SCOTTISH SCHOOLS SCIENCE

EQUIPMENT RESEARCH

CENTRE

Bulletin No. 31. May, 1969.

Contents

Introduction

Following on the retiral of Mr. A.J. Mee, H.M.I., his place on the Development Committee of SSSERC has been filled by Mr. A. Jeffrey, H.M.I.

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Although this Bulletin may not appear in time for the earlier of these dates, we can now announce our exhibition programme to the end of the current session. As yet we have had no requests for exhibitions for session 1969/70.

Exhibition	Place	Time
Integrated Science Course	Aberdeen	Saturday, 7th June
S.Y. Studies Chemistry	St. Andrews	Friday, 20th June
Integrated Science Course	Lerwick	Tues.- Wed. 24th-25th June
S.Y. Studies Physics	Aberdeen	Monday, 14th July

Opinion

What I said in this column on S.I. units and their application in the last Bulletin may take some time to sink in; that it needed saying was confirmed by a manufacturer's exhibit shown at the A.S.E. meeting in Galashiels last month. There I saw a compression spring balance by Waymaster, calibrated in newtons. Which of course is as it should be, except that the style of the balance indicated that it was intended for use in the bathroom of the overweights. For the ladies who go on slimming diets or swallow pills, the quantity they want to reduce is their mass, and the means by which they measure it are immaterial provided they are accurate. Get one of them to stand on three different balances, which show her weight respectively as 140lb, 64kg and 620N, and there is no doubt in my mind which she will choose. The psychological advantage of quoting the lowest number will not be lost upon her. If Waymaster sell any of these balances to the slimming public, how are they to explain to them that the steak from their butcher is counted in kilogrammes while their own unwished-for flesh is reckoned in some peculiar things called newtons?

There must be many other instances where the purist will have to give way to the convenience of the lay public. No doubt it would be nice to have the domestic weather barometer calibrated in newtons per square metre, including the 10^5 factor. But I doubt if we shall wean the public away from inches of mercury for a very long time, even as far as millibars which should be an acceptable alternative to the scientist. It would be nice - but how convenient? - to have all our thermometers calibrated in ^{o}K; as things are, the Fahrenheit scale is a long time a-dying. Our weather forecasts/

forecasts on radio and television still after two years give Fahrenheit and Centigrade (which should be Celsius) equally. The urge for the sensational drives the newsmen into the Fahrenheit scale whenever our temperatures rocket up or plummet down seasonably. There is nothing spectacular about temperatures of 37° in the shade, or 15° of frost. Wont and usage die hard; let us not sell the pass by insisting on a too rigorous interpretation of S.I.

Chemistry Notes

We are reproducing below, with permission from the Chemistry Department of St. Andrews University, the circuit of the constant current power supply unit designed by them and used for coulometric titrations of Sixth Year Studies Course in Chemistry. We have made two slight alterations in the circuit, using OA81 diodes in place of the recommended 1SJ150 type, because the former are made more readily available, and incorporating an anti-surge 68Ω resistor in the transformer centre tap lead. This limits the current through the diodes at the moment of switching on, but has no effect on the running of the circuit.

The components and sources are as follows:

Transformer	Min Mains 20V	Radiospares	-.12s. 6d.
2 x 100µF 50V Capacitors	Tubes, 100µF, 50V	"	-. 4s. 6d.
6 Resistors, values as in diagram	½W Res.	"	-. 6s. -d.
Zener Diode	M-ZE 6.2V	"	-. 3s. 9d.
Potentiometer, wire wound	STD W/W V.C., 5kΩ	"	-. 5s. 6d.
Neon Indicator*	Wire Neons	"	-. 7s. 6d.
Change-Over Switch	Toggle SPDT	"	-. 3s. 6d.
Mains Switch	Toggle DPST	"	-. 4s. -d.
2 x 4mm Sockets**	Sockets	"	-. 6s. 9d.
2 x OA81 Diodes	-	L.S.T. Components	-. 3s. -d.
2N696 Transistor	-	"	-. 9s. 6d.
20mA Meter	MR38P	G.W. Smith	£1. 5s. -d.
Veroboard	100 x 32mm	Duxford Electronics	-. 3s. 3d.
			£3.14s. 9d.

* Cost per pack of 5 (minimum quantity supplied)

** Cost per dozen (minimum quantity supplied)

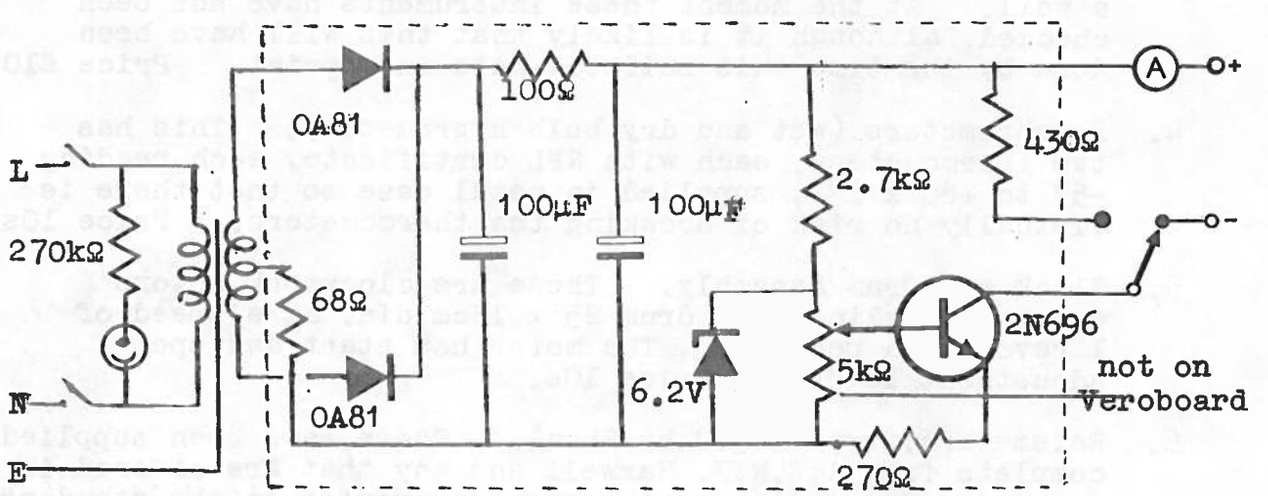
Nuts and bolts, mains cable and plug, wiring, one rubber grommet and a container for the unit will also be needed, bringing the total cost to around £4.

All components shown inside the dotted lines were mounted on the Veroboard strip. A technician should have no difficulty in carrying out this assembly, following the technique detailed in Bulletin 18. The unit was constructed with ample room for all components inside a metal box measuring 210 x 110 x 50mm, using it upside down so that the lid forms a detachable base. The wire-ended neon indicator push fits into a suitable rubber grommet; other components are bolted on the bottom of the box, and the Veroboard strip is bolted on the side.

To test the performance, a decade resistance box was connected across the output, when we found that the current remained constant at the value set initially by the potentiometer from a short-circuit load, up to the maximum resistance value given in the table:

Current mA	Max. Resistance, Ω
5	4500
10	1500
15	900
18.5 (Maximum Obtainable)	600

Since for most electrolysis cells, the resistance is of the order of hundreds of ohms, the unit readily supplies a constant current of 15mA. In conjunction with a stop-clock, this allows an accurately measured quantity of charge to be passed between the electrodes of the cell.



Physics Notes

Recent purchases of second-hand equipment from various sources mean that we can offer a wide range of sometimes standard, sometimes exotic apparatus to physics departments, as detailed on the following pages.

1. A large scale moving coil ammeter. Intended for vertical operation this could be converted to a multi-range demonstration meter. The basic movement is 18mA F.S.D. and can be supplied either centre or left-hand zero, although the scale marked on the instrument will be for 100A or above. The scale radius is 11cm, length approximately 13.5cm. The instrument is fitted with a B.C. socket to take a tubular pilot lamp which would illuminate the scale from the rear. Price 10s.

2. Aircraft aneroid barometers. These have an 8mm diameter tube for attachment to the pressure system. The dial is a clock-face type with two hands, and completely circular scale calibrated 0 - 10. The "minute" hand reads millibars, one complete revolution corresponding to 100mb. Zero corresponds to 1000mb. The scale range is given as 150 - 1050mb, but we have pushed one (with a bicycle pump) to 1800mb. The scale diameter is 6cm. Being supplied for aircraft use, the dial and hands are coated with luminous paint, which has considerable radio-activity. With an MX168 Geiger tube, an average count of 20000 per minute was registered. The zero is adjustable by means of a small screw reset into the front of the instrument. Having a 1mb sensitivity, it is possible to show the difference in atmospheric pressure by carrying it up three flights of stairs. Price 10s.

3. Experimental mercury barometers. These are Fortin type, but have been constructed to eliminate the need to set the mercury level at the base of the barometer. The scale in mb reads from 870 to 1100, with a vernier reading to 0.1mb. Fitted to the stem is a thermometer with NPL calibration, reading 260 - 320 x 1°K. The barometers contain approximately 1.6kg mercury. They are supplied in a wooden lockable case which could be used as a mounting for the barometer by bolting it vertically to a wall. At the moment these instruments have not been checked, although it is likely that this will have been done by the time this Bulletin gets into print. Price £10.

4. Psychrometers (wet and dry bulb hygrometer). This has two thermometers, each with NPL certificate, each reading -57 to +80 x 1°F, supplied in metal case so that there is virtually no risk of breaking the thermometers. Price 10s.

5. Clock and Drum Assembly. These are clockwork motors driving a cylindrical drum 25 x 13cm dia. at a speed of 1 revolution per day. The motor has start and speed adjustment levers. Price 10s.

6. Ratemeters, type 1037C by Racal. These have been supplied complete from A.E.R.E. Harwell and any that are offered in working order will have the input converted to the standard P.E.T. connector used with the normal school instrument. By switching ranges, the output meter can register from 1 to 100 000 counts per second F.S.D. Adjustable discriminator bias is obtainable, and three switched paralysis times of 5μs, 200μs and 5ms. The ratemeter also has outputs for driving a mechanical register, and a pen recorder of 5mA or 100mV sensitivity, both on 4mm terminals. Price £5.

7. Scaler, type 1009E by Dynatron Radio. These have discriminator bias continuously adjustable to a maximum of/

of 50V, and paralysis times of 5μs and 10ms, and hence are intended for Geiger tube pulse counting. However, there is no geiger tube input nor H.T. power supply for operating such a tube, and the unit must be looked upon purely as a pulse counter. The count is indicated by neon bulbs operated from a binary counter up to 100, and thereafter on a four-digit electromechanical relay. Price £1. The unit will count sine waves of greater than 5V peak amplitude up to 4Hz on the mechanical register, and will provide an alternative 2V negative pulse output to operate a further scaler up to 100kHz.

8. Scaler, type 1266B by Ericsson Telephones. Similar to Item 7, in that bias and paralysis times are variable, but there is no geiger tube input or H.T. supply. The count is indicated on 5 decatrons. Price £1.

9. Scaler, type 101A by Ericsson Telephones. Similar to Item 8, but much smaller and more portable. The count is registered on four decatrons, and will register with greater than 5V peak amplitude, sine or square wave. A 20V D.C. pulse output is obtainable from each decatron when the zero count position is passed. Maximum count frequency 5kHz. Price £1.

10. Nife cells measuring 13 x 5.5 x 28.5cm high. The capacity has been checked as 75Ah at 3A discharge rate. The terminals will require modification to 4mm size, but crocodile clips can be used direct. Supplied filled and charged, price £1.

11. Single channel recording milliammeter by Elliott Brothers. The sensitivity is 5mA D.C. F.S.D., and the chart speed (mains operated) is 3in per minute. At present penless, we are trying to obtain pens to fit. Price £5.

12. Dual channel recording milliammeter by Elliott Brothers. Two channels each have 75mA or 15V D.C. or A.C. sensitivity F.S.D. Also mains driven, and without pens, the chart speed of this model is 1in per hour. Price £5.

13. Power Unit type 1182B by Isotope Developments. A stabilised D.C. power supply continuously variable to 500V and 150mA. This is in working order but has not had its output checked on external load. Other outputs are three sets of 6.3V A.C., 3A, one of which is tapped at 2 and 4V. Price £5.

14. Heavy Duty Rheostat. Rated at 1.5A, 500Ω. This consists of two parallel windings with the adjustable contact forming a shorting bar between the two. Fitted to the windings are one fixed and two adjustable taps. Price 10s.

15. A large variety of electromagnetic relays, all unchecked but many are new and unused, all priced at 1s.

16. A large variety of switches, heavy duty types, micro-switches, multi-bank wafer etc. Price 6d each.

17. Potentiometers, mostly new and unused, wirewound, carbon and printed circuit types for most resistance values and including some ganged types, all at 6d each. Also a few 10 turn helipots by Colvern, one value only, 2.7kΩ at 2s each.

18./

18. Block paper capacitors in most values from 0.1 to 8μF at a range of working voltages, including some in the kV range, 6d. each.

19. Moving coil meters. These are mostly milliammeters although there are some with μA F.S.D. All have been checked for F.S.D., as many have peculiar scales. Price 5s. each. Also a few with their own shunts or multipliers to allow two or more ranges, all new and unused at 10s. each.

Orders for any of these items can be invoiced to the school for payment out of petty cash, or to the local authority or other governing body. Where items are not personally collected, postage or carriage charges will be added to the cost.

Display Laboratory

The following items have been added to the display laboratory since this item was last included in Bulletin 29.

Item	Manufacturer
Demonstration D.C. Motor	SSSERC
Electrolysis Cells	SSSERC
Speedframe Trolleys	SSSERC
Pupil Chemistry Apparatus Kit	SSSERC
pH Meters	Chandos
Gas Syringe Oven	Exelo
Cosmetic Science Kit	Griffin and George
Magnetic Stirrer	Griffin and George
Magnetic Stirrer	Gallenkamp
Magnetic Stirrer	Chemlab
E.L.T. Power Unit	Linstead
L.T. Power Unit J1	Irwin
L.T. Power Unit EJ32	Irwin
Vibrating Reed Switch	Unilab
Microscope Model ABF	Opax
Microscope Model OWW	Opax
Microscope Model GVF	Opax
Microscope Myacope Junior Student	Macfarlane Robson

Trade News

All conical flasks and beakers currently being produced in the Pyrex range are calibrated, and production of uncalibrated items has ceased. There is no increase in price as a result of this change.

From Exelo comes a 1x 0.01ml pipette, sold in packets of 10 but costing only 6d each. These are intended as disposable serological pipettes but could find applications in school work. Catalogue number is DP1010.

Pyrex have also introduced a low pressure gauge which could/

could be a useful accessory for indicating the state of vacuum in a system. It will indicate pressures of 18cm or less of mercury. Catalogue number 2112/04; price £1.

From A. Christison and Sons comes an Aerosol propellant spray to which any desired fluid to be sprayed can be attached. The 12oz. size of propellant costs £1.4s; the container for the sprayed fluid costs 1s.6d. and propellant refills are 10s.6d.

Fabricated units in Dexion speed-frame, such as shelving, trolleys etc. can be made up to order by a new firm of Carlyle Wishart, established for this purpose. While the fabrication charge varies with the amount and nature of the work involved, as an average guide, labour costs will be 10 - 20% of the cost of the speed-frame used.

Elesco-Fraser are agents for the range of W.P.A. equipment now offered to schools. The same firm are also selling a small battery charger which gives fixed outputs of 6 and 12V at up to 4A current, with an output ammeter, at £3. For many experiments this can be an adequate power supply.

One of the advantages claimed for the "Locktronics" electronic teaching kit made by A.M. Lock is its versatility. The method of connecting components is essentially that of the Worcester circuit board with each component mounted between phosphor bronze springs which press-fit between pillars on the baseboard. Changing a component value to observe its effect on the circuit is than a matter of seconds only. Baseboard LK0 costs £2.12s.6d. or £20 for 8 sets; the introductory transistor set LK20 costs £5.12s.6d. or £44 for 8 sets.

We have been asked by Griffin and George to point out that the price of their 5μCi Plutonium source is now £13.10s., and not £17 as was stated in Bulletin 30. This price reduction took place too late for inclusion in their Griffin 69 catalogue, and for our own physics equipment list, Item 146.

British Drug Houses have introduced a compressed gas service which in Scotland should be ordered through their agents, Macfarlane Robson Ltd. Quantity varies with the gas, but is around $2ft^3$. For the common gases, the costs are - hydrogen £1.10s; oxygen £1.6s; nitrogen £1.8s; carbon dioxide £1.18s.6d. To this must be added the hiring charge for a cylinder, £3.10s. for any of the above gases, and of which 80% is recoverable if returned within 6 months, 50% within 18 months. The same adaptor, 8s. and control valve, £1.10s.6d., can be used on all the above gases.

In The Workshop

The model motor is based on a design shown at an exhibition of laboratory technicians work in the Glasgow Science Centre, and had been constructed by technicians at Garthamlock Secondary School. We like it because its size makes it possible for a pupil to see the commutative action, because it uses readily available materials, and because it runs sufficiently slowly to be non-self-starting, thus showing the spasmodic nature of the force on the coil limbs.

Top and bottom of the motor frame are two pieces of $\frac{3}{4}$in thick/

thick chipboard, measuring 90 x 290mm. The top has a 20mm dia. hole drilled centrally through it, and is then cut away at one side to allow insertion of the commutating ends of the coil. The lower has a central hole drilled to take a nylon bush which forms the lower bearing of the motor. The sides of the frame are 80 x 400mm sheets of 16 SWG mild steel, fixed with three wood screws top and bottom.

The coil is a single loop of 14 SWG bare copper wire bent to the dimensions shown on the diagram. A brass pin, formed by tapering down one end of a 3mm dia. brass rod, is soldered half way along the lower horizontal limb of the coil and rests in a small depression drilled in the nylon bush referred to above; this forms the lower bearing. Tapering the rod can be done by holding it in the lathe or power drill and using a file while it is rotating. The end 5mm - or more if this be thought too small to handle properly - is then cut off and tinned before soldering to the lower coil limb. Any out-of-balance produced by fixing this pin bearing can be corrected by bending the vertical limbs of the coil slightly. The ends of the coil are brought up through the upper part of the frame and fit into two holes in another nylon bush. The spacing here is not critical; on our own model there is a gap between the connecting ends of about 1mm.

The brushes are two strips of phosphor bronze measuring 55 x 4mm, bolted using 8BA bolts to a tufnol block 40 x 20 x 12mm and bent to that they are in contact with the ends of the coil for most of its turning circle. The tufnol block is secured to the upper frame by a single bolt which may require to be countersunk at its lower end to prevent it fouling the top limb of the coil during its rotation.

A U-bracket in 16 SWG aluminium holding a tapered brass 2BA bolt forms the upper bearing, this again seating into a small depression in the top nylon bush. The magnetic field is produced by two ring magnets, measuring 30 x 62mm dia., taken from old loudspeakers which we believe are a fairly common type of 8" speaker. The magnets adhere naturally to the sides of the frame and give a clearance on the coil limbs of about 6mm on each side. Once the top bearing pivot has been set, insertion or removal of the coil does not require that the bearing be adjusted; the coil is sufficiently resilient to allow it to be sprung into place. With one Nife cell, or with the Nuffield E.L.T. power unit designed for use with the Westminster electromagnetic kit, the current drawn is about 5A and the rotation speed 2Hz.

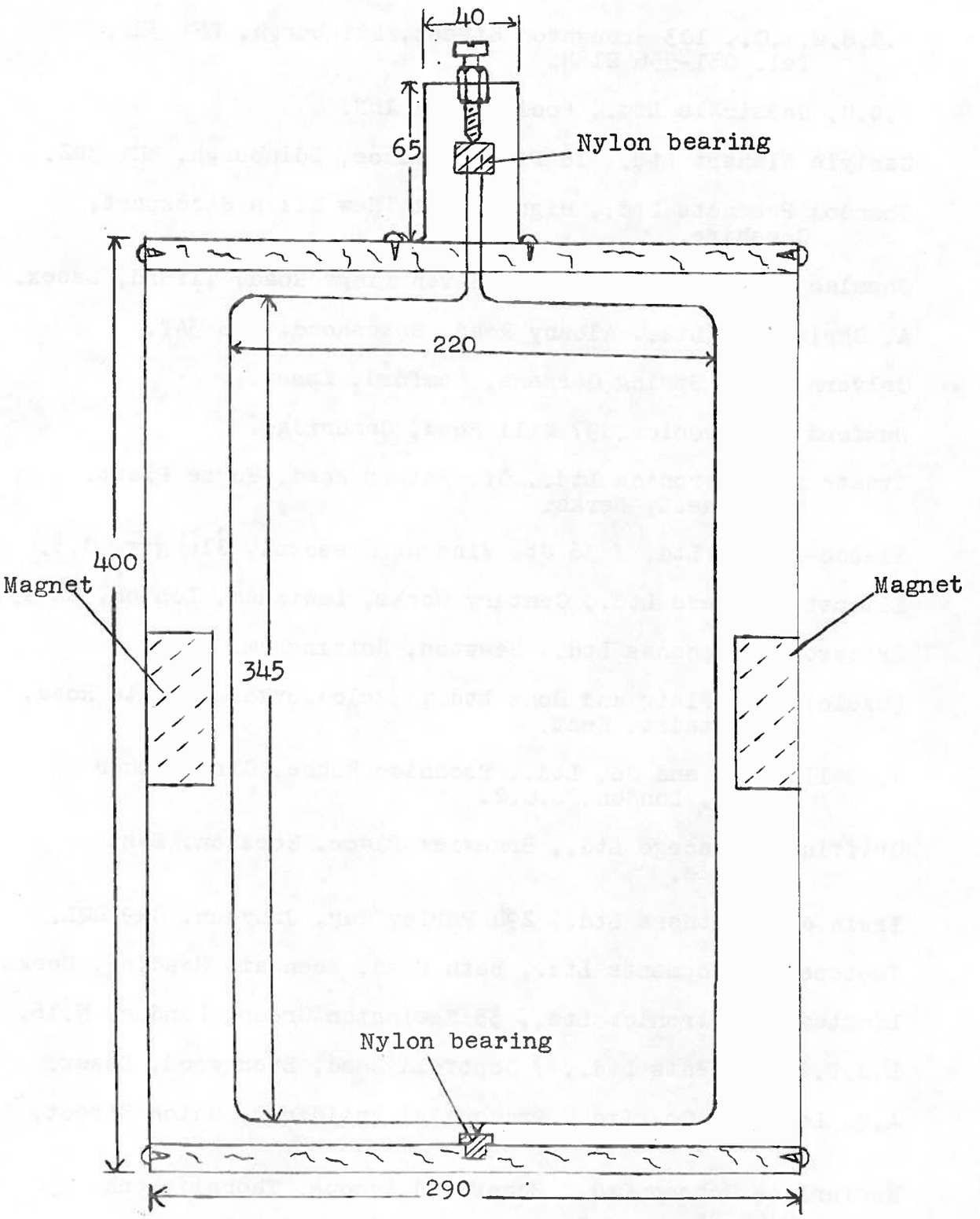


Fig. 1. Motor elevation. All dimensions in mm.

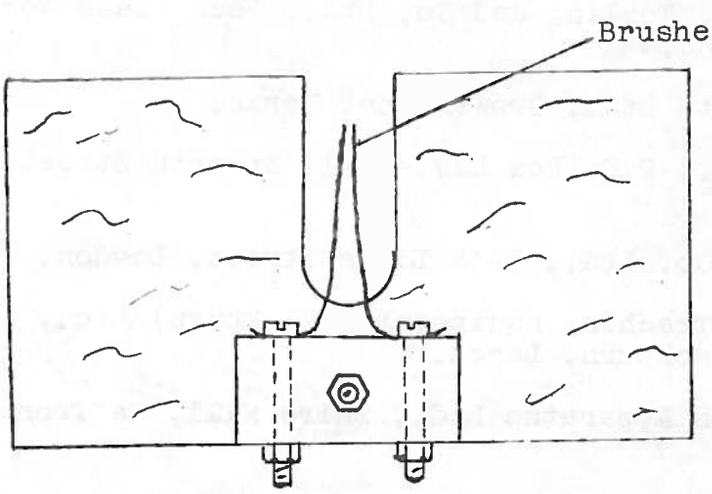


Fig. 2. Brush mounting.

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

B.D.H. Chemicals Ltd., Poole, BH12 INN.

Carlyle Wishart Ltd., 18 Picardy Place, Edinburgh, EH1 3RZ.

Chandos Products Ltd., High Street, New Mills Stockport, Cheshire.

Chemlab Instruments Ltd., 1b Seven Kings Road, Ilford, Essex.

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

Colvern Ltd., Spring Gardens, Romford, Essex.

Duxford Electronics, 97 Mill Road, Cambridge.

Dynatron Electronics Ltd., St. Peters Road, Furze Platt, Maidenhead, Berks.

Elesco-Fraser Ltd., 36 St. Vincent Crescent, Glasgow. C.3.

Elliott Brothers Ltd., Century Works, Lewisham, London, SE 13.

Ericsson Telephones Ltd., Beeston, Nottingham.

(Exelo) W.G. Flaig and Sons Ltd., Exelo Works, Margate Road, Broadstairs, Kent.

A. Gallenkamp and Co. Ltd., Technico House, Christopher Street, London, E.C.2.

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

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

Isotope Developments Ltd., Bath Road, Beenham, Reading, Berks.

Linstead Electronics Ltd., 35 Newington Green, London, N.16.

L.S.T. Components Ltd., 7 Coptfold Road, Brentwood, Essex.

A.M. Lock and Co. Ltd., Prudential Buildings, Union Street, Oldham, Lancs.

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

Opax Ltd., 6 Frant Road, Tunbridge Wells, Kent.

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

Racal Instruments Ltd., Crowthorne, Berks.

Radiospares Ltd., P.O. Box 427, 13-17 Epworth Street, London, W.12.

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

Unilab Science Teaching Equipment (Blackburn) Ltd., Clarendon Road, Blackburn, Lancs.

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