REACTALYSER

By B.H. BAILY

THERE are several ways of putting human reaction to the test, whether it be of a light-hearted nature or of more serious intent. Some reactions are very quick, such as the kick of a leg after a gentle tap at the knee.

Probably one of the most useful forms is in the time it takes for the hands to react from an impulse stimulated by a visual movement. If a dog was to dart in front of your car while driving, how quickly can you take evasive action? Readers no doubt will find several examples which require alertness of mind coupled with well controlled reaction of the body.

How can we put reaction to the test without actually setting a scene that might be difficult or even impracticable?

The "Reactalyser" described in this article will fit the bill and will be found to be simple to build and operate. If required it can form the basis of an amusing game of skill at a party (particularly after a round of drinks).

The instrument uses a simple panel mounting moving coil meter, mounted in a plastics box with two push-button controls.

To operate it, the subject is required to press both buttons together, release one, then wait till this button pops up after a random time of a few seconds, before releasing the second. The time elapsing between the pop-up of the first button and the operator's release of the second is then shown by the meter pointer.

LOADED EMITTER FOLLOWER

The circuit is a single emitter follower stage in which the emitter load is a 0–5mA meter in series with a preset variable resistance VR1 (see Fig. 1).

In the non-operating condition S1 is held against its upper contact A by the spring fitted to the push-button rod. Switch S2 is a conventional push-button switch normally open circuit. When the subject operates the device, he holds down S1 and S2. TR1 base is now grounded via R1.

Pressure is now released from the rod attached to S1 but S2 is held depressed until the gradual air leak releases the suction pad. The rod kicks up and changes the state of S1 so that TR1 is now connected to the battery positive line via R1 and S2.

Immediately this happens, C1 begins to charge at the time constant determined by the values of C1 and R1. As C1 charges exponentially, the base voltage also rises exponentially and the emitter follows it faithfully. The meter indicates the climbing potential as TR1 is now conducting. The emitter voltage continues to rise until the subject removes his finger from S2. Once he does this, the charging path to C1 is broken, and the final charge attained on C1 is represented by the indication on the meter scale.

The capacitor will tend to discharge through TR1 base-emitter circuit, since S1 has, by this time, reverted to position A. Since this discharge path is of relatively

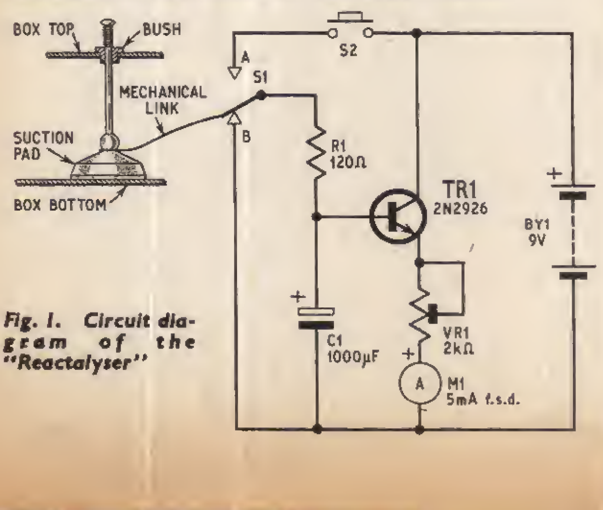

Fig. 1. Circuit diagram of the "Reactalyser"

high resistance, and the value of C1 is high, there is sufficient time to read the meter before any significant drop in current is indicated.

The meter scale can be calibrated in time and VR1 is set to facilitate this (see notes on calibration).

COMPONENT VALUES

The values shown for components are critical, and have been chosen as a result of experiments. All are based on the use of a 0–5mA meter movement. If a 0–1mA meter were used, VR1 would have to be about 10 kilohms maximum, again using the same supply of 9 volts.

The choice of the 2N2926 for TR1 was chiefly one of convenience, but most silicon types (*npn*) would suit this circuit.

The omission of an on/off switch may justifiably be questioned, but in fact the design of the circuit makes this component unnecessary since the current drain through TR1 is almost zero when C1 is discharged, provided S1 is momentarily depressed and no further charge can build up until the next time S2 is operated. Therefore, the instrument should be left in this condition after use. Alternatively, the battery can be removed if the period of non-use is likely to be long.

Capacitor C1 can be 1,000μF or (as in prototype) four capacitors 250μF each connected in parallel. The knitting needle was a handy means of making a plunger for S1. Readers could make their own style from $\frac{1}{8}$in steel rod.

CONSTRUCTION

Any convenient box may be used, the principal feature being only that it will house the meter comfortably with a little room to spare for the circuit and battery (see photograph). The circuit was built on a single 5-way tag strip (Fig. 2), this being held in position by a spot of glue.

RANDOM TIMER MECHANISM

The random timer press-button rod is made from a No. 10 knitting needle fitted with a compression spring under its head. In the prototype, the rod passes through a 3·5mm jack socket from which the contacts have been removed, but this could be replaced by a less expensive guide brush through which the needle may readily slide up and down.

The bottom end of the needle is fitted into a rubber suction pad to which it is secured by rubber adhesive (Fig. 3). When the needle knob is firmly depressed, the suction pad is forced on to the bottom of the case where it adheres. To prevent permanent adhesion, a little talcum powder is dusted on the suction pad rim, and on the box bottom. This ensures a slow air leak which eventually leads to the suction pad succumbing to the action of the spring.

The time taken for this to happen depends on more than one factor, and may vary from 3 to anything like 12 seconds; this prevents the subject under test anticipating his cue.

A miniature microswitch could be used for S1, provided that it had a single pole changeover contact set. In the prototype a switch was constructed by soldering a short length of close-wound light tension spring to the end tag of a short tag strip. The other end tag is bent up to contact the spring when the latter lies along the strip.

The spring formed the moving arm and the second changeover contact was fashioned by bending a short

COMPONENTS . . .

Resistor
R1 120Ω 10% $\frac{1}{4}$W

Potentiometer
VR1 2kΩ linear preset skeleton

Capacitor
C1 1,000μF 12V

Transistor
TR1 2N2926

Meter
M1 0–5mA f.s.d. moving coil

Battery
BY1 9V type PP3

Switches
S1 Single pole changeover (see text)
S2 Single pole push on, release off, push button

Miscellaneous
6-way tag strips (2 off)
Spring for S1 (see Fig. 3)
Knitting needle No. 10 with head
Rubber suction pad
Plastics box $2\frac{3}{8}$in × $2\frac{1}{8}$in × 4in long with end caps (D.E.W. Ltd., 254 Ringwood Road, Ferndown, Dorset)

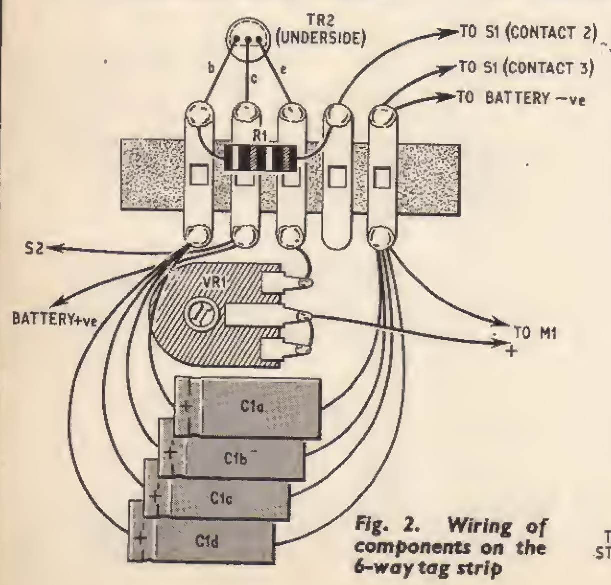

Fig. 2. Wiring of components on the 6-way tag strip

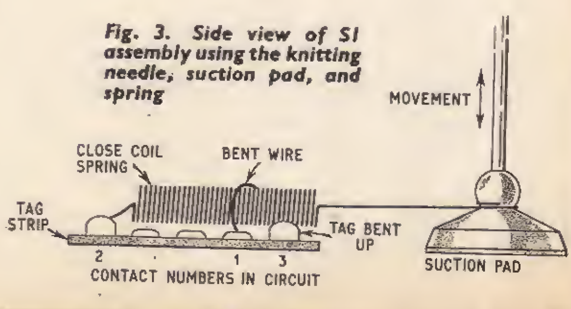

Fig. 3. Side view of S1 assembly using the knitting needle, suction pad, and spring

piece of stout wire to form an inverted "L" over the spring, which makes contact when it is raised off the lower tag. The wire contact was anchored by soldering it to an intermediate tag. The last 1½ turns of the spring are bent out from the coil and looped around the waist of the suction pad.

CALIBRATION

Calibration is simple. Start with VR1 set for maximum resistance in circuit and the random time rod S1 in the "up" position. Hold S2 depressed and watch the meter read part-scale deflection: it will settle very quickly.

Keep S2 pressed and turn VR1 very slowly until M1 just reads full scale. Do not exceed this position or the meter may be damaged. The instrument is then ready for use.

The meter scale could easily be re-calibrated if desired, to suit the constructor's taste. The author coloured the higher end of the meter scale in red (having once found he could always score better than half-scale, of course).

OPERATION

To test your own reaction, simply press S1 and S2 firmly down, release S1 and, while still holding S2 down, wait for S1 to pop up. Remember that every millisecond that elapses after this will count against the competitor, and that the reaction time of the circuit is quicker than his.

Quick release of S2 when S1 pops up is important to achieving a competitive reading on the meter. Your "score" is shown inversely on the meter scale; i.e. "low" is good, "high" is bad. ★