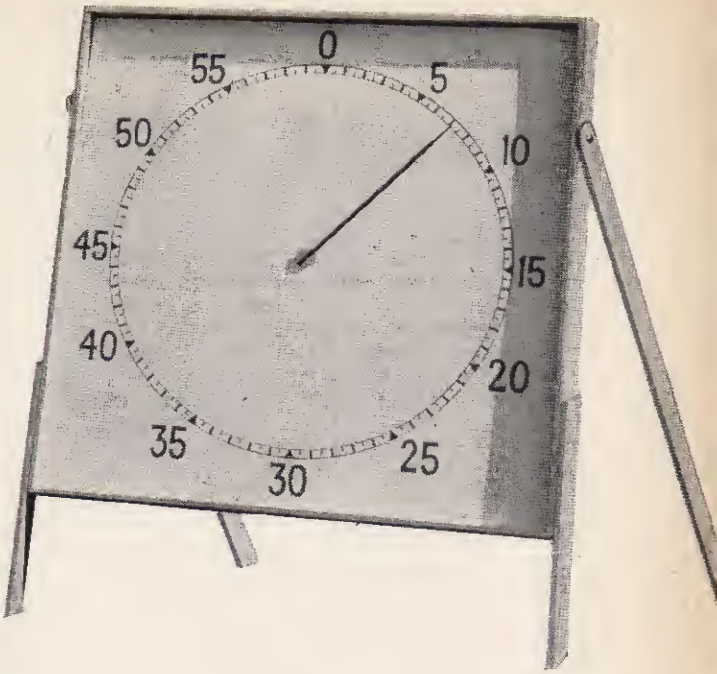
SPORTS EVENTS TIMER

described by J. HILLIER



TIMING competitors to a second, or even part of a second, is necessary in many sporting events including in particular show jumping and car driving tests. The usual method of taking these times consists of manually-operated stop watches. There is much greater interest for the spectators however if a large clock with a sweep second hand can be displayed and started and stopped for each competitor.

This article describes a practical clock consisting of a solenoid-operated escapement controlled by a relay in a simple transistor multivibrator circuit with adjustment for regulating the speed.

WEATHERPROOF UNITS

As space is almost unlimited there is no need to employ miniature components or to pack the parts into the smallest possible space. But as the equipment must be portable and operate out-of-doors in all weather conditions, it should be robust and adequately protected. For these reasons, in the prototype diecast boxes with close fitting lids are used for the two chassis. The larger one houses the electronic timing circuit and the smaller accommodates the escapement mechanism—a ratchet arrangement which moves the sweep hand of the clock.

There are a number of additional refinements which are desirable such as automatic start and stop, quick reset to zero after each competitor, indication of the number of minutes elapsed and such like. It is hoped to deal with some of these circuits in a later article, but it is advisable to get the clock functioning correctly before adding these extra items.

THE ELECTRONIC CIRCUIT

The basic circuit is a simple two transistor multivibrator with the component values chosen so that it operates at about two cycles a second. This gives timing on the sweep hand to half a second. A higher frequency allows even more precise timing to be achieved but it introduces greater problems in connection with the mechanical ratchet arrangement. The principal reason for deciding on half-second timing is because those constructors without the facilities (or the desire) to make the escapement mechanism for the clock can obtain a suitable ex-government component for a few shillings which does the job quite satisfactorily (see components list).

Experiments have shown that the components used in the oscillator circuit are not critical either regarding type or values. However, in view of the importance of the task that the clock has to perform, and bearing in mind the small number of parts involved, it is better to play safe and use only the best.

In the multivibrator circuit the capacitors are paper types and the resistors high stability components rated well above their operating wattage. Transistors are OC72's but any other similar types should be satisfactory.

To provide accurate operation over long periods a separate 9V dry battery (Ever Ready PP9, Vidor VT9 or equivalent) is housed in the box and supplies the power for the multivibrator only. This is better than drawing the supply from the same 12V car battery that is required to actuate the hand mechanism.

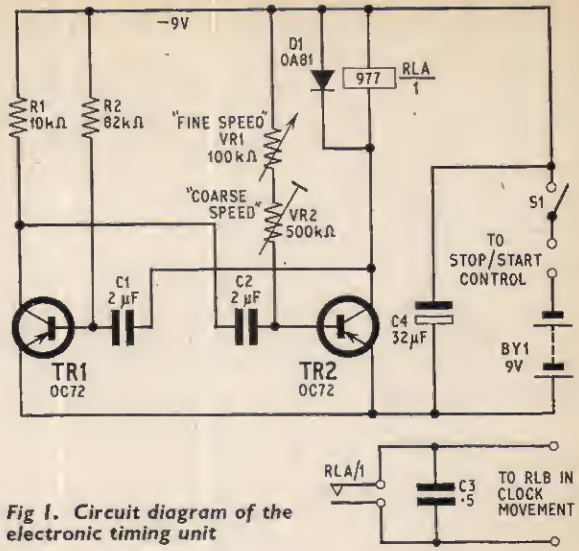


Fig 1. Circuit diagram of the electronic timing unit

COMPONENT LAYOUT

The circuit of the electronic unit is given in Fig. 1 and a suggested component layout in Fig. 2. At the very low frequencies involved layout is not important and constructors can vary this to suit the parts they have in hand.

COMPONENTS . . .

ELECTRONIC UNIT

Resistors
R1 10kΩ R2 82kΩ
5%, ½W, high stability, carbon

Potentiometers
VR1 100kΩ carbon, linear, with switch (S1)
VR2 500kΩ carbon, linear

Capacitors
C1 2μF paper 150V
C2 2μF paper 150V
C3 0·5μF paper 150V
C4 32μF electrolytic 15V

Transistors
TR1 OC72 TR2 OC72

Miscellaneous
BY1 9V battery, PP9 or VT9
D1 OA81 germanium diode
RLA Lightweight relay. 977 ohm coil (B. & R. type B14/12)
S1 Single pole on/off switch—see VR1
Eddystone 845 die-cast box. Five insulated terminals. Snap fasteners for battery. Piece of perforated plastics sheet. Eddystone dial, 1½in dia., with 0-10 graduated scale. Nuts, bolts, wire and sleeving, etc.

CLOCK MOVEMENT

One ex-government G45 film footage counter (sold by various retailers as lap markers for Scalex cars).

One Eddystone 650 die-cast box

CONTROL UNIT

One push-on, push-off switch

One Eddystone 896 die-cast box

CLOCK

One hardboard sheet 4ft × 4ft
Softwood as follows:
20ft of 6in × ½in
4ft of 3in × ¾in
16ft of 1in × 1in
8ft of 2in × 1in

Adhesive figures

2ft of ⅜in × ⅛in balsa wood for hand

White paint. Nails, screws, nuts and bolts, etc.

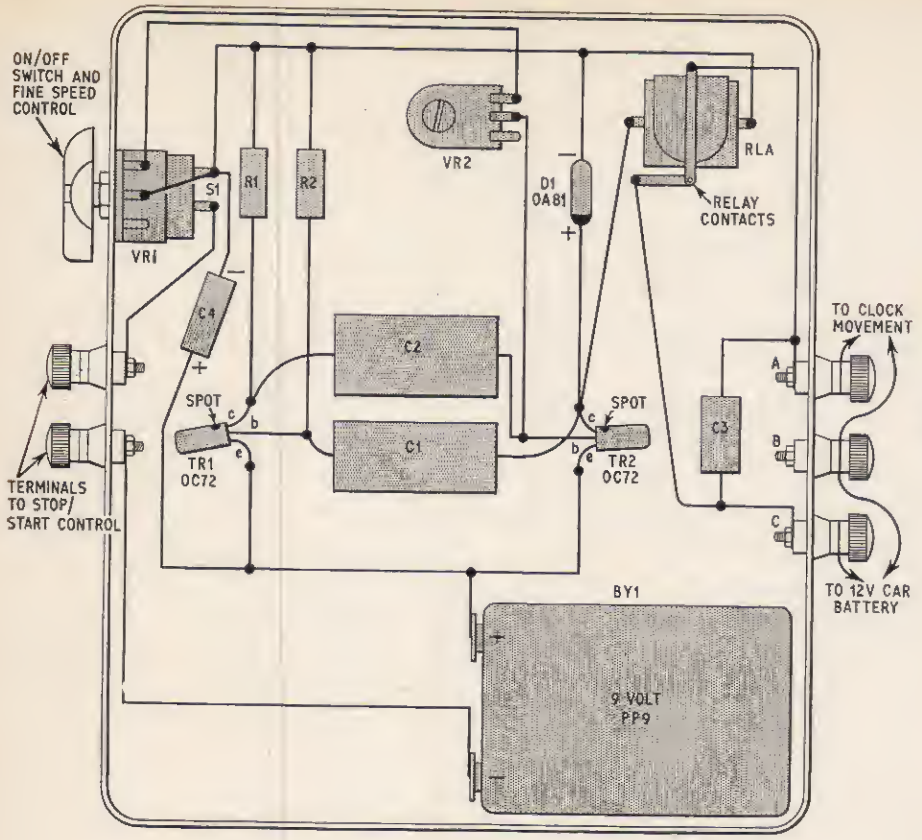
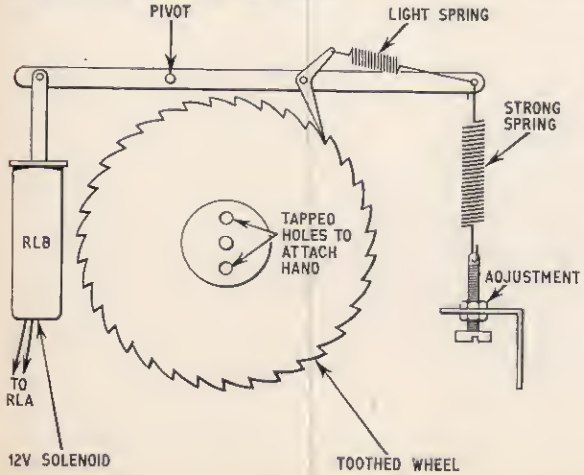
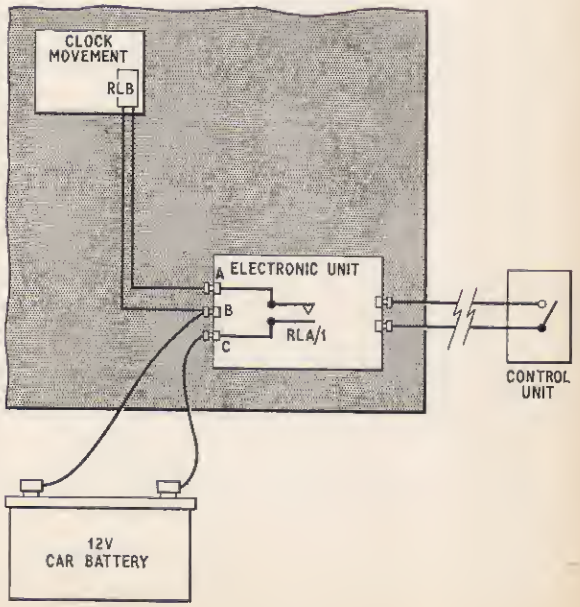


Fig. 2. Details of the component wiring showing positioning of the battery, transistors, relay and preset control VR2. Note that VR1 is ganged to the on/off switch

Fig. 4 (right). This diagram shows the interconnections between the various units

Fig. 3 (below). The escapement mechanism which drives the sweep hand of the clock. Note that the toothed wheel must have either 60 or 120 teeth





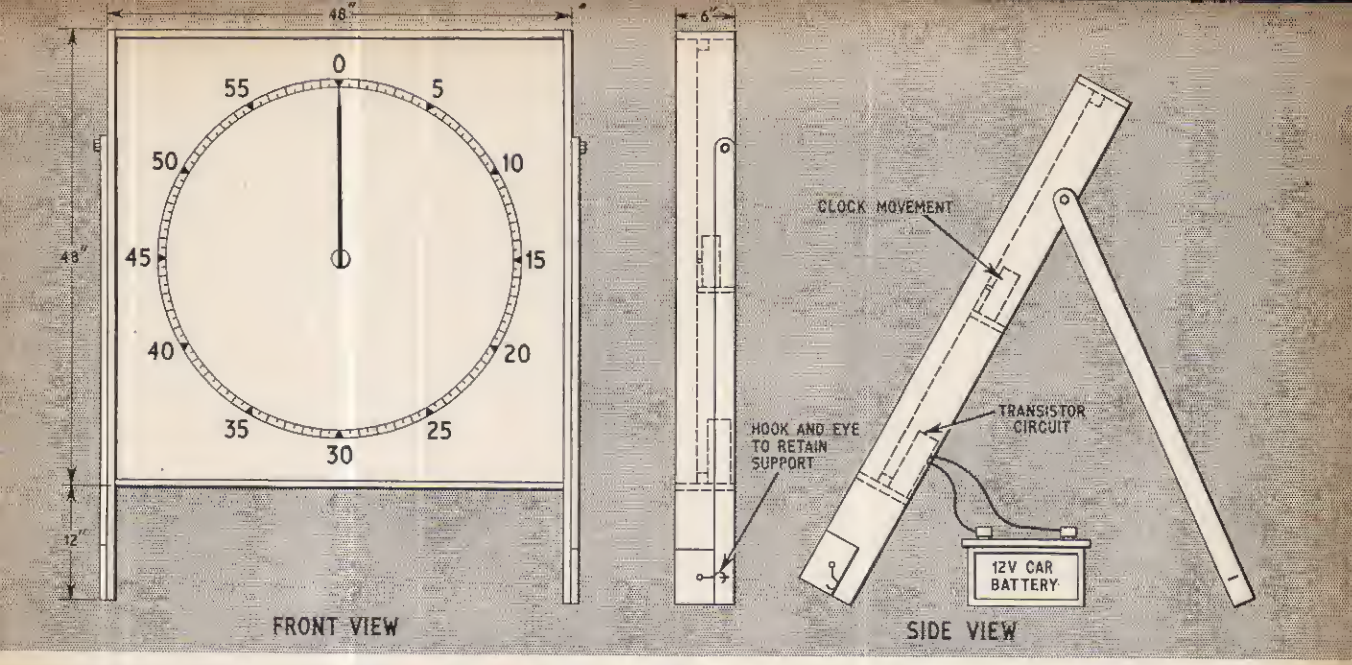
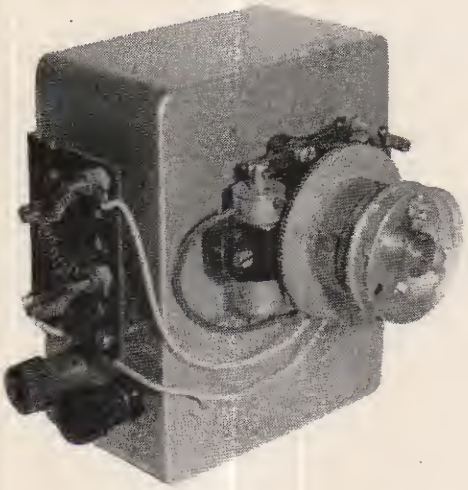


Fig. 5. Front and side view of the complete clock showing the overall dimensions

It will be seen that two variable controls are included. VR1 is ganged to the on/off switch S1 and acts as a fine speed regulator. It is provided with a 0–10 graduated scale so that the correct position to give an exact 60 second sweep can be noted and reset instantly when required. The other control VR2 has a wider range and is preset so that the speed is approximately correct with the fine control set against 5 on the scale. This allows slight adjustment either way to compensate temperature changes, battery voltage variations and other conditions.

The mode of operation is quite simple. As soon as power is applied to the multivibrator it starts oscillating and the relay RLA in the collector circuit of the second transistor opens and closes in time with the oscillations.



Close-up of the ratchet arrangement based on the mechanism used in G45 film footage indicators (the wire wound resistors mounted on the side panel are experimental components only and not normally required)

Each time the relay RLA contacts close the main solenoid RLB actuating the hand movement is energised pulling down the operating lever against the spring pressure—see Fig. 3. As soon as the contacts open the lever is released and as the spring pulls it back to its normal position it moves the hand one division.

When making the escapement it is necessary to include "stops", preferably adjustable, to limit the movement of the operating arm so that the hand is moved only to the extent of one tooth.

As already mentioned, an ex-government piece of equipment can be employed very satisfactorily for this purpose. This is the G45 film footage counter, available from a number of retailers.

DETAILS OF THE CLOCK

The clock itself is made of wood and hardboard, the prototype being four feet square. Originally it was found that when standing in grass the lower figures were obscured so additional side pieces have been added to raise the clock 12 inches from the ground. This can be allowed for when constructing.

The main framework is constructed of 6in × ½in boards cut to length and nailed together. Battens of 1in × 1in are fitted round the inside so as to support the hardboard clockface. The face is given an undercoat and a finishing coat of white paint and then marked out as a clockface numbered 0 to 60. If a large enough compass is not available a piece of string tied to a nail at the centre does the job admirably. An easy method of marking the circles instead of painting is to use waterproof spirit ink. This is available from stationers, in all colours, in small bottles with a felt nib.

Figures may be painted on or, as in the prototype, cut out of self-adhesive "Fablon" or "Contact" and stuck in position. Ready-made self-adhesive figures are also available. To be clearly visible at a reasonable distance the figures should be at least four inches high.

continued on page 488

SPORTS EVENTS TIMER

continued from page 483

ESCAPEMENT MECHANISM

A shelf mounted on fixing blocks must be provided at the back of the face to mount the escapement mechanism (or clock movement) for the sweep hand. It is advisable to keep the weight of the moving parts to a minimum and for this reason the hand is made of balsa wood using a strip $\frac{3}{8}$in wide tapered to a point and painted black. This has proved to be better than the original hand which was of 18 s.w.g. aluminium and counter-balanced.

Another point learnt from experience is the desirability of keeping the operating solenoid away from the multivibrator relay. For convenience these were originally together on the same box but it was found that the heavy field produced by the solenoid RLB acted on the relay coil and caused a "chattering" effect.

Rear view of the clock showing the units in position and the leads to the 12V car battery which is required to energise the actuating mechanism. The small box houses a press-button switch for remote start and stop

OPERATING THE TIMER

On/off switching can be performed from distances up to 100 yards from the clock, using ordinary twin flex. A push-on/push-off single-pole switch fixed either to a small board or in a small box is the most convenient control to operate and is almost foolproof.

When setting up at the start of a function it is advisable to switch the oscillator on and allow it to run for about 10 minutes. Then check the speed with a stop watch and adjust the fine speed control VR1 so that the hand just completes a circuit in 60 seconds. Note the reading on the fine speed control scale for future reference.

An occasional check with the *same* stop watch during the period of the event is a worthwhile precaution, although in practice this device has been found to maintain extremely accurate time. ★