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The ground equipment for the F-type radiosonde

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ABSTRACT. The paper describes the latest model of the F-type radiosonde receiver and recorder designed and constructed in the laboratories and workshops of the Meteorological Office at Poona. The receiver is of the conventional super-regenerative type. The original moving iron armature in the recorder has been replaced by a moving coil and the construction of this equipment has been described in detail.

1. Introduction

The technique employed in the Fan type radio-meteorograph of the India Meteorological Department has been briefly described by Venkiteshwaran and others in an earlier publication of the India Meteorological Department (1948). Since then, a number of improvements were made in the design and construction of the ground equipment used for receiving and recording the signals from the radio-meteorograph. In a more recent paper Venkiteshwaran and his colleagues (1949) have also described a portable equipment for receiving and directly counting the signals from the meteorograph. In the present paper a description of the latest type of receiving and recording arrangement designed and constructed in the laboratories and workshops of the Meteorological Office at Poona is given. The chief improvements effected in the design are—

(*i*) The replacement of the moving iron armature of the recorder with one of the moving coil type in an electromagnet,

(*ii*) The replacement of the pen recorder with capillary tubes and suitable inking arrangements,

(*iii*) Increasing the sensitivity of the D. C. amplifier and

(*iv*) Mounting the whole equipment in a suitable rack assembly.

This ground equipment will be of use not only to the members of the meteorological department who have to do radiosonde work, but will also be of interest to workers in related branches who wish to record signals from distant mobile transmitters.

2. The rack assembly

The rack (Fig. 1) is in two halves and the upper portion is so arranged as to house the receiver and the recorder. A lockable folding cover is provided in the lower half of the rack. This folding cover serves as a desk for the operator for evaluating the records on the paper tape while the signals are being received during flight. At the back of the rack is a removable panel which furnishes convenient access to the equipment when inspection, adjustment, or minor servicing is necessary. The top of the assembly houses the loudspeaker and contains a coaxial cable connector through which the aerial is connected to the receiver by means of two lead in wires. An easily detachable front cover protects the receiver and the recorder from dust and unauthorised handling when the equipment is not in use.

3. The receiver unit

The receiver is a specially designed super-regenerative set complete with built in power supply and loudspeaker and a D.C. amplifier for working the recorder. The advantage of the super-regenerating method lies in the very high amplification that is produced by a single tube, giving a degree of sensitivity approaching the thermal agitation noise level of the tuned circuit. Super-regenerative receivers find their chief usefulness in the

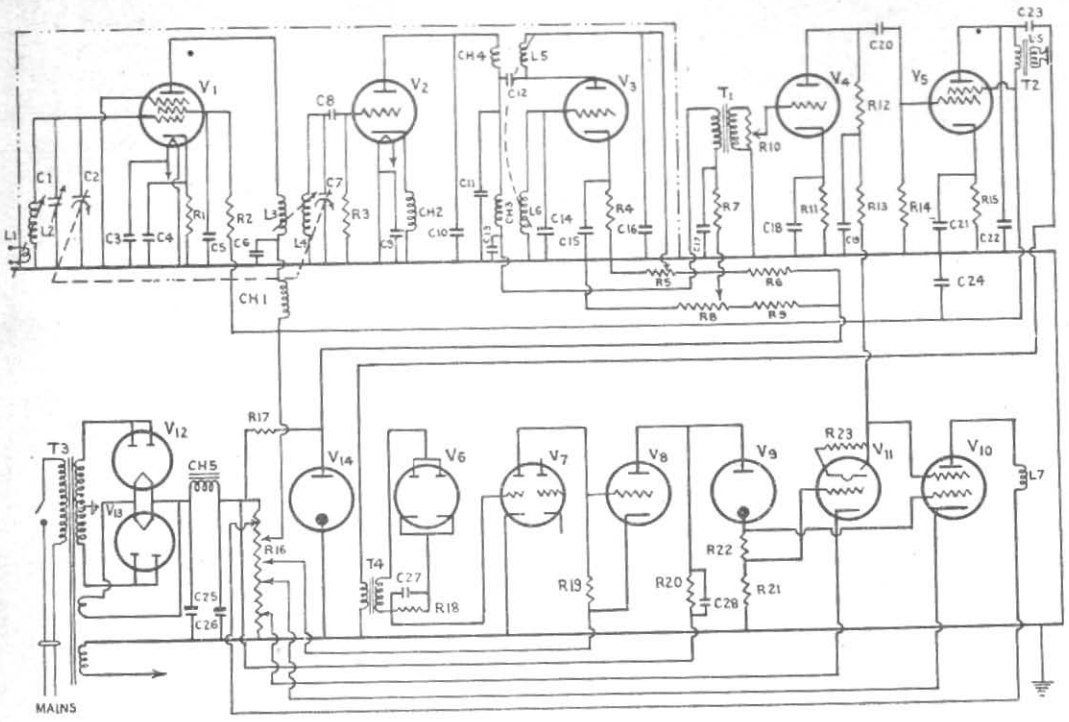

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Fig. 2. Super-regenerative receiver for F-type radiosonde (3-4 metres)

wave length range 0·5 to 10 metres, and provide a very large amount of radio frequency amplification at frequencies which are difficult to amplify by conventional methods. The circuit wiring of the receiver is given in Fig. 2 and the details of construction can be seen from Fig. 3.

The radiosonde receiver performs the following functions—

(*i*) It picks up the R.F. signals from the radio-meteorographs and amplifies and detects it

(*ii*) It transforms the detected signal into a D.C. voltage of a suitable value to operate the recorder.

The specifications of the receiver are—

Type	:	V.H.F. Super-regenerative receiver
Frequency range	:	60 to 90 mcs (3·3 to 5·0 metres)
Sensitivity	:	0·5 micro-volts
Power supply	:	220 volts, 50 cycles
Power consumption	:	90 watts
Number of tubes	:	14

4. The radiosonde recorder

The recorder performs the following functions—

(*i*) The moving coil is attracted towards the electromagnet when a signal is received in the receiver

(*ii*) It records the movement of the coil on a moving paper tape by an inking mechanism

(*iii*) It records also the time marks every 15 seconds on the moving paper tape. As the records of pressure, dry bulb temperature and wet bulb temperature are not synchronous

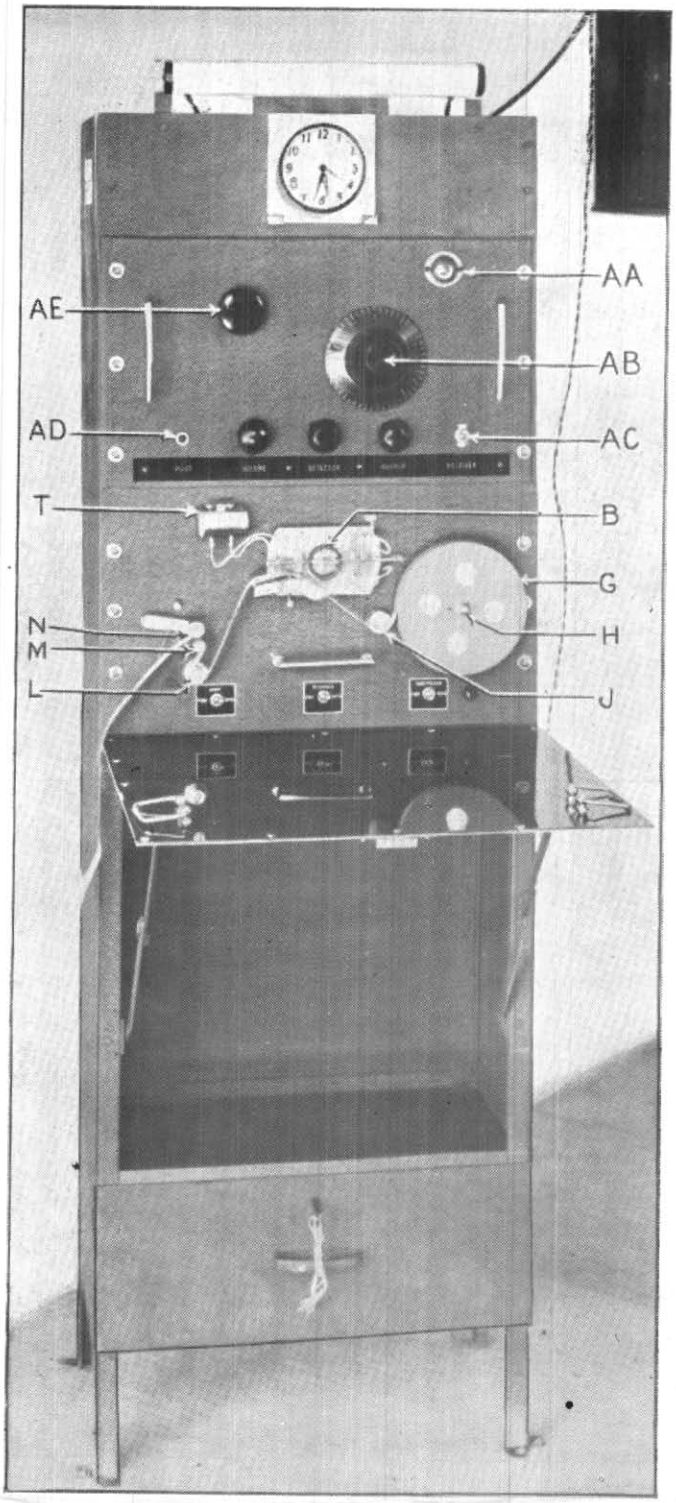

Fig. 1

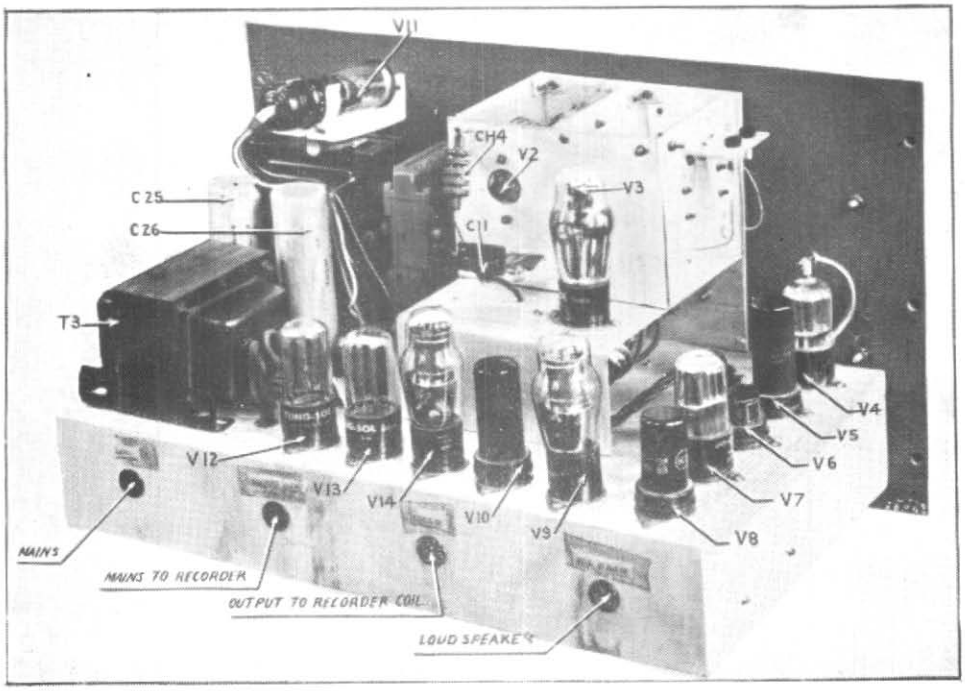
V11
CH4
V2
V3
C25
C26
C11
T3
V4
V5
V6
V7
V8
V12
V13
V14
V10
V9
MAINS
MAINS TO RECORDER
OUTPUT TO RECORDER COIL
LOUD SPEAKER

Fig. 3

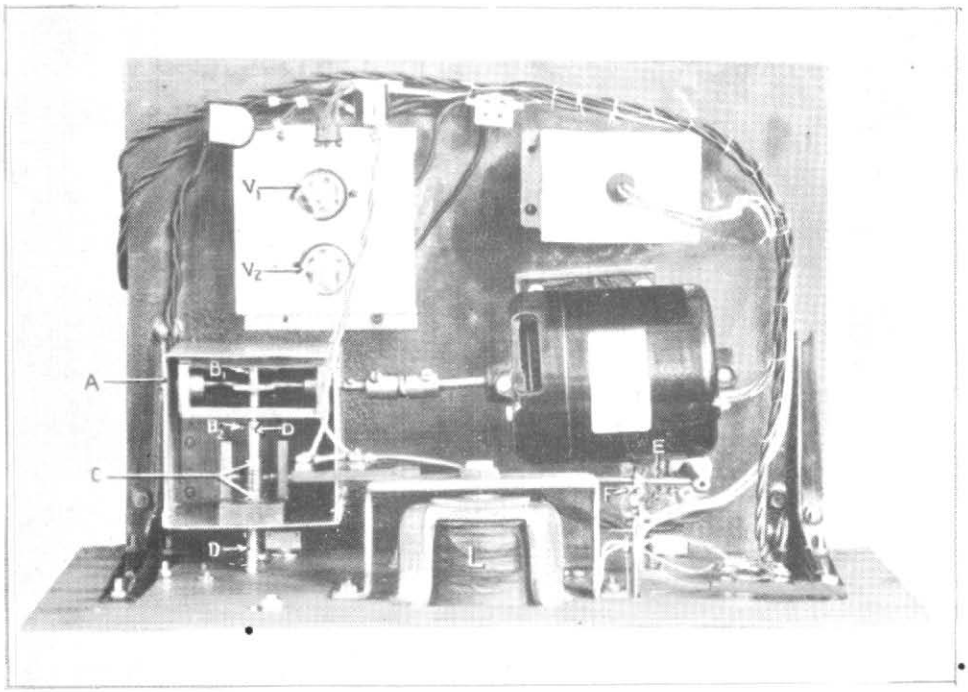
V1
V2
A
B1
B2
D
C
D
E
L

Fig. 4

but occur in succession, to evaluate the data at a particular instant the elements are plotted against a common time axis and their values at any particular instant picked up from these curves for computation.

The signal recording mechanism can be seen from Figs. 1 and 4. In the centre of the recorder panel is mounted an electromagnet with the moving coil recording assembly. A spool of paper tape is mounted on the right and the tape pulling rollers on the left. Intermittent direct current from the receiver is fed into the recorder coil which is then attracted. A pen arm is fixed on the tufnol former on which the recorder coil is wound and at the end of this pen is attached a steel capillary tube. Recording ink is fed from a small tank to the capillary tube through a thin plastic tube. The steel capillary tube first rests on the moving paper tape in which it records the signals.

The electromagnetic field in which the recorder coil moves, is obtained from the 220 volts mains with two rectifier valves 117Z6 connected in the usual conventional way. After rectification the current passes through a filter unit consisting of two 8 microfarads (450 volts) bypass electrolytic condensers and a 2500 ohms wire-wound resistor. After smoothing the D.C. voltage by the filter unit, it is fed into the electromagnetic coil. This coil consists of approximately 10,000 turns of 38 S.W.G. enamelled copper wire with a resistance of 2000 ohms over a soft iron core producing a strong magnetic field in the small annular space between the soft iron core and the electromagnetic coil.

The recorder coil is wound on a tufnol former and moves freely in the annular space of the electromagnet. The moving coil is fixed on an arm, one end of which is pivoted and the other end carries a capillary tube for writing on the paper tape. The capillary tube can be made to touch and record on the paper tape by raising the platform over which the paper moves by means of a screw at the bottom.

There is another pivoted arm for the time marker pen and this also has a capillary tube fixed at one end. The other end of this arm is linked to a lever. The vertical pivoting arm of the time marker rests on a small spring under its lower end, and by means of a thumb screw this pivot can be raised or lowered until the recording end of the capillary tube rests on the moving paper tape with the necessary pressure. The time marking mechanism consists of a worm and gear assembly coupled to the tape pulling shaft of the motor. The shaft in the gear train makes one revolution in about one minute and carries a wheel with four teeth, one of which is double pronged; on this wheel rests one end of an arm coupled to the lever operating the time marking pen. Each tooth on the wheel will actuate the arm resting on it which in turn will actuate the lever arm, and therefore the time marking pen will move every 15 seconds; but one out of every four will be double, to count the full minutes conveniently.

A small cylindrical tank contains the recording ink and is fitted at one corner of the panel. The tank is kept at a higher level than the recorder pens so that automatic flow of ink by gravitation can be maintained. The ink is fed to the two capillary pens by means of plastic tubings. The openings in the base of the tank can be controlled by two screws, so that the amount of ink flowing through the tubes can be adjusted. This will ensure the proper feed of the ink to the pen without smudging the paper tape.

The tape pulling arrangement consists of a shaft from a gear train operated by a motor. A knurled roller is kept pressed on this shaft by a spring. These two rollers move the paper tape between them with a speed of about four feet per minute. There are two other frictionless rollers which act as guides to the paper tape. The paper tape from its spool passes over a platform under the capillary recording pens. The platform has a screw for moving it up or down to adjust the pressure of the pen recording the signals from the receiver. It also contains another screw for moving the tape towards

or away from the panel so that records from two different radiosonde flights can be made on the same side of the paper tape. The paper tape wound on a brass spool can be easily fitted on a shaft on the panel. There are two steel balls resting on springs on the shaft. The paper spool can be slid on the shaft to the required position to obtain two records on the same side. The tape guide rollers can also be screwed towards or away from the panel by means of the knurled head.

5. Conclusion

The whole equipment can be easily dismantled, transported and assembled anywhere. It can also be conveniently used on a ship or installed in a truck. The total power consumed is of the order of about 3 amperes on 230 volts, A.C., 50 cycles. At any place where electric supply is not available it can be run on a portable generator. The aerial is also portable and can be erected on a tripod stand similar to that used with a theodolite.

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