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A mean windspeed indicator

J. C. BHATTACHARYYA and SURYA PRAKASH

Meteorological Office, Poona

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ABSTRACT. A simple instrument which would indicate directly at a distance the mean windspeed over any desired interval of time, is described in this note.

1. Introduction

The paper discusses a simple instrument which would indicate directly at a distance the mean windspeed over any desired interval of time. Such an instrument designed and constructed at the Instruments Division of the Meteorological Office, Poona is described in the present paper.

2. Description

2.1. The instrument consists of four main units—

(*i*) A cup contact anemometer, which gives an electrical impulse for a definite run of wind and transmits the information in the form of electrical impulses,

(*ii*) A counter which adds up the impulses and retains the total over any pre-determined period,

(*iii*) An electro-mechanical device which transfers the stored information in the counter to the indicator, and

(*iv*) A programme unit, which transfers the information from the counter to the indicator and resets the counter for the next operation at regular intervals.

The last three units are housed in a small cabinet, connected to the anemometer by a length of cable (Fig. 1).

The equipment is designed for operation with 230 V, 50 cps A.C. power supply, the total consumption being less than 30 watts. The transmitter and indicator units are connected by a two conductor cable, there being practically no limit to the length of the cable which can be used. The panel has an on-off switch, which is virtually the only control for the equipment. For checking the zero reading occasionally, a manual reset switch is also provided on the panel.

2.2. The cup contact anemometer is a standard unit. The cup frame carries three 5″ conical beaded cups and the spindle runs a reduction worm gear arrangement which momentarily closes a tilting type mercury switch for every 27 revolutions of the cup frame. The closing of the mercury switch energises a relay in the counter unit.

2.3. The counter unit (Fig. 2) consists of a ratchet wheel R of 100 teeth, which is moved by lever L_1 by one tooth, every time the coil M_1 is energised. When coil M_2 is energised, it pulls the lever L_2. This operation releases the ratchet wheel which is brought to its zero position by the weight W falling through gravity.

2.4. The ratchet wheel R is coupled to Muirhead magslip transmitter type E–39–A/1–1½″, so that any angular movement of the ratchet wheel turns the magslip rotor through an equal angle. The repeater of the

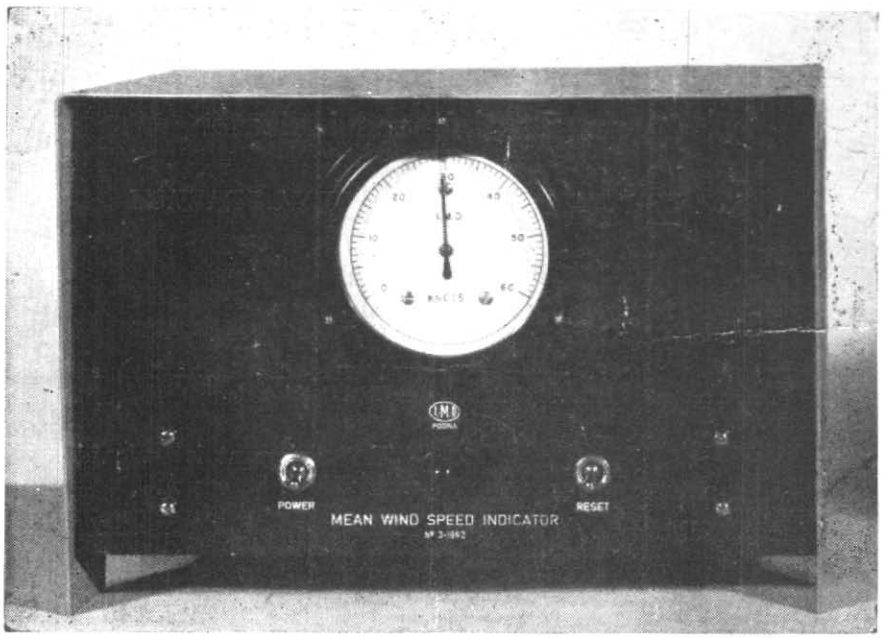

Fig. 1

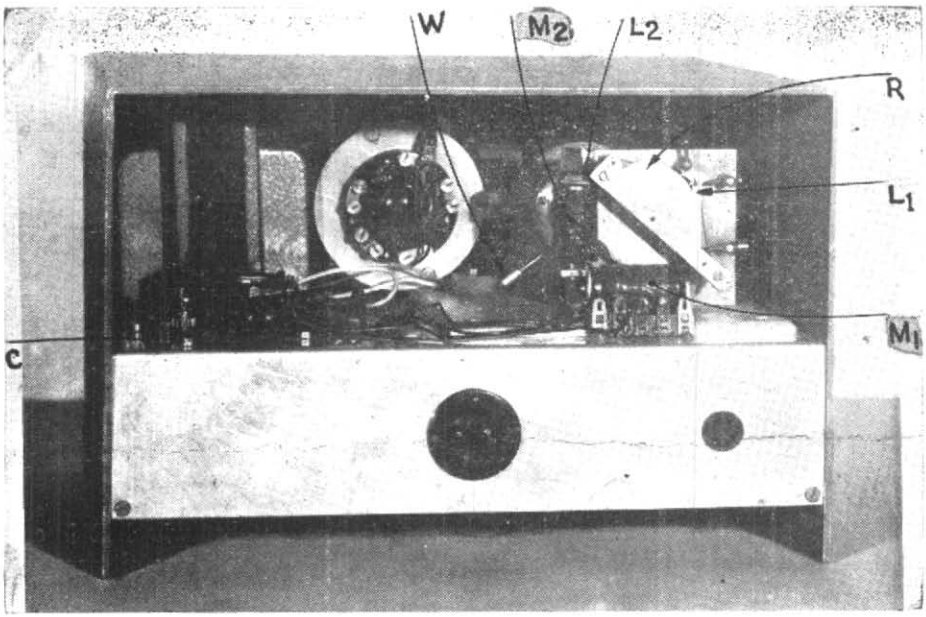

Fig. 2

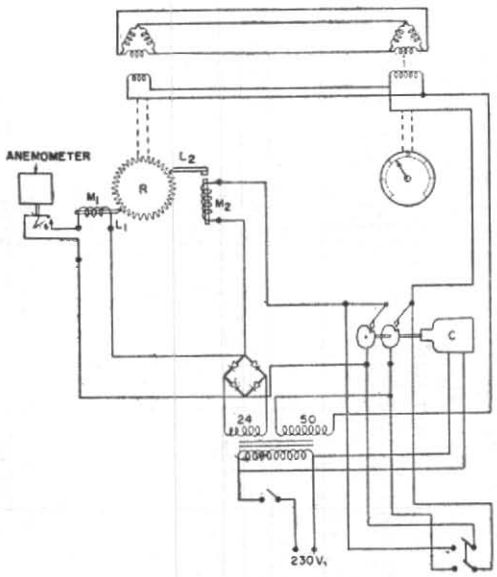

Fig. 3

magslip pair carries a pointer indicating angular position of its rotor. The magslip system is energised through a contact every three minutes, when the pointer rotates to take up the position of the transmitter rotor at that instant.

2.5. The command control consists of a synchronous motor C, internally geared down to a speed of 1 rpm which drives a set of two cams at a constant speed of 1 revolution every three minutes. The two cams are set to operate two one-second contacts with a delay of one second between them. The first of these two contacts energises the magslip pair, enabling repeater rotor to take up the angular position of the transmitter rotor and then immediately disconnect. The second contact energises coil M_2, which sets the ratchet wheel R together with the transmitter rotor to their respective zero positions.

3. Principles of operation

The electrical connections of the instrument are shown in Fig. 3. The operation of this equipment may be described as follows. Let us assume the start of the cycle at a point the second contact has just been closed and released. The ratchet wheel R together with the transmitter rotor are in their zero positions. The pointer on the repeater magslip rotor has been left at a position indicating the position of the transmitter rotor, when the break of the first contact had electrically disconnected the pair. As the anemometer cups are driven by the wind, the mercury switch S makes periodic contacts energising solenoid M_1. This operates the lever L_1, moving the ratchet wheel R, forward by steps. Since there are 100 teeth on the wheel, each impulse moves the wheel by 1/100th of a complete rotation. This continues for three minutes until the cam on the synchronous motor C closes the first contact; thereby energising the magslip pair. Assuming there had been n contacts in the mercury switch, the ratchet wheel has rotated through an angle $\theta=(n/100)\times 360°$ during this period. As soon as the pair is energised the repeater rotor aligns itself, so as to take the position, shifted by an angle θ with respect to zero on the dial, which corresponds to the position of the rotors with the ratchet wheel R in its zero position . The first contact then breaks, de-energising the pair, and then the second contact closes, energising coil M_2. This operation sets the ratchet wheel and transmitter rotor to their zero positions. The repeater rotor, being electrically disconnected from the transmitter, however, continues to be in the same position. Then the second contact breaks, and the cycle starts again. As the counting of impulses goes on during the next cycle, the indicator shows the position attained at the end of the earlier cycle, till it is replaced by fresh information at the end of the cycle. If at any time the power is switched off, the first reading after restoration of power has to be omitted as this may be based on impulses counted over a fraction of a cycle.

4. Range and accuracy

The measuring scale of the equipment may be calculated by considering that each contact in the mercury switch represents a 1/20 mile run of wind past the anemometer. If there are n contacts in a 3-minute period, the total run of wind is $n/20$ miles; so that

the average speed in this interval is $(n/20)\times 20 = n$ miles per hour or $0{\cdot}9\ n$ knots. Since n can have a maximum value of 100 in this instrument, it is possible to measure up to a speed of 90 knots over a three-minute interval. Slight correction is necessary for the fact that there is a blank period of 3 sec in the 180 sec cycle, when transfer of information and resetting are carried out. This is incorporated in the calibration of the indicator dial.

The indicator dial has been calibrated from 0-60 knots covering about two thirds of the available range, in actual comparison with standard airmeters in a wind tunnel.

5. Comparative results

Besides calibration in the wind tunnel against standard airmeters, the equipment was test run in the Weather Central, Poona, with the anemometer installed on the tower of the Meteorological Office. The mean readings were compared with the computed means from the Dines P. T. anemograph records, when remarkable consistency was observed.

6. Acknowledgement

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