SCOTTISH SCHOOLS SCIENCE EQUIPMENT RESEARCH CENTRE

Bulletin No. 41. September, 1970.

Contents

Introduction

The only firm date we have for future exhibitions is the 15th October, in the Miller Street Centre, Clydebank from 6 - 10 p.m. This will be a general exhibition, consisting largely of items constructed in the Centre, and covering all branches of science. Science Advisers, groups of teachers or Training College staff are asked to write to the Director should they feel that an exhibition on some aspect of science apparatus would help in their area.

Physics Notes

The following items of surplus equipment are still available, and from Item 62 onwards we give details of new lines not previously listed. The number in brackets after each item indicates the Bulletin in which the item was first advertised, and in which a full description will be found.

Item 1 (31) Large Scale Ammeters, 10s.

Item 2 (31) Aneroid Barometers, 10s.

Item 3 (31) Mercury Barometers, £10.

Item 7 (31) Scaler, £1. Also one slightly defective in that the circuit registering digit 4 does not operate, 10s.

Item 15 (31) Relays, 1s.

Item 16 (31) Switches, 6d.

Item 17 (31) Potentiometers, 6d.

Item 18 (31) Block Paper Capacitors, 6d.

Item 22 (32) Wire-Wound Resistors, 5s.

Item 23 (32) Fahrenheit Thermometers (both types) 5s.

Item 24 (32) Transformers and chokes, 2s.

Item 25 (32) Electronic Valves, 6d.

Item 26 (35) Heavy Duty Rectifier, 10s.

Item 48 (36) Sine/Cosine Potentiometer, 10s.

Item 49 (36) D.C. Voltmeter Relay, 5s.

Item 50 (39) Ratemeters, £1.10s.

Item 51 (39) Rotary Transformer, 7s.

Item 52 (39) Rotary Transformer, 5s.

Item 53 (39) Double Reduction Gear Train, 10s.

Item 56 (39) Height Capsule, 2s.

Item/

Item 61 (39) S.B.C. Bulbs, type (b) only, 3d.

Item 62 (39) Silica Gel Desiccant, 6d. per lb.

Item 63. Nickel Cadmium Cells, 3 AH, measuring 25 x 55 x 90mm. Supplied filled and charged, 2s.6d. Note: As these cells are not leak-proof, they cannot be despatched to schools and must be collected. As is the case with all our surplus equipment, we are prepared to keep these in the Centre until collection can be arranged.

Item 64. Valve Voltmeter, type BW211B by Salford Electrical Instruments with input probe. Ranges 1.5, 5, 15, 50 and 150V A.C., 10s.

Item 65. Millivolt/ammeter. 150mm mirror scale, F.S.D. 150mA or 150mV D.C., 10s.

Item 66. Wheatstone Bridge by Gambrell Brothers. Ratio arms 10, 100 and 1000Ω. Variable arm 9,999 x 1Ω. Eight of the shorting keys are missing, 5s.

Item 67. A.C. Dynamometer by Pullin. 170mm mirror scale. Ranges, 25,500mA, 1, 2.5, 5, 25A; 25, 50, 100, 250, 500V. Power ranges are the products of any of the current and voltage ranges except the 25mA range, hence the minimum F.S.D. power measured is 12.5W and the maximum 12.5kW, £5.

Item 68. Pocket Dosimeters. These are far too insensitive for use with school radio-active sources, but by cutting off the electrical section, they can be made into a microscope, magnification approximately 50, 1s.

Item 69. Dosimeter Charging Units. These are intended to charge up the pocket dosimeter described above, and consist of a hand generator, rectifier and capacitor to produce 250 - 300V, 5s.

Item 70. Sound Powered Telephones. Two of these connected together with twin flex will transmit speech over 20m or more, without the aid of batteries, 2s. each.

Item 71. Telephones. This unit contains three of Item 70, two of which are in a conventional handset, and a hand generator. Weight 6.8kgf, 10s.

Item 72. Fractional Horsepower Motor, 110V D.C. input, with reduction gear giving 120 rev/min at 1 lb in torque. The direct drive shaft is also accessible, giving approximately. 4000 rev/min, 10s.

Item 73. Waveform Monitor Type 3794B by E.M.I. This is a calibrated oscilloscope with separate power supply, both mounted on a trolley. Differential amplifier input to Y plates, maximum sensitivity 25 mV cm^{-1}. Time base duration from 50ms to 1.5μs. With circuit diagram, but no instruction book, £2.

Item 74. Oscilloscope Type 723 by Airmec. Frequency range 0 - 5mHz, with provision for single ended, or differential amplifier/

amplifier input. Sensitivity 200 and 30mV cm^{-1}. Time base range from 0.5s to 1μs for 7cm deflection. Final anode voltage can be switched for 1, 2 or 4kV. The instrument has been designed for photographic recording, using the camera below, £5.

Item 75. Oscilloscope Camera Type 758 by Airmec. This can be used on single exposure or for continuous recording in conjunction with a built-in motor giving film speeds of 0.5, 1.5 and 4.5 ft s^{-1}. Price £2.

Note: We have two of Item 74, but only one camera, and one copy of the operating instructions for camera and oscilloscope.

Item 76. Stabilised Voltage Regulator by J. Langham Thomson. A.C. input 190 - 260V, this will deliver any preset voltage between 220 and 240V at up to 3kVA. Output voltage varies by 1½V between zero and full load. Weight 85kgf. Price £3.

Item 77. Ribbon Atwood Machine, by Cussons, £1.

Item 78. Spherical Mirrors, 50mm dia. Concave and convex types, usually f = 20cm, 6d.

Item 79. Camera Lenses, one Dallmeyer wide angle F/6.5, f = 5.5in, 5s; one Dallmeyer F/4.5, f = 8.5in, 10s.

Chemistry Notes

In the memorandum for the guidance of teachers on the Certificate of Sixth Year Studies, issued by the Scottish Education Department, Experiment 18 (p.8) gives details of the reaction between chlorine and methane initiated by ultra-violet light. We repeated the experiment, following the detail given in the memorandum (except for using a 125 x 16mm test-tube; 2 x 14mm seemed a bit small), in order to determine which type of ultra-violet lamp was most suitable. Chlorine was first collected over water to half fill the test-tube, then methane was added, also over water. The U-V lamps used were a 12V, 60W Mazda bulb, obtained from Service Trading Co., one from Unilab, and a Griffin and George mercury vapour lamp. The distance between test-tube and lamp was 5cm. Out of 35 tests, only one mixture exploded sufficiently to raise the stopper a few inches; all others gave no effect.

We next tried a mixture in which the gases had been collected by displacement of air. Two test-tubes were filled, one of chlorine and one of methane, the tubes put mouth to mouth and continually inverted for not less than a minute. Four tests were carried out; all were negative. A further ten tests, in which the chlorine was dried out with sulphuric acid, and the methane with silica gel, also gave negative results.

Because photographic flash bulbs can be used with the similar reaction between hydrogen and chlorine, we tried these, using/

using Mazda flash type AG1B blue, obtainable from photographic dealers. We reverted to collection over water as described earlier. Ten test-tubes were filled with the mixture and tested. The first two tests were positive, giving an explosion, with the third the stopper was pushed out, and the remainder were negative. The results suggested that the test should be carried out as soon as possible after the gases have been mixed. By doing this, and by placing the flash bulb as close as possible to the test-tube, we obtained 9 out of 10 successful explosions, the stopper rising to a height of between 1 and 2m.

Four similar tests were then done on a mixture of the dry gases. Only one exploded, and this quite violently, even although the stopper had been inserted as lightly as possible, and only sufficiently to give a seal by spreading the vaseline. Because of the violence of the explosion we would recommend that teachers should not try this experiment using a mixture of the dried gases. In the Workshop section of this bulletin we give the practical details of how the experiment is assembled.

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Filling a test-tube with a gas sample for test purposes sometimes presents difficulty when the gas is collected over water. The test-tube is filled from the water tap and the difficulty arises when it has to be inverted into a beaker or electrolysis cell without spilling water and admitting air. A square of paper slipped over the end of the full test-tube (the inverted tumbler trick) allows this to be done easily, and the paper falls off as soon as the mouth of the test-tube is under water.

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Perhaps the most commonly used solvent for expanded polystyrene is benzene which is toxic, and we suggest that toluol be used instead. Fragments of polystyrene are added to toluol until a syrupy solution is obtained. This can then be used for cementing polystyrene balls to assemble atomic models.

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Following the distribution to schools of our Basic Equipment List, we received a note from a teacher stating that the wire type test-tube holder which we included in the list, Item 48, was dangerous in use. If accidentally heated, as children are likely to do sooner or later, the wire 'jaws' contort themselves, become untwisted, and in one case separated so that the test-tube was flung across the room. We repeated the test, deliberately heating the jaws which were holding an empty test-tube, and were surprised to find that parts of the jaws could be raised to dull red temperature before much warning was conveyed by conduction along the wires to the fingers. Under these conditions the jaws did untwist, and would after a few doses of such treatment be made useless. Holders from Christison and Griffin and George behaved similarly, possibly because they have a common origin, and certainly they could not be distinguished physically. Griffin and George subsequently sent us a modified holder using a ring to keep the two/

halves of the holder together. This did not prevent the jaws distorting, although it stopped them flying apart and hurling the test-tube around the room, but heating made the ring less easy to slide on the wires so that the holder jammed. As other types of holder have their own disadvantages when it comes to heating them (wooden handles etc.) perhaps the only moral that can be drawn from this is "Don't."

Trade News

Morris Laboratory Instruments have again been obliged to raise the prices of most items in their catalogue. A copy of their price lists can be had on application to the firm. As an example of how prices have moved, their Vuespec now costs £95; absorptiometer £55; linear air track, £18.

The latest catalogue from Radiospares lists several items which will be of interest to schools. Most important perhaps is a range from 1 to 10μF of 63V polyester capacitors. These are the values which we consider most suitable for demonstrating the dependence of reactance on frequency, and for which we have listed block paper capacitors, Item 170, in our Physics List. Besides being cheaper, the new range has the advantage of smaller physical size, so that any value can be mounted on the circuit boxes recommended in Bulletin 27 for smaller components.

With the take over of W.B. Nicolson by Baird and Tatlock, the former's factory and premises in Glasgow are being closed down leaving only a sales office. Deliveries will be made from London, using an outside firm of freight carriers.

A small and very compact chart recorder, the Rustrak model 288, can be obtained from West Instruments, who are the Scottish agents for Rustrak, for £64.10s. The recorder has 1mA F.S.D. sensitivity, and input impedance of 100Ω. It is normally supplied for single chart speed operation, but possible speeds vary from 1/8in per hour to 1in per min. Adaptors, which are essentially a gear box to give a different chart speed, cost £3.10s. The chart paper is 60mm wide and is pressure sensitive, so that the recording system is dry, and there is no messing with ink. The paper is supplied in 63ft rolls at 16s. per roll.

Omal have introduced a new overhead projector, the Omal Mk II which, complete with acetate roll and attachment, costs £49.

Moving coil meters of Japanese origin which we have recommended in our equipment lists as being supplied by G.W. Smith are now to be obtained from another firm, Barnet Factors. Orders addressed to G.W. Smith are passed to the latter firm for them to handle. The prices of these meters have also risen lately; the MR38P which is the smallest size now costs £1.7s.6d. and the black bakelite type MR65, £1.15s.

An/

An Edinburgh firm, Electro-vision, have servicing facilities for the repair of all types of electronic equipment such as signal generators, oscilloscopes, scalers and pH meters. They will not, however, undertake the repair of multi-range meters. Estimates are given before the work is commenced.

Following on a merger between the three main glassware manufacturers, viz. Jobling (makers of Pyrex), E-Mil and Quickfit and Quartz, their products may now be bought only through agents and not directly from the firms concerned. Scottish agents are Glass Appliances, Griffin and George, Macfarlane Robson and Townson and Mercer.

Walden Precision Apparatus have produced an adaptor type KN90A for use with their Edspot galvanometer. The adaptor converts the galvanometer into a demonstration meter with sensitivities of 1mm per μA, 1mm per 10μA and 1mm per 100μA. This corresponds to F.S.D. of 180μA, 1.8mA and 18mA. The cost of the adaptor is £1.15s.

Interlocking storage boxes for small components are obtainable from Maryland Plastics. The smallest size, type 1D has inside drawer dimensions 2" x 2" x 4½", and costs £4 per carton of 48 boxes. The next larger 2D has twice the drawer width, and costs £3.12s. per carton of 24. Because of the interlock facility they can be assembled to form a compact drawer unit.

Vickers Instruments have introduced a new microscope to replace the Biolux model. The M10A has provision for incident and transmitted illumination. Basic cost with three objectives, giving up to x400 magnification of the mirror model is £28.9s; ditto with built-in illumination, £32.13s; with phase contrast, but omitting the x3 objective and phase telescope. £41.9s.

Integrated Science

Our request a few months ago for information on how science departments were containing the worksheets used in the course brought a variety of replies. It is interesting to note for instance that provided one collects it from the factory one can get scrap Melanex film from I.C.I., Dumfries, for practically nothing. Two sheets of this with some form of binding is probably the cheapest solution to the problem, but it is not one which is nationally applicable.

Most of our informants have separated the problem into two parts: firstly how to provide a container for a relatively small number of sheets (say one or two sections) actually in use at the time, and secondly, how to construct a file which will hold at least a year's supply of sheets and which in most cases will be kept in the pupil's home. There is a temporary complication in that/

that the sheets are A4 size whereas most folders, files etc. which one sees in shops are still either quarto or foolscap, the first of which is too small, and the second too large for the A4 size sheet.

The second part of the problem can be solved by supplying ring binders at costs which vary between 5s and 10s depending on the quality and number ordered. Reinforcing discs to prevent tearing at the punched holes are also necessary. The binders are returned at the end of the course and because of the infrequency of use should last many years, probably (tongue in cheek) outlasting the course itself. For daily carriage of a section of worksheets something cheaper and probably expendable, is required. Cheapest is the ubiquitous polythene bag which when bought by the thousand costs between 1½ and 2d. We have these on trial at the moment in a school, heavy weight grade, which means about 500 gauge, size 9" x 12". They can be bought from Peter Plastics or slightly cheaper from Transatlantic Plastics.

Next on the cost scale comes the plastic wallet in 'frosted' P.V.C. These are available from Goudie's of Bothwell at a cost of 1/2d each when bought by the thousand. Finally, there is the slide binder which is a hollow triangular section in plastic with an opening at one apex so that the material is slid into the join and the natural resilience of the plastic secures it in place. The slide binding can be bought cut to A4 size or in yard lengths. Manilla or P.V.C. folders can be bought as a cover material. The cost varies between 1/9d and 2/3d. Since slide binders can be obtained which will take up to 100 sheets, this method may be used both for daily carriage and home storage of worksheets, and may eventually prove to be the most economical overall solution, although the life span of the covers is still uncertain. Slide binders and covers are obtainable from Spicer Cowan and Elk and Co.

Our thanks are due to all those who contributed information on the above.

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The second cycle of the integrated science, variously and vicariously called "mini" syllabuses or Brunton projects, is composed of a number of science topics for which we are currently preparing equipment lists which will be issued in due course. One of these topics which we thought might be deservedly popular, is photography. Photography requires cameras in the ratio of one per pupil, and despite the fact that most pupils of this age will have their own camera, we felt that a teacher might still wish to have a standard model on which to give instruction. The pilot course in photography had been carried out with a plastic camera made in Hong Kong and bought over the counter at Woolworths. We made enquiries, and found that although no longer available, Woolworth would import a similar camera in bulk for sale to a retailer, but did not intend to put the camera on general retail sales.

None/

None of the normal school suppliers whom we approached was prepared to risk a few pounds on this venture, so we reluctantly placed an order ourselves with Woolworth for an initial consignment, which then fell a victim of the dock strike. Although at the time of writing it has not yet reached us, we believe the cameras are in the U.K. and should be available by the time this Bulletin is in print. The camera will take a 16 exposure 120 film. In its own language, the camera has "three apertures for various weather, three distance ranges for different spaces, and two shutter settings for snap and bulb." They cost 6s.6d. each, plus packing and postage.

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We are currently testing stereo-microscopes, and require information on the eye separation distance to be found in pupils who will use these microscopes. We suspect that a stereo-microscope is designed for adult use, and it may be the case that some younger or smaller pupils cannot use them because their eyes are not far enough apart. We therefore ask your co-operation to determine the norm, and the statistical variation in this measurement for first year pupils only.

To ensure standard conditions, we suggest the following technique. The subject, using spectacles if these are normally worn, should look at an object sited 30cm from the bridge of the nose, on a level with the eyes. By holding a ruler on the subject's brow, the observer should attempt to estimate the position against a mm scale of the centre of the pupil for each eye. Then calculate the distance between the pupils. This information should then be sent to us, grouped into 2mm bands, i.e. the number of pupils with eye separation between 44 and 45.9, 46 and 47.9mm etc. If we get a sample large enough to draw a normal distribution curve, we shall then be able to say for any stereo-microscope what percentage of first year pupils will be unable to use it.

In The Workshop

Below we give details of the apparatus used for the reaction between methane and chlorine, discussed on p.3 of this Bulletin. The only originality that can be claimed for it is the idea of enclosing both test-tube and light source within the safety screen. This brings the two into close proximity, and eliminates absorption of ultra-violet light by the screen.

The safety screen is a 3ft length of extruded acrylic (Perspex) tube, 4in diameter and 1/8in wall thickness. While we could translate these dimensions into equivalent metric sizes, they would not be understood by the supplier, and when a non-standard length carries a surcharge of 20% as it does in this case/

case, it is sound economics to bend one's principles. The tube is obtainable from Peter Plastics at 12s.6d. per foot, and there is a 12½% surcharge for orders under £5.

A square block of hardwood, 65 x 65 x 25mm, is used for a base to support all components, and is cut and drilled as shown in Fig. 1. The slot at one side is cut to accommodate the lid of an Andrews Liver Salt tin, 8oz size, the underside of which makes a convenient concave reflector. To secure the flash bulb, Mazdaflash type AG1B, and also make the electrical connection, a Terry Clip, No. 480-037 (or in the older labelling type 80, size 00) is cut in half. The two halves of the base are soldered to the heads of two No. 6 wood screws, 20mm long, the clip being fitted into the slot in the screw after it has been screwed into the baseboard. At the same time a 1m length of connecting wire is soldered to the same point. As bought, the connection to the flash bulb is by two wire loops, see Fig. 4. The outside leg of each loop must be cut off with wire cutters as close as possible to the glass pillar (points X on diagram) and the wire straightened and bent up around each side of the pillar. When the bulb is pushed into the Terry clip holder, each wire is sandwiched between the clip and the pillar, making the necessary electrical connection.

The trigger circuit for firing the flash bulb is given in Fig. 6 and the layout of the necessary components inside a circuit box, obtainable from Wm. Foster (see Bulletin 27), in Fig. 5. All components are obtainable from Radiospares, except the battery, which is Eveready type B155, 22½V, and can be bought from photographic suppliers. The battery is secured by a suitable Terry clip to the side of the box and leads are soldered to its terminals. The capacitor charges up through the resistor and the flash bulb when the latter is fitted into position on the baseboard, and the bulb is fired by discharging the capacitor through it, triggered by pressing the push-to-make switch. This is done when the test-tube is in position and the perspex tube has been lowered over the apparatus. If necessary, two slots can be filed into the lower edge of the tube to allow the connecting wires to pass out to the control box, although the screen is stable enough without this. In all our tests the rubber stopper, lightly coated with vaseline, was fitted lightly into the test-tube, and only sufficiently to give a seal by spreading the vaseline.

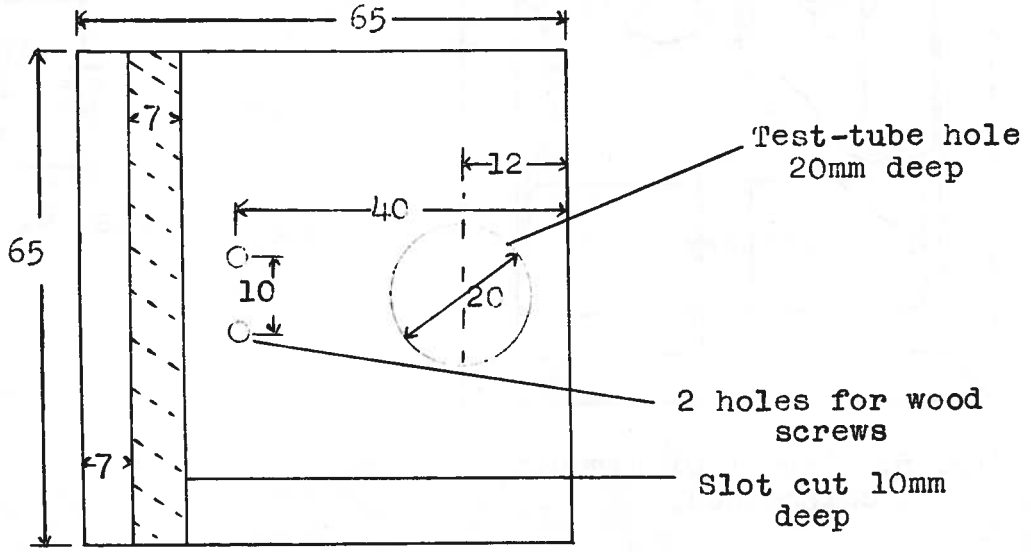

Fig. 1.
Baseboard, dimensions in mm

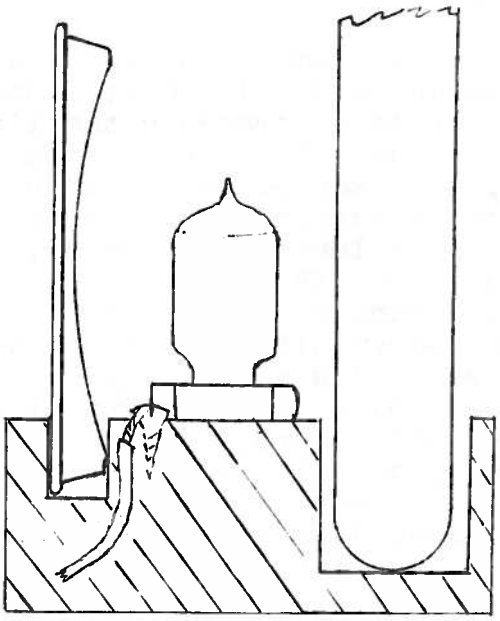

Fig. 2. Location of components.

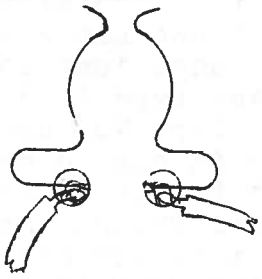

Fig. 3. Detail of connection to flash bulb

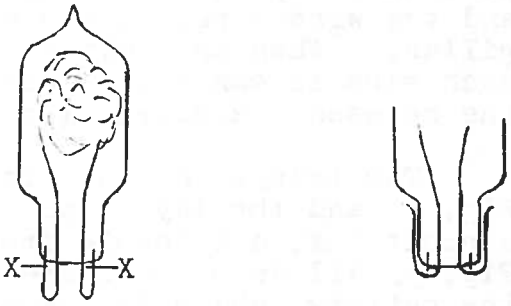

Fig. 4.

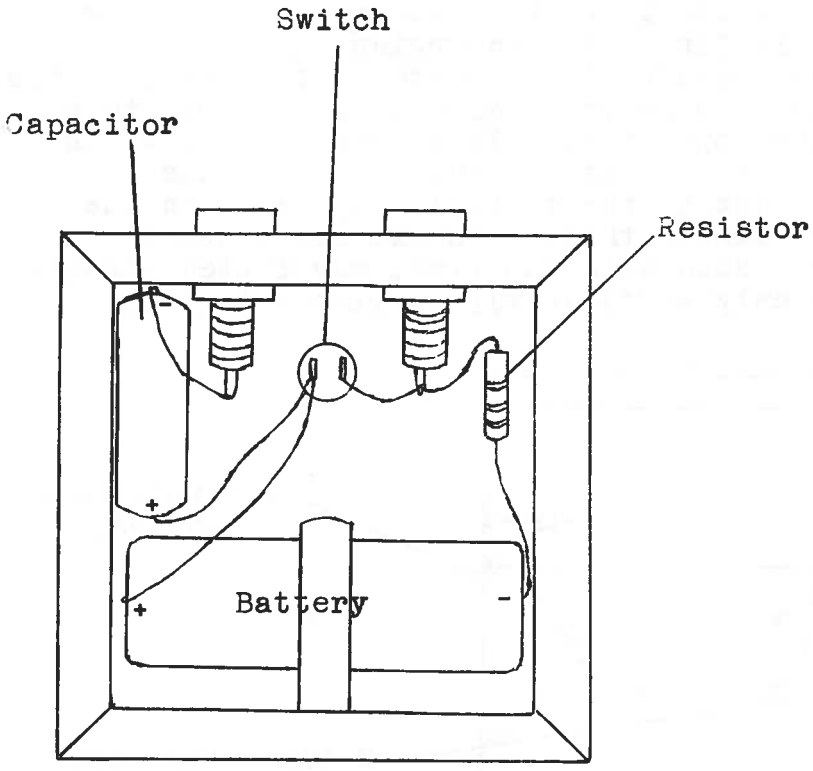

Fig. 5. Layout of circuit components.

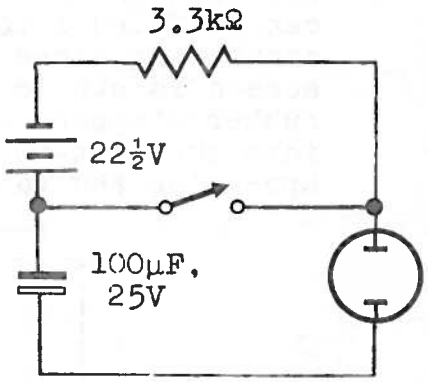

Fig. 6. Trigger circuit

Bulletin Supplement

Below is a summary of tests carried out on low voltage power supplies. Individual reports on these can be borrowed for up to one month by writing to the Director. The classifications used are: A - most suitable for school use; B - satisfactory for school use; C - unsatisfactory.

Model No.	J1	EJ32	LV169
Supplier	Irwin and Partners	Irwin and Partners	Weir Electrical Instrument Co.
Price	£12.10s.	£19.16s.	£19
Voltage Control	Wander Plugs	Variable Transformer	Variable Transformer
Maximum AC output at zero current DC	12.6V 5.2V	12.6V 16.0V	13.5V 17.6V
Maximum AC Current DC	8 and 5A* 8 and 5A*	8A 8A	8A 8A
Outputs at maximum current AC DC	11.3V 3.7V	11.0V 10.0V	12.0V 11.0V
Overload Protection	Primary fuse 2A	Thermal cut-out	Primary fuse, 1A Sec. fuse, 10A
Behaviour on continuous load	Satisfactory	Satisfactory	Not tested **
Smoothing	None	4000μF	5000μF
R.M.S. ripple at max. load	-	1.7V	2.4V
Stacking Ability	Good	Good	Good
Assessment	B	A	B

Notes * 8A for 1 hour, 5A continuous.

** Since our tests, which showed that the rectifier was over-rated, this component has been changed.

S.S.S.E.R.C., 103 Broughton Street, Edinburgh, EH1 3RZ. Tel. 031-556 2184.

Airmec Electronic Instruments Ltd., High Wycombe, Bucks.

Baird and Tatlock Ltd., Freshwater Road, Chadwell Heath, Essex.

Barnet Factors Ltd., 147 Church Street, London, W.2.

A. Christison Ltd., Albany Road, Gateshead, NE8 3AT.

G. Cussons Ltd., The Technical Works, Lower Broughton, Manchester, 7.

Electrovision Ltd., 210 Morrison Street, Edinburgh.

Elk and Co. Ltd., Elkon Works, West Moseley, Surrey.

E.M.I. Electronics Ltd., Hayes, Middlesex.

(E-Mil) H.J. Elliott Ltd., Treforest Industrial Estate, Pontypridd, Glam.

Gambrell Brothers Ltd., Purley Way, Croydon, Surrey.

Glass Appliances Ltd., 488 Holburn Street, Aberdeen.

Goudie's of Bothwell Ltd., 29-35 Main Street, Bothwell, Glasgow.

Griffin and George Ltd., Braeview Place, Nerston, East Kilbride.

Irwin and Partners Ltd., 294 Purley Way, Croydon, CR9 4QL.

James A. Jobling and Co. Ltd., Wear Glass Works, Sunderland.

J. Langham Thomson Ltd., Bushey Heath, Herts.

Macfarlane Robson Ltd., Burnfield Avenue, Thornliebank, Glasgow, S.3.

Maryland Plastics Ltd., 14A Marshgate Lane, Stratford, London, E.15.

Morris Laboratory Instruments Ltd., 96-98 High Street, Putney, London, S.W.15.

W.B. Nicolson Ltd., Thornliebank Industrial Estate, Glasgow.

Omal Group Ltd., Educational Division, Omal House, 170 Tottenham Court Road, London, W1P 9LG.

Peter Plastics Ltd., 234 Paisley Road West, Glasgow, S.W.1.

R.B. Pullin and Co. Ltd., Phoenix Works, Great West Road, Brentford, Middlesex.

Quickfit and Quartz Ltd., Stone, Staffs.

Radiospares Ltd., P.O. Box 427, 13-17 Epworth Street, London, E.C.2.

Salford Electrical Instruments, Peel Works, Silk Street, Salford, Lancs.

Service Trading Co. Ltd., 57 Bridgman Way, London, W.4.

G.W. Smith and Co. Ltd., 3-34 Lisle Street, London, W.C.2.

Spicer Cowan Ltd., 15 Caledonia Avenue, Dixons Blazes, Glasgow, C.5.

Townson and Mercer Ltd., 4 Teviot Place, Edinburgh, 1.

Transatlantic Plastics Ltd., Garden Estate, Ventnor, I.O.W.

Unilab Science Teaching Equipment (Blackburn) Ltd., Clarendon Road, Blackburn. BB1 9TA

Vickers Instruments Ltd., Haxby Road, York.

Walden Precision Apparatus Ltd., Shire Hill, Saffron Walden, Essex.

West Instruments, 21 Alva Street, Edinburgh, 2.

Weir Electrical Instrument Co. Ltd., Bradford-on-Avon, Wilts.