SCOTTISH SCHOOLS SCIENCE EQUIPMENT RESEARCH CENTRE

Bulletin No. 13. April, 1967.

Contents

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Introduction

Further to our list of exhibitions which SSSERC is staging in various Scottish Centres, readers might care to note that we shall be holding an exhibition, mainly of biology apparatus. in conjunction with an A.S.E. meeting at Callander on 12th and 13th May, and one on the apparatus for the Secondary Science Course in Dumfries on 9th June. In addition it is likely that there will be an exhibition in Fortrose Academy on 20th May. Teachers or others who would like an exhibition staged in their own area should write to the Director at an early date. Any such requests should be for dates in the 1967-68 school session, as we cannot undertake exhibitions in the current session other than those already planned.

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We intimated in Bulletin 12 that apparatus lists for Years I and II of the Secondary Science Course could be obtained by writing to the Centre; these have now been distributed to all who asked. We have also prepared equipment lists, giving sources and prices, for Years I, II and III of the alternative physics syllabus. These may prove useful to teachers in Junior Secondary Schools which are not yet fully equipped for the alternative syllabus, or to teachers equipping a new school. These lists can be had on request from the Centre. Teachers are reminded that a similar list of Year IV equipment appeared in Bulletins 6 and 7.

Opinion

While arguments and protests against the incorporation of the private sector of education under the comprehensive umbrella of the state wax furious in letters to the Press, two recent pieces of reporting might serve to reassure opponents of the merger that not all education at the taxpayer's expense is dull, drab and lifeless. One is an account by the Senior Physics Master of Kettering Grammar School, which I take to be authority controlled, of how he and his pupils located a previously unknown Russian satellite launching site. Although the account - in the March issue of Wireless World, Vol. 73, No. 3 - is deceptively simple. the apparatus used comprised nothing more than a receiver. tape recorder and clock. Using the Doppler shift principle. the time of closest approach of the transmitting satellite was determined on successive days, from which the orbital period could be calculated. It is then possible to calculate backwards to the initial orbit and launching site.

The second example is that of Buckhaven High School, reported in the "Scotsman" of Tuesday, 21st February, of closely co-operating with the employees of Hughes International (U.K.) Limited in the construction of computer logic and similar electronic circuits. Both examples serve to show that the age of the individualist is not over; that there are opportunities, even under the shackles of a local authority which the enthusiastic teacher can seize and develop; and although not all will reach the columns of the national press, few would wish to, being more satisfied with the obvious stimulus which this type of project provides to the pupils.

It is a pity that both examples are from the field of electronics. After many years of contact with teachers and students I am convinced that with electronics there can be no half-measures; one either takes to it like a duck to water, or it forever remains a closed book. But there must be many other fields in which the willing teacher can find a project topic suitable to his interests, and if chemistry and biology follow in the wake of the proposed post-Higher physics syllabus, the development of these topics will assume greater importance in the future. "The Certificate of Sixth Year Studies (post-higher physics) will be awarded on the basis of ... (2) an experimental project or projects conducted by the pupil, who will be required to submit a report on his work which will have been prepared during the session." The above is quoted from the syllabus on post-Higher physics issued by the S.C.E. Examination Board.

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Finally as a tail-piece I give the verbatim text of a reply we received recently from the sales department of a microscope firm, changing only the microscope references. If anyone can explain what it means, I shall be very grateful. It supports what many of us have believed for a very long time, that while salesmen are loquacious by nature, the language which they use is emotive in its appeal rather than logical.

"The difference in the price for the 27X between the Nuffield and our standard 27 is that in the standard 27X the sub-stage condenser is fixed with .65NA. The Nuffield 27X we are supplying has a focusable type of Abbey (sic) Condenser NA 1.25. The prices for the two instruments are the same."

Physics Notes

Whether this can properly be classified as an oscillation we leave the teacher to decide; from energy considerations it would seem very analogous to the pendulum clock. The experiment comes from Linlathen Secondary School, Dundee.

Half-fill with water a 400ml flask fitted with stopper and glass tube about 30cm long, inside diameter 5mm. The tube need not project inside the flask. Then invert in a clamp over the sink.

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We have had numerous suggestions for alternative methods of connecting components on the Worcester circuit board, other than the curtain rods and bolts in the Nuffield (Philip Harris and Griffin and George) versions. The Mullard Educational Service and Hawick High School both suggest brass eyelets, obtainable in drapery stores in various sizes, fitted into holes in pegboard, or specially drilled holes in hardboard. Leads are pushed through the eyelets and held in place by pegs - this was the standard technique of the radio amateur for securing leads to a grid-bias battery with a matchstick. Mullard recommend plastic golf tees for the pegs, but Hawick reports that these tend to work loose, and have had to make up their own soft wood pegs for the purpose.

Another suggestion is the use of close-wound springs, the component leads being sandwiched between adjacent turns. The springs /

springs are obtainable from Heathkit No. 258/512 at 11s. per 100. They are secured to pegboard by 6BA bolts and washers. These have been successfully used in Linlathen Secondary School, Dundee, and in Dunoon Grammar School.

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From Notre Dame High School, Glasgow, we have a useful tip to avoid trailing mains leads when electronic equipment has to be transported and stored. Fix a bulldog clip, available from stationers, to the outside case and use to clip the cable in position.

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A method of showing the independence of horizontal and vertical motions in free fall has been suggested by Galashiels Academy. The projectile is strobe photographed on 35mm film and the negative projected onto paper on a drawing board. Pins with small flags, to render them more easily seen, are stuck in the projectile positions. The drawing board is then placed flat at one end of the laboratory and the pins illuminated from the side with the projector. Viewing on a level with the board from the other end of the laboratory will show either the horizontal or the vertical motion, depending on the orientation of the board. If necessary the pins can be photographed from about 3m distance, when the two photographs can be analysed to show constant velocity and constant acceleration respectively.

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A 300V power supply which will be adequate to operate a single valve - and more often than not this is all that the teacher requires - can be made up using a standard valve filament transformer, e.g. Radiospares "Standard" or "Hygrade" types in reverse. The filament winding is made the primary and is fed with 6V from another low voltage transformer such as the Nuffield Item 27. The mains winding is made the secondary and put in series with a BY100 rectifier, and 16μF, 350V working electrolytic condenser. Up to 300V D.C. will then be available across the capacitor. The "Hygrade" transformer, having a more powerful rating, will give better regulation. It should be pointed out that the energy stored at 300V in a 16μF condenser can give a nasty shock to anyone touching the output terminals, and a safety resistance and/or fuse could be incorporated in the output lead.

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Following the statement in Bulletin 12 that the use of induction coils is now banned in schools, one or two teachers have written asking for an authoritative statement on the present position. While we cannot in any way anticipate the requirements of the S.E.D. memorandum on this and the related problem of use and storage of radio-active substances, at present in course of preparation, the principles employed must be similar to those in force in England and Wales and given in the Department of Education and Science Administrative Memorandum 1/65: The Use of Ionising Radiations in Schools, from which we quote (p. 35).

"With the exception noted in paragraph 1, the prior approval of the Secretary of State must be obtained if it is desired to operate at a voltage of 5KV or above any apparatus capable of producing X-rays directly or indirectly; this approval will not be given unless proposals for the suitable screening of the apparatus have been approved by the Department. For maintained and assisted establishments responsibility for applying for approval /

approval and for ensuring safe working when it has been given rests with the Local Education Authorities: for direct-grant and independent establishments it rests with the governing bodies or proprietors."

The exception referred to is the use of television sets; teachers will realise that the 5KV limit rules out the use of induction coils for showing discharge phenomena in gases.

Chemistry Notes

A recent note in Gallenkamp's News and Review is well worth repeating as a warning to teachers. Silicone greases should not be used to lubricate stopcocks on burettes or other graduated glassware. The reason is that silicones migrate and may form a thin irremoveable film which prevents proper wetting of the glass and thereby ruins the calibration accuracy. Rubber or Apiezon grease is recommended instead.

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Since writing in our last Bulletin on standards of purity in chemical reagents, we have had a note from a teacher pointing out that the sodium chloride supplied by one firm gave an alkaline reaction with phenol phthalein, making the salt unusable for corrosion tests. We would welcome similar instances of chemicals failing to come up to the required standard and, like this one, will pass the information on to the CLEAPSE sub-Committee.

Trade News

Griffin and George have reduced the prices of their power units designed to meet Nuffield Physics specification. The new prices are:

E.H.T. supply, GN14	£38	5	-
H.T. supply, GN15	20	-	-
L.T. Transformer, GN27	6	-	-
L.T. Variable Voltage A.C. and D.C. supply, GN59	25	-	-
Low Voltage Power Unit for Westminster Kit, GN104	5	-	-

The same firm have reduced the price of their GN23 microscope, mentioned in our last Bulletin. The new prices are; with mirror, £17.18s.6d., and with 12V illuminator, £19.5s. A seventeen page booklet for pupil use explaining the uses of the instrument goes with the microscope. Additional copies can be purchased for 5s.

Sterile blood lances, called Armolets, can be obtained from Andrew H. Baird for 1s.2d. per dozen. These are hygenic, painless to use and in every way preferable to the pin or needle one commonly /

commonly finds used for such a purpose. They should, of course, be used once only.

We have to point out that, contrary to the statement in Bulletin 12, the new Nuffield physics catalogue from Morris Laboratory Instruments contains an alphabetically indexed list.

When verifying the conservation of momentum in two dimensions using the magnetic pucks apparatus, time and film is often wasted because an inept pupil or colleague muffs the initial projection of a puck. This can be avoided using a puck catapult from Philip Harris, P10040/27P, £3.15s., which attaches to the edge of the puck table and allows a successful trial shot to be repeated precisely.

The following is an extract from a letter from a Director of Morris Laboratory Instruments, commenting on a statement we made in Bulletin 12.

"At the foot of page 2 under 'Trade News' there is a paragraph about the Griffin and George 1966 catalogue. In commenting on this you go on to say, "It is safe to say that the only firm prices available from any schools supplier are those for the Nuffield syllabuses." This statement is completely false, and we consider it most damaging to the reputations of companies such as our own who have, in the face of increasing costs, kept their prices to education stable over a long period. There have been no increases in M.L.I. prices since July 1963, either in the case of Nuffield or non-Nuffield apparatus. Our price lists are valid now and will be in the foreseeable future. If, and when, we change our prices it will be a major policy step and our customers, generally, will be informed of this. As far as M.L.I. is concerned there is no creeping increase of prices of which the customer only becomes aware when he is invoiced for the goods."

In the case of this particular firm, our observations were based on a cursory comparison between their 1964 price list and their Nuffield Physics catalogue, which have certain items in common. In the former we found the Whitley Bay smoke cell listed under 90-100 at £4, and in the Nuffield Catalogue under 95-29 at £2.10s. Similarly we thought we had detected a reduction in price between their energy conversion units (79-500 to 544) and the Malvern energy conversion set, 95-9 at £39.

We are glad to be able to apologise to Morris Laboratory Instruments, and to any other schools suppliers at present unknown, who may have felt aggrieved at the sweeping statement made. Customers of the former firm will be pleased to have the assurance that M.L.I. prices will remain firm until they have been informed of a change, which, if it happens, presumably means through the medium of this Bulletin at some time in the future.

A range of mirror galvanometers have been developed by Walden Precision Apparatus and are offered at an ex works price of £20. Their characteristics range from the high voltage sensitivity model K101 with sensitivities of 290 mm/mV and 12 mm/μA to the high current sensitivity model K107 at 9.3 mm/mV and 430 mm/μA. The makers claim that the basic movement has been subjected to a 12 volt car battery short circuit on the most sensitive range, and to a 12 inch drop test onto a wooden table, without damage. Three ranges of x1, x0.03 and x0.001 are provided; the flat dual-scale with both centre and left-hand zero is 18 cm long.

Display Laboratory

Added to the display laboratory since Bulletin 11 are the following items.

Item	Manufacturer
Transistor circuits	SSSERC
Transistor Lecher-wire oscillator	SSSERC
Radioactive decay analogue	SSSERC
Powerless current	SSSERC
Orbiting electron model	SSSERC
Reflex action model	SSSERC
Condenser energy storage	SSSERC
Thermo-electric power generation	SSSERC
Swimming fish	SSSERC
Forces demonstration Box	SSSERC
Binary adder	SSSERC
Rotational and translational K.E.	SSSERC
Radiation kit	Philip Harris
Energy Conversion Kit	Philip Harris
Bromine Diffusion Apparatus	Philip Harris
Elastic Materials Kit	Philip Harris
E.H.T. Power Supply	Advance Electronics
LT Power Supplies	Advance Electronics
OS25 Double Beam Oscilloscope	Advance Electronics
Crystal Diffraction Model	W.B. Nicolson
Model V10 Balance	Oertling
Mirror Galvanometer	Walden Precision Apparatus

The following have been removed from the display laboratory.

Model R10 Balance	Oertling
Model J10 Balance	Oertling
Sartorius 2748 Balance	MacFarlane Robson
35mm Slide Holder and Viewing Box	MacFarlane Robson
Electron Diffraction Tube	Teltron
Conductimetric Titration Flask	John Moncrieff
Decade Resistance Box	Derritron
Multi Range Meter	Derritron
Micro-Galvanometer	Derritron

In The Workshop

From Kingsway Technical College, Dundee, comes the following suggestion for an automatic burette filler.

Materials:

Squezy or similar plastic bottle.

1 m length rubber tubing.

2 cork bungs, single holed.

Tapered glass tube.

On the bung which fits the burette top, a notch is cut down the side to allow air entry. The tapered glass tube is inserted in this bung and its position adjusted so that the tapered end is level with the zero mark. Rubber tubing then connects the glass tube to the plastic bottle through the second bung.

To refill the burette, squeeze the bottle containing the reagent until the burette has filled above the zero mark. Releasing the bottle allows the excess to siphon back, an action which is broken at the zero mark by air entering the tapered tube.

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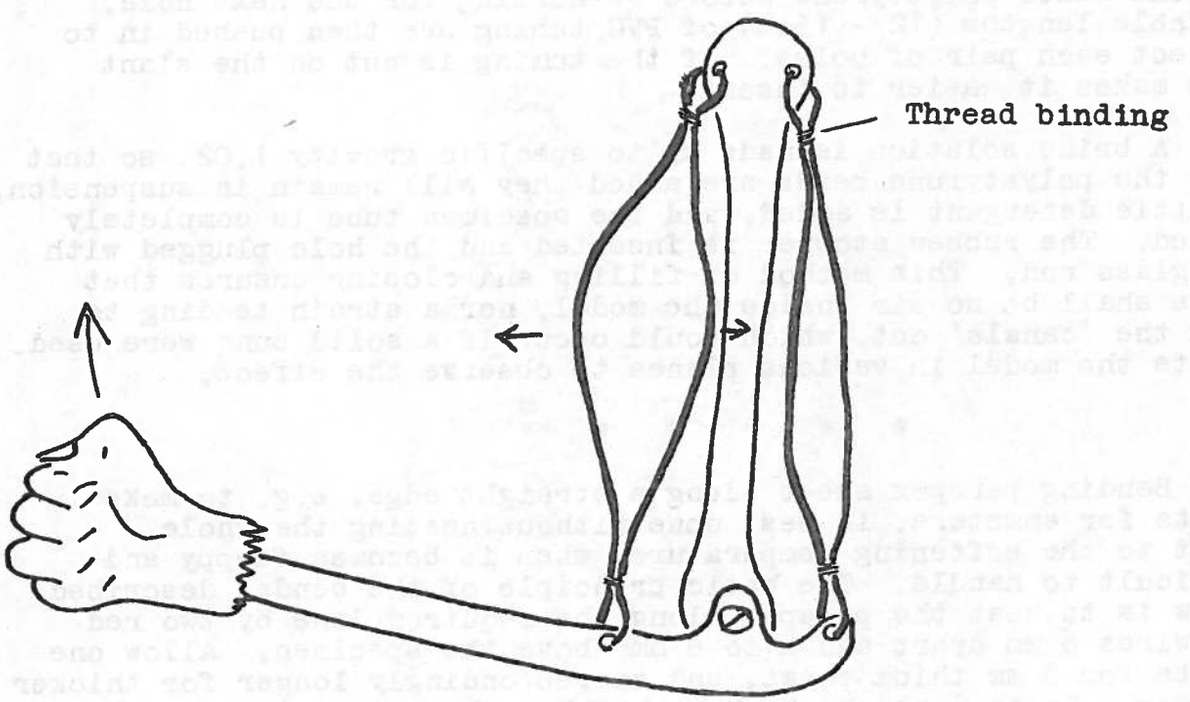
A modification to the traditional fore-arm movement model consists in using a double string instead of the rubber bands, or balloons to simulate the fore-arm muscles. Each double string is bound top and bottom with thread. By pulling each string of a "muscle" outwards an equal pull is exerted on fixed and moveable bones with consequent rotation of the latter. At the same time the idea of a muscle becoming shorter and fatter is well illustrated.

The bones can be cut from hardboard with a fret-saw; a 4 BA nut and bolt will make a suitable elbow pivot. The fixed bone should then be mounted on a suitable frame.



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Semi-circular canals model

Materials:

Polystyrene specimen tube 62 x 18 mm diameter,
e.g. S42-141 from Griffin and George

No. 17 single holed stopper, from Griffin and George

Clear Polyvinyl tubing, 6 mm outside diameter,
e.g. TX-475 from Gallenkamp

30 mm length glass rod to fit stopper

Polystyrene beads, L54-960 from Griffin and George

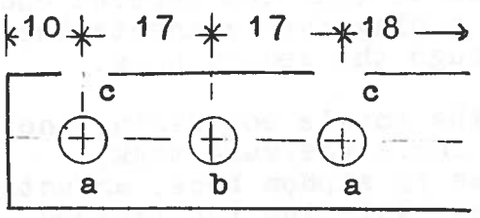

Fig. 1

Hole forming details. The second b hole is diametrically opposite the one shown.

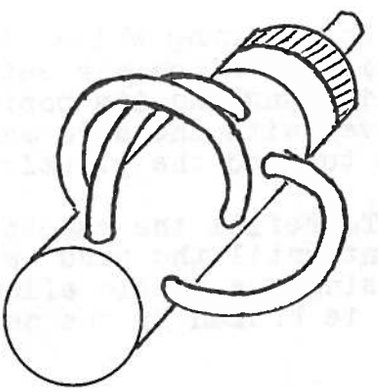

Fig. 2

General View

Drilling holes in a curved polystyrene surface is not particularly easy, and a satisfactory alternative is to melt them out with a heated cork borer, No. 1 size. Only gentle heat is required, sufficient to bring the borer up to 150 - 200°C. The borer is slightly undersize, and requires to be worked round the initial hole. The PVC tubing must be a tight fit, since no adhesive is used. Three pairs of holes, a,b and c are taken out as in Fig. 1, the second hole b being diametrically opposite on the far side of the tube to that shown. Allow the borer to cool, and punch out the waste polystyrene before re-heating for the next hole. Suitable lengths (12 - 15cm) of PVC tubing are then pushed in to connect each pair of holes. If the tubing is cut on the slant this makes it easier to insert.

A brine solution is made up to specific gravity 1.02, so that when the polystyrene beads are added they will remain in suspension, a little detergent is added, and the specimen tube is completely filled. The rubber stopper is inserted and the hole plugged with the glass rod. This method of filling and closing ensures that there shall be no air inside the model, nor a strain tending to push the 'canals' out, which would occur if a solid bung were used. Rotate the model in various planes to observe the effect.

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Bending perspex sheet along a straight edge, e.g. to make mounts for ammeters, is best done without heating the whole sheet to the softening temperature, when it becomes floppy and difficult to handle. The basic principle of the bender described below is to heat the perspex along the required line by two red hot wires 6 mm apart and 4 to 6 mm above the specimen. Allow one minute for 3 mm thick sheet, and correspondingly longer for thicker perspex. Up to 6 mm thick sheet has been bent in this way. A straight edge in wood should be available to act as a jig so that the perspex may be bent round it to the proper angle; cold water should then be poured over it to hasten cooling and hardening. The angle thus formed has a nice rounded corner; if only a single wire is used the surplus material will build up and crinkle on the inside of the bend.

Materials:

Chip or block-board base 24 x 40 x 2 cm.

Connecting wire and 4 mm plugs.

22 S.W.G. Nichrome wire.

Any suitable pulley and axle bolt.

2 BA brass terminal.

Shorting link

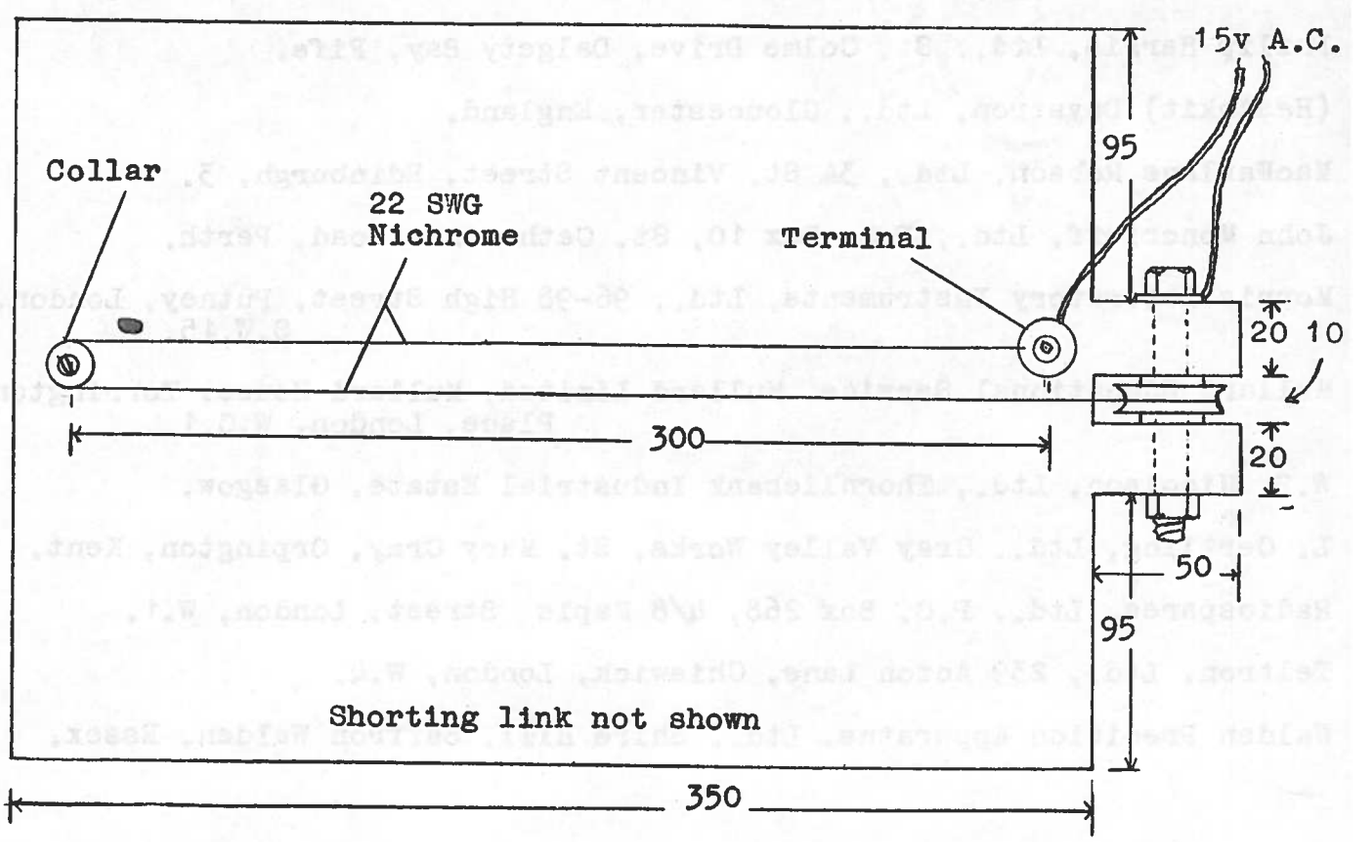
4 BA bolt, 33 mm long.

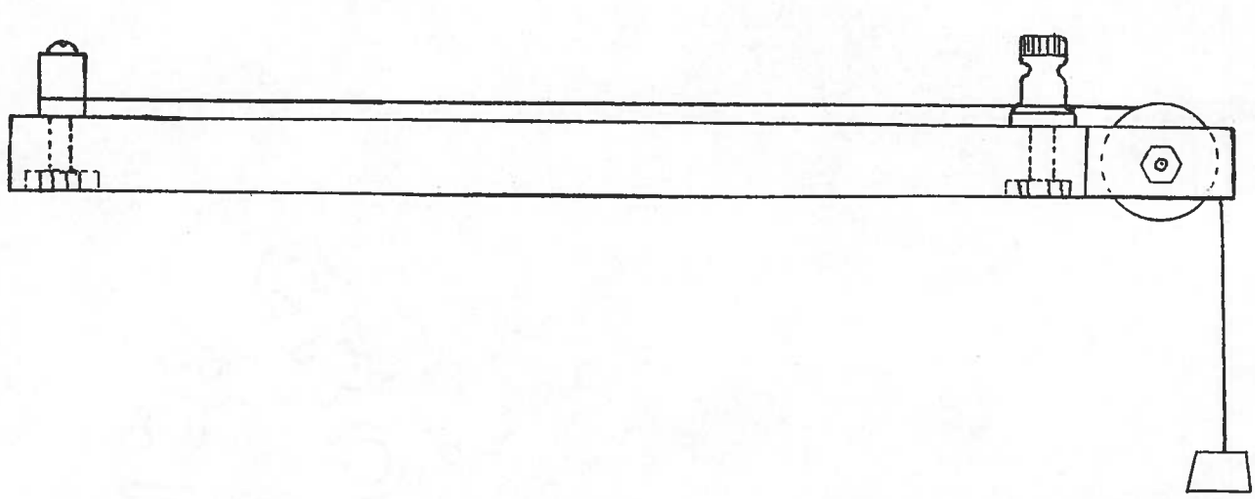
Metal collar 10 mm long to fit loosely on above.

1 Kg weight or similar and S-hook.

The shorting link is made from two crocodile clips joined by thick stranded wire and is used to clip on to the Nichrome heating element to short out part of it and so provide easy means of temperature adjustment. For the dimensions given the supply can then be kept at 15V A.C.

The pulley should be mounted so that the wire is about 5 mm above the baseboard. At the far end the wire is looped round the collar on the 4 BA bolt; even with this arrangement it is necessary to pull on the weighted end of the wire to take up the slack caused by heat expansion. One of the electrical contacts is to the brass terminal, the other is soldered to a washer on the pulley shaft, so that current enters the wire through the pulley itself. Holes are countersunk into the underside of the wood to accommodate the nuts for the terminal and the collar support so that the whole can be laid flat on the bench.





All dimensions in mm

S.S.S.E.R.C., 103 Broughton Street, Edinburgh, 1. Tel. WAV 2184

Advance Electronics, Ltd., Roebuck Road, Hainault, Ilford, Essex.

Andrew H. Baird Ltd., 33-39 Lothian Street, Edinburgh, 1.

Derritron Instruments, Ltd., Parklands, Cainccross, Stroud, Gloucestershire.

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

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

Philip Harris, Ltd., St. Colme Drive, Dalgety Bay, Fife.

(Heathkit) Daystrom, Ltd., Gloucester, England.

MacFarlane Robson, Ltd., 3A St. Vincent Street, Edinburgh, 3.

John Moncrieff, Ltd., P.O. Box 10, St. Catherines Road, Perth.

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

Mullard Educational Service, Mullard Limited, Mullard House, Torrington Place, London, W.C.1.

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

L. Oertling, Ltd., Cray Valley Works, St. Mary Cray, Orpington, Kent.

Radiospares, Ltd., P.O. Box 268, 4/8 Maple Street, London, W.1.

Teltron, Ltd., 239 Acton Lane, Chiswick, London, W.4.

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