer view is shown in *Fig. 4*. Being back-to-back, the terminals are on the front panel in order to make connections easy.

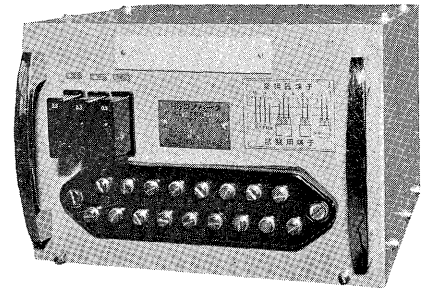


Fig. 4 External view of primary converter

For the primary converter of power and reactive power, the conventional HG converter is used. In other words, voltage and current detected by a potential transformer (PT) and current transformer (CT) are multiplied by means of a hall generator to obtain d-c voltage in proportion to power or reactive power. The circuit is illustrated in *Fig. 5* in a diagram as well as in *Fig. 6*. *Fig. 7* shows an inner view of HG converter.

The primary converter for voltage and current is such that voltage and current detected by PT and CT are rectified through a semi-conductor rectifier via an isolating transformer or an auxiliary current transformer. This is the system heretofore in use as voltage sender and current sender. Circuit diagrams are shown in *Fig. 8* and *9*.

Water level is detected by a variable resister (so-called potentiometer) so that d-c bridge is made and

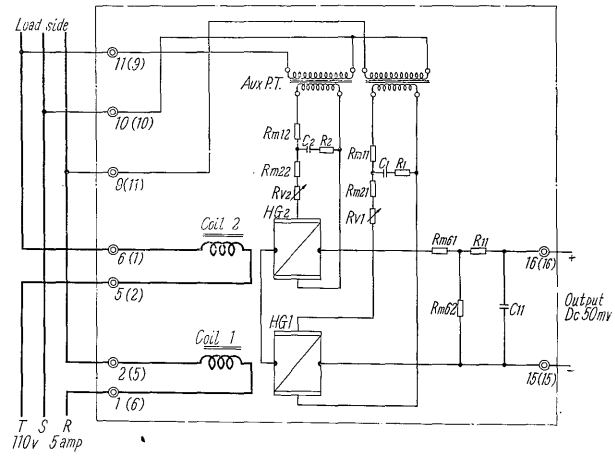


Fig. 5 Circuit diagram of power converter

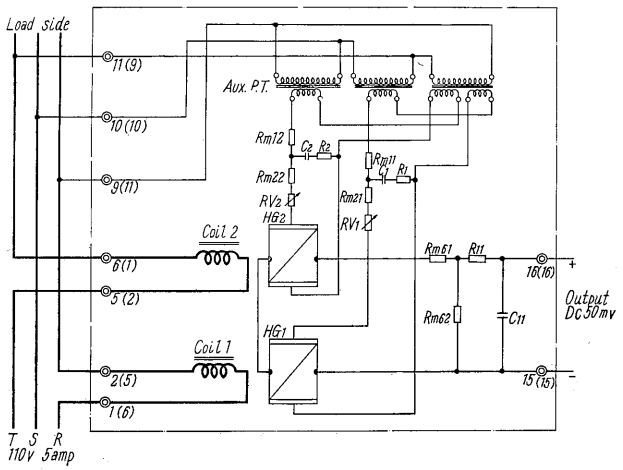


Fig. 6 Circuit diagram of reactive power converter

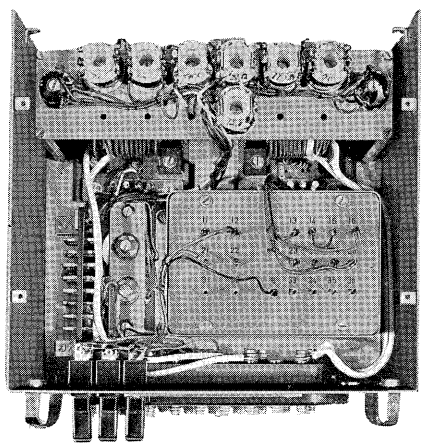


Fig. 7 Inner view of HG converter

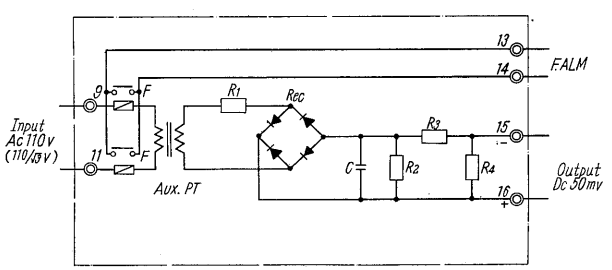


Fig. 8 Circuit diagram of voltage converter

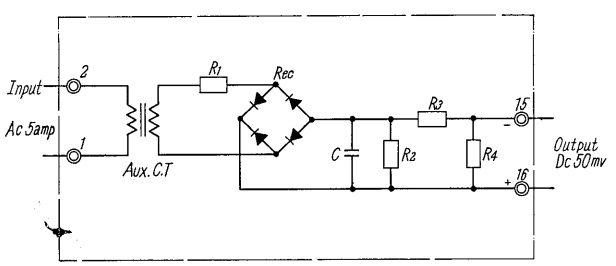


Fig. 9 Circuit diagrm of current converter

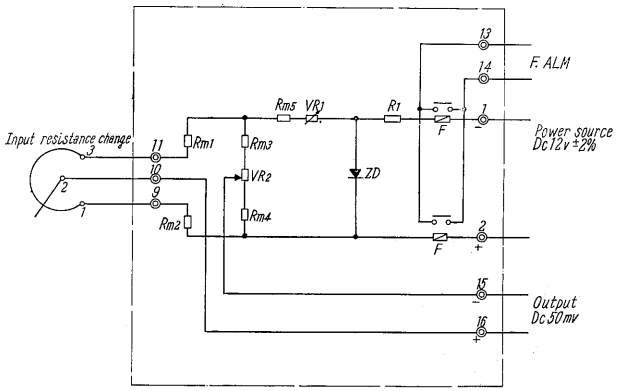


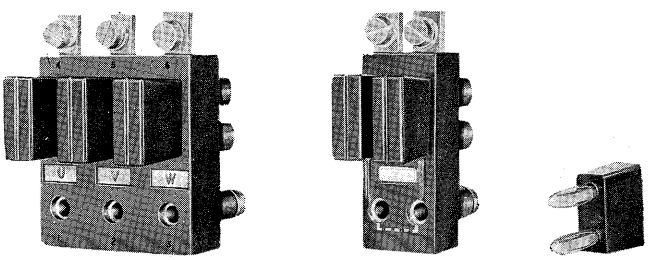
Fig. 10 Circuit diagram of resistance converter

its galvanometer circuit voltage is utilized as the output voltage. Its circuit diagram is shown in *Fig. 10.*

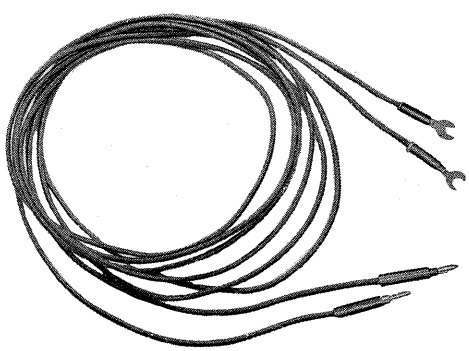
Accuracy of these primary converters is 0.5% respectively.

2. Testing Terminal for Primary Converter

To meet the requirements that a primary converter may be fitted and dismantled from the surface, that the test of PT and CT circuits may be possible and that the circuit structure may be standardized, new testing terminals in particular have been developed.



(a) Model STT4-V1 (b) Model STT4-A1 (c) Model STT4-Z1



(d) Model STT4-X1

Fig. 11 Test terminals and test plugs

The conventional stud type occupies a large space and its operation is rather complicated. Hence, the employment of a plug-in construction. As for the type, the one for PT circuit is called STT4-V1, the one for CT circuit STT4-A1, the one for short-circuit plug STT4-Z1 and the plug for testing with 3 m cord, STT4-X1. (*Fig. 12*)

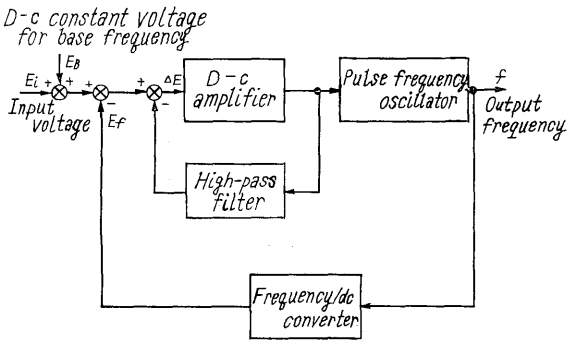


Fig. 12 Block diagram of secondary converter

3. Secondary Converter

This is to convert output d-c voltage of the primary converter to pulse frequency (12～24 c/s). The one used here is wholly electronic of the latest conception, of which a block diagram is shown in *Fig. 12*. Output d-c voltage 0～50 mv from the primary converter is added by constant voltage for base cycle and after it is compared with feedback voltage, error voltage is amplified by a transistorized chopper d-c amplifier which drives a multi-vibrator and obtains pulse frequency. This pulse frequency is converted into a proportional d-c voltage by a saturation transformer and made into feed back voltage. As a compensator for dynamic action, feedback is given from the d-c amplifier output through high- pass filter. Circuit diagram of the whole is shown in *Fig. 13*. Parts of the circuit are such static parts as semi-conductor and iron core. And one of the merits is the absence of movable parts. Accuracy is 0.5% and by compensating the dynamic action with minor feedback it performs very stable function. This converter is composed of four printed circuit plates all plug-in system, and by switching a dial, 12 c/s and 24 c/s can be checked. *Fig. 14* shows external views of four printed circuits.

Output pulse frequency is conveyed to a signal transmission device.

4. Receiver

The signal thus transmitted is again demodulated back to pulse frequency by the signal demodulator. The receiver converts this pulse frequency into d c and for this end a saturation transformer type frequency d-c converter is used.

Its construction, like the secondary converter, is of printed circuit (one sheet) which makes it convenient for adaptation to the " T " bay. *Fig. 15* illustrates the circuit diagram while *Fig. 16* shows the exterior view.

5. Power Source Device

Power source is d-c 24 v for communication apparatus but since d-c 12 v is required for the secondary converter and receiver, a power source constant voltage of 12 v within ±1% approx. is prepared by a simple stabilized power source circuit. The circuit diagram is shown in *Fig. 17*.

An over voltage protector circuit is inserted in the power source device to protect the telemetering equipment from a sudden voltage rise (10～20%) of d-c 24 v source. *Fig. 18* shows its circuit diagram.

The first stage differential amplifier compares constant voltage with power source voltage and if the latter should become higher than the set value the

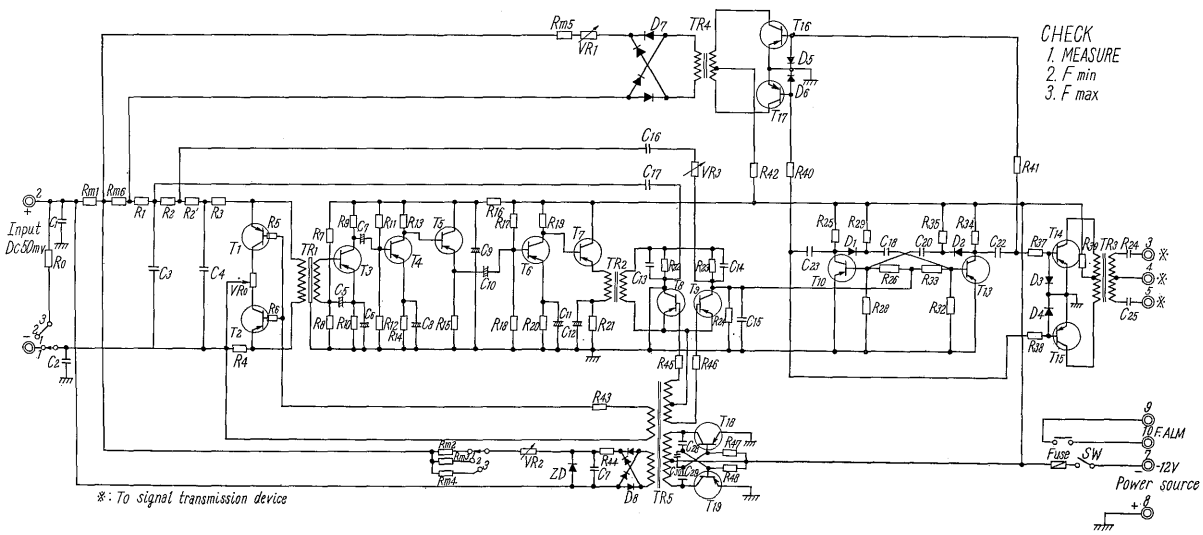
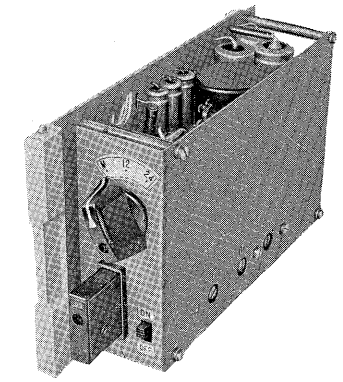
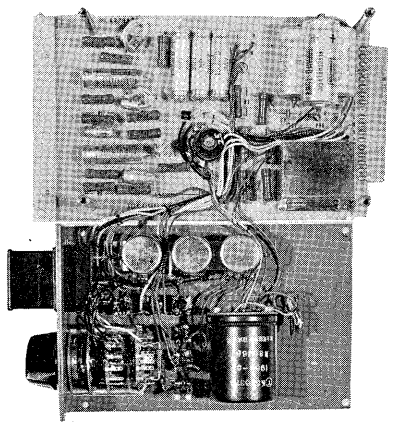


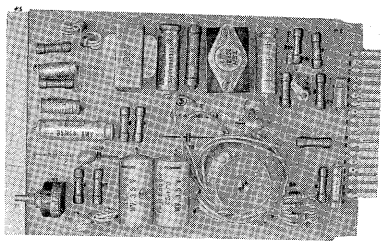
Fig. 13 Circuit diagram of secondary converter



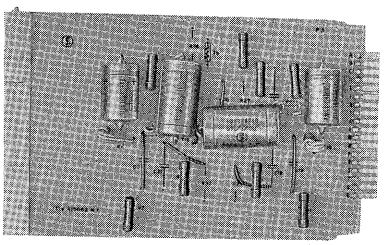
(a) External view of P1



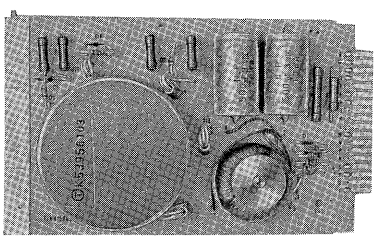
(b) Internal view of P1



(c) P2



(d) P3



(e) P4

Fig. 14 Printed circuits of secondary converter

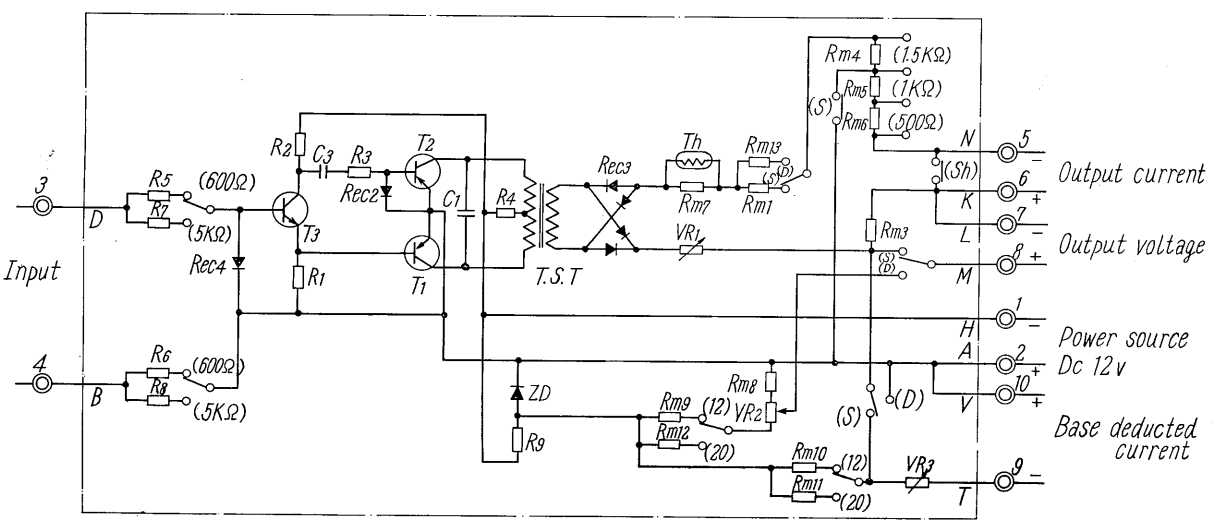
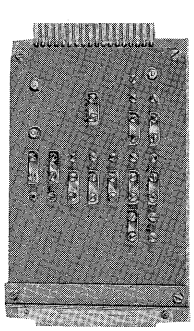


Fig. 15 Circuit diagram of receiver



External view

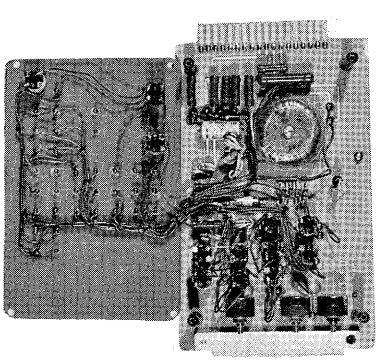


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Fig. 16 Receiver

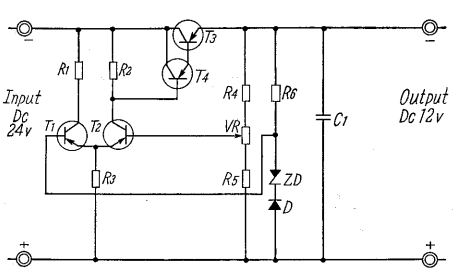

Fig. 17 Circuit diagram of power source

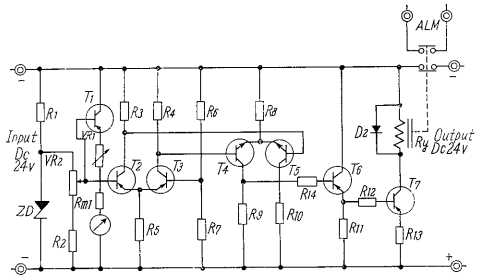

Fig. 18 Circuit diagram of over voltage relay

next differential amplifier amplifies the difference, excites a relay for circuit break and the relay cuts off the equipment. Voltage to break is adjustable between 24 v+0~20%. In the past, an auxiliary relay was used as an overvoltage protector but this time a transistorized amplifying system is used and efficiency is improved.

6. Indicator Device

This indicator device is composed of a power source overseeing indicator and output pulse frequency overseeing Indicator.

The former checks 24 v power source voltage, 12 v constant voltage circuit output, 24 v consumption current, etc. by switching and the indicator employed is a general purpose meter model SM3B of our manufacture. Alarm buzzer, push button of buzzer stop, buzzer lock switch (to be explained later) are fitted to it.

The latter checks output frequency of the secondary converter by switching, which houses the receiver inside, of which the indicator is also SM3b. The terminal is found underneath the switch, which permits checking of output wave and measuring of level.

Fig. 19 shows an outer view of the indicator panel.

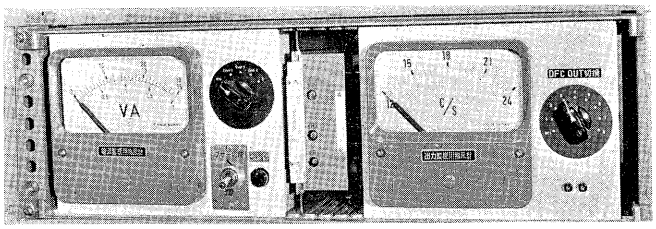

Fig. 19 Indicator panel

7. Alarm Device

When a fuse is broken or an overvoltage protector acts, an alarm lamp flashes and at the same time a buzzer sounds. When the overseer pushes a push button for a buzzer stop on the above-mentioned indicator device, the buzzer stops and only the red lamp remains lit. The circuit is such that when the trouble is removed the lamp goes out. When it is

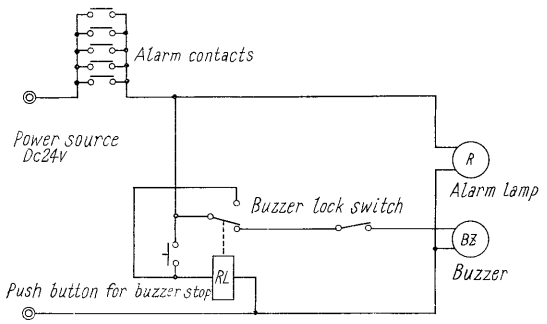

Fig. 20 Circuit diagram of alarm device

not necessary to sound the buzzer during the trouble, a switch is provided to lock the buzzer, of which a circuit diagram is shown in *Fig. 20.*