

SCOTTISH SCHOOLS SCIENCE

EQUIPMENT RESEARCH

CENTRE

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Introduction

Miss A. Hetherington has resigned from the Development Committee and has been replaced by Mr. A. Doig, Principal Teacher of Biology, Greenock High School. The place of Mr. A.J. Mee, who retired some time ago, has been taken by Mr. A. Jeffrey, H.M.I.

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The annual meeting of the Scottish Branch of the A.S.E. will take place in the Appleton Tower, Edinburgh University, from 30th March to 2nd April. On the Tuesday and Wednesday of that week we shall show a wide range of apparatus and experiments which have featured in past issues of the Bulletin as well as some still to be published, mainly in our Workshop section. We shall also have a number of government surplus items for sale at the exhibition.

Because the meeting is in Edinburgh this year, we would remind A.S.E. members that the Centre will be open throughout the meeting, and any interested are invited to visit us, although our resources will naturally be somewhat depleted due to the staging of the exhibition in the Appleton Tower. The members' exhibition at the meeting has in the past been a fruitful source of ideas to us and teachers in general, and to encourage members to exhibit we should like to offer the loan of any auxiliary apparatus e.g. power units, signal generators, oscilloscopes, which a member may require to complete his exhibit but which may be bulky or heavy to transport. Members should notify their needs to us as soon as possible.

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We have no confirmed dates for exhibitions after the one mentioned above before the month of June, and it would be possible to squeeze in one or two in the summer term should any authority or group of teachers desire it.

Opinion

A copy of the monthly journal 'Design Engineering' landed on my desk the other day and in the section headed 'Design Ideas' which is presumably informative of new ideas in engineering, I noted an article headed "Dry Ice Moulded on Site Speeds Pipe Repairs." The following is a quote from that article.

The idea of freezing stationary water in pipes to effect repairs to those pipes is not new. However, the early method used solid blocks of carbon dioxide ice, brought to the site and offered up to the area of pipe around the burst or repair. It was then a matter of waiting until the dry ice had frozen a plug of ice inside the pipe sufficient to block the pipe during the repair. This obviously needed a supply of solid blocks of carbon dioxide dry ice to be available and transported to the site of the repair. Also the blocks had to be well insulated for the length of their journey and sufficient quantity and size blocks had to be/

be gauged to last for the duration of the repair. This method obviously had short-comings.

A method has been devised which uses the property of rapid expansion of a liquid to cool itself. This property is the same as is used in compressor type domestic refrigerators.

In this instance the Distillers Company uses liquid carbon dioxide from a 20lb cylinder which is injected into a thermally insulating jacket via a length of Nylaflo, nylon reinforced high pressure hose. The jacket is wrapped round the length of pipe to be frozen, sealed with a velcron sealing strip and the ends are tied firmly to the pipe by nylon cords.

When the valve on the cylinder is opened, liquid carbon dioxide flows through the pipe and through a nozzle into the jacket. The sudden drop in pressure and consequent increase in volume causes a drop in temperature. The solid carbon dioxide is formed when the temperature reaches -78°C (-109°F). This extremely low temperature quickly freezes the water in the pipe forming an ice plug which effectively seals the pipe.

All of which is effectively the same method as is used to generate dry ice for the magnetic pucks experiment in Nuffield physics and which was certainly being used four years ago. If industry has only recently discovered this application, it is interesting to speculate on the reasons for the delay. One would like to believe that an early Nuffield physics pupil in a pilot school retained enough of his school physics to put it to use in his adult job as a plumber, but the real reason is probably the much more prosaic one of independent discovery.

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The Bill to curb inertia selling at present before Parliament prompts me to make a few observations on a kind of inertia selling, perfectly legal and which cannot be limited by statute which exists in the compilation of school science requisitions. While there are still authorities who decree that a school requisition shall be given in toto to a single firm, there are many where teachers have freedom of choice but where they do not all take advantage of this. Instead, some teachers prefer to work their way through the comprehensive catalogue of one of the few major suppliers, not comparing prices or standards of quality with other catalogues. This I would class as inertia buying. It can be defended on the grounds that one order to one firm means less paper work for all concerned with a possible saving in costs.

But the teacher must then be prepared to receive his order in dribbles, initially from the warehouse of the firm of his choice and later, although coming from the same firm, individual items will have been re-ordered from other firms. Avo meters for example, if ordered in Scotland come through their agents Elesco-Fraser. If the meter fails it must be returned to the firm from whom it was ordered, who return it to Elesco-Fraser, all of which wastes time. There may also on occasion be the odd mark-up of prices to be classed as a handling charge. Teachers with freedom of choice but who do not exercise it to the full should talk occasionally to their less fortunate colleagues who complain bitterly of having to accept model X from supplier Y, when they asked for model Z made by manufacturer W.

Chemistry Notes

We recently asked the Scottish Gas Board for a statement on the position regarding the introduction of North Sea gas into Scotland and how this would affect schools. Their reply stated that beginning in April of this year, the first supplies of natural gas will be received in the Borders. Starting with Kelso, the Gas Board expect conversion to natural gas to be completed by September, and that from October to March 1971 conversion will be taking place in the Coatbridge-Airdrie area. All existing bunsen burners in school laboratories will be replaced free of charge by the Gas Board whenever natural gas is introduced into any area. It is not satisfactory to convert an existing bunsen.

For use as a carrier in gas chromatography, the Board believe that natural gas is probably better than town gas because of its more constant composition. A typical analysis of North Sea gas is: methane 95% by volume, ethane 2.9%, nitrogen 1.3%, propane 0.5%, butane 0.2%, pentane 0.1%.

* * * * *

Following representations made by advisers in science, the Development Committee considered the question of standardisation of glassware. A reduction in the sizes and types of glass apparatus should ease the storage problem in schools and one could hope by concentrating demand on standard items that a reduction in price might be possible. The Committee were guided in this exercise to a large extent by work already carried out by the CLEAPSE Development Group and except in one or two cases, all items on our list below are included in the CLEAPSE rationalised list. While we have been concerned to standardise on sizes only, CLEAPSE have further specified the type by giving the British Standard specification number, and we have printed this as a reference for those who could wish to standardise on type. The centre column gives the reference to the item in our Chemistry 512 list where it will be found that we do not always specify a B.S. type.

<u>Item</u>	<u>Size</u>	<u>SSSERC Ref.</u>	<u>CLEAPSE Type</u>
Measuring Cylinder	100cm ³	3	BS604: 1952
Measuring Cylinder	500cm ³	(a)	BS604: 1952
Bulb Pipette	20cm ³	(b)	BS1583: 1961 Class B
Graduated Pipette	10cm ³	107	BS700: 1962 Class B, Type 2
Burette	50cm ³	100	BS846: 1962 Class B
Squat Beaker, Borosilicate Glass	100cm ³	90	None
	250cm ³	90	None
Conical Flask, Borosilicate Glass	500cm ³	90	None
	250cm ³	25	None
Test-tube, rimmed, Borosilicate Glass	50 x 6mm	(c)	None
	125 x 16mm	6 (d)	None
	150 x 25mm	6	None

Filter Tubes	150 x 25mm	20	None
Reagent Bottle	250cm ³	8 (e)	None
Filter Funnel	75mm dia	9	None
Gas Jar	150 x 50mm	21	None
Gas Jar Cover	75mm dia	22	None
Petri Dish	94 x 15mm	35	None
Combustion Tube	125 x 16mm	58	None
Specimen Tube	75 x 25mm	86	None
U-Tube	125 x 15mm	87 (f)	None
Crystallising Dish	100 x 50mm	(g)	None
Watch Glass	50mm dia	(g)	None
Watch Glass	100mm dia	(g)	None

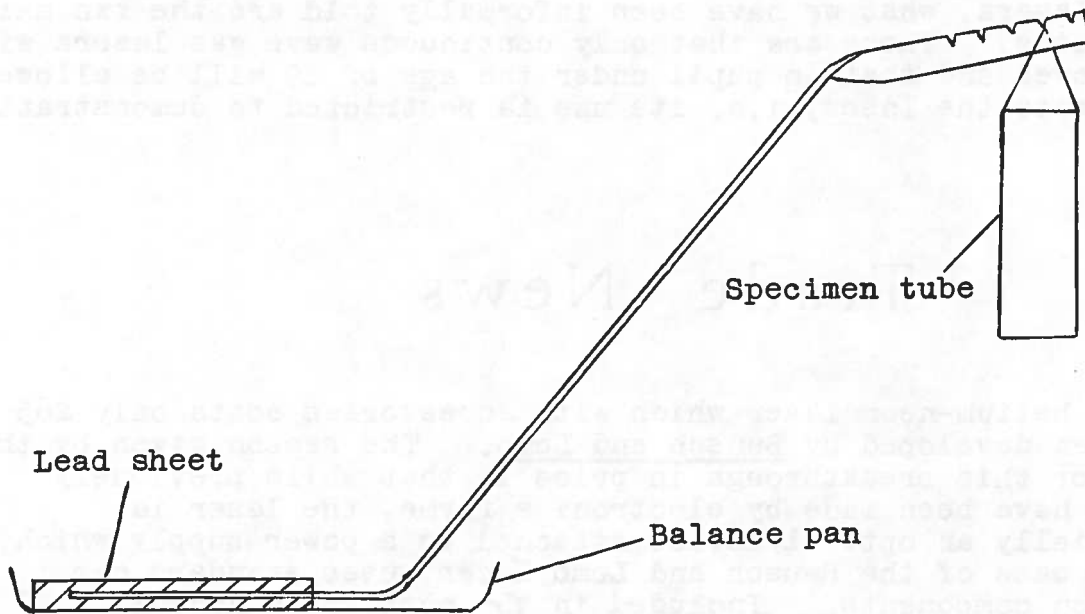
- Notes
- (a) 500cm³ size is recommended in place of the 250cm³ size given in Item 4 on our list.
 - (b) 20cm³ size is recommended in place of the 25cm³ size given in Item 103 on our list.
 - (c) This is an additional size to those given in Item 6 on our list.
 - (d) This single size is recommended in place of the 13mm and 19mm dia sizes given on our list.
 - (e) Narrow mouth type with plastic stopper is recommended.
 - (f) This is a size larger than that recommended on our list.
 - (g) These are additional items which do not feature in our lists but for which the Committee thought there might be a place.

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When gases are collected by air displacement it is necessary to sample the gas to decide if the collecting vessel is full. This can be done by placing the nozzle of a 2ml syringe to the mouth of the vessel and withdrawing a 2ml sample. This can then be tested in the normal way, e.g. ejecting it into an open flame if the gas is combustible, and the method works for both upward and downward collection.

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The evidence for unpaired electrons in an atom has been based on the paramagnetic effect, and is commonly called the Gouy experiment. A solid sample of a paramagnetic salt, e.g. ferrous ammonium sulphate, is placed in a specimen tube and weighed with and without the presence of a magnetic field. The suggestion we give on page 5 is for a support to a specimen tube which will allow a magnetic field to be introduced without interfering with the normal operation of a direct reading or top pan balance.



A length of 15 SWG aluminium strip, 5mm wide is crimped between two lead sheets the shape of which can be tailored to fit the individual balance pan and then bent in a convenient shape so that the specimen tube can be hung on a short length of thread from a notch at the upper end of the strip. Lead sheet or foil can be added to bring the centre of gravity of the support approximately to the centre of the balance pan, testing this roughly by balancing the support on a finger. While the sketch shows the type of support necessary for an enclosed balance with the magnet resting on the bench, a straight, or even a bent down shape can be constructed for a top-pan balance. The mass of our support, complete with an empty 70 x 16mm specimen tube, was 118g.

Physics Notes

In the Trade News section of this Bulletin we give details of a gas laser costing only £65 at which price many schools will want to have one for S.Y.S. Physics projects. Indeed, at the A.S.E. meeting at Lancaster one teacher admitted that he had just ordered one. If a few eyebrows are being raised at the idea that a teacher should have such a facility of purchase, let it be said that he serves in an independent school, many of which still live up to their name.

The point of this note, however, is to warn teachers that the S.E.D. have under preparation and will shortly issue a Code of Practice for the use of lasers in schools intended to safeguard/

safeguard pupils and teachers alike. While we cannot anticipate all the provisions of the code, we can give now for the guidance of those schools - and we know there are some - which are already using lasers, what we have been informally told are the two main provisions. These are that only continuous wave gas lasers will be allowed and that no pupil under the age of 19 will be allowed to operate the laser, i.e. its use is restricted to demonstration.

Trade News

A helium-neon laser which with accessories costs only £65 has been developed by Bausch and Lomb. The reason given by the firm for this breakthrough in price is that while previously lasers have been made by electronics firms, the laser is essentially an optical device attached to a power supply which, in the case of the Bausch and Lomb laser, uses standard car ignition components. Included in the cost are a Ronchi diffraction grating and a sample hologram.

A small and compact magnetic stirrer costing £6 is manufactured by Grant Instruments. The rotation speed is 600 rev/min and the stirrer can be held in an ordinary clamp and used horizontally if required to stir a liquid being heated.

We have always disliked single purpose apparatus as being uneconomic (used only once per year) and wasteful of storage space. For this reason it is good to see a water bath being used to do duty as an egg incubator. Grant Instruments have produced an incubator set which fits their JB2 bath (mentioned in our Chemistry apparatus list) costing £7.10s. While the capacity may be low it could well serve the smaller school and save the cost of a conventional incubator.

Griffin and George have produced a constant current supply unit for coulometric titrations which will supply a continuously adjustable current up to 20mA. For a 5:1 change in load resistance, the current varies by 0.1%. The supply costs £10. A design for a constant current (up to 15mA) supply was published in Bulletin 31.

A series of prepared slides on embryology are available from Mackay and Lynn at prices ranging from 2s.9d. to 4s.6d. each. Among the slides provided are chick embryo at ten days and rat foetus at nineteen days. The same firm informs us that they are sole Scottish agent for Pyser-Britex microscopes.

Baird and Tatlock (formerly W.B. Nicolson) have produced a small ripple tank for pupil use costing £7.2s.6d. The tank itself is a plastic tray with a working surface measuring 24 x 34cm. Two firm wire loops which clip over the ends of the tray form the legs and have the advantage that the tank can be assembled or dismantled in a very short time.

Advance Electronics have ceased production of all their power supplies and of the V1 electro-magnetic vibrator. Alternative sources for the vibration generator are Linstead Electronics, at £8, and Griffin and George at £12.12s.

A new overhead projector from Griffin and George costs £49.18s. A range of accessories for use with the projector for demonstrations which include fluid flow, electrostatic fields and polarisation but so far not for ripple tanks, can also be purchased. The projector can also be up-ended to bring the projection surface vertical when it can be used for projecting test-tube experiments, etc.

A portable fume cupboard which can be wheeled on a trolley from laboratory to laboratory has been designed by CLEAPSE and is being marketed by Scofield and Flexton at £75, or without the trolley at £65. The top of the cupboard has a 'penthouse' mounted in the centre and this carries an acid resistant Ventaxia fan. Fumes from the fan are carried to any convenient window by collapsible tubing which is kept inflated by the fan. The cupboard is not intended for the storage of corrosive chemicals (which applies to the fixed installation cupboard also) but it has the overwhelming advantage of being transparent on all four sides so that at least some of the class have a clear view.

In The Workshop

The design for this ticker-timer was sent to us from Kirkcaldy High School. The coil former is a 40mm length of 20mm dia plastic tube which can be cut from a specimen tube. Two cheeks, 40 x 40mm are cut from 10mm thick softwood, first drilling two holes to take the specimen tube which is glued into them. The coil consists of about 150 turns of 30 SWG enamelled copper wire; a 10cm length of wire at each end is brought out through small holes in one cheek for connection to 4mm terminals. The coil is secured to a baseboard 160 x 110 x 15mm of softwood in the position shown in Fig. 1, using woodscrews which, like all other bolts in the baseboard, are countersunk into the wood.

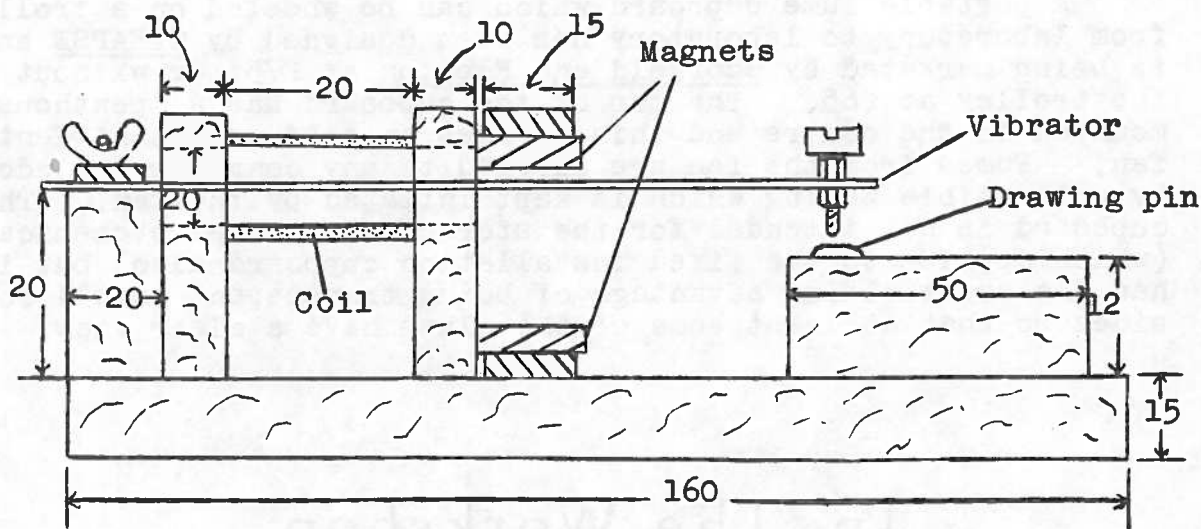
An 11cm length of hacksaw blade, tapered slightly at one end and fitted there with a 6BA bolt, forms the vibrator. At its fixed end the blade is clamped between a piece of mild steel strip, 75 x 15 x 3mm and a softwood block 75 x 20 x 20mm, which is glued to the baseboard. Two long 2BA bolts pass through baseboard and block and are fitted with butterfly nuts to tighten the metal strip down on the hacksaw blade.

The magnetic field is provided by two magnadur magnets from a Westminster kit held by their own attraction on a U-shaped yoke bent up from a length of 3mm x 15mm mild steel strip. This is cemented with Araldite to the baseboard.

The blade is tuned to resonance by applying 4V from a transformer to the coil and altering the blade length, clamping down the butterfly nuts at each change until a large amplitude of vibration is obtained.

The tape support is a softwood block, 40 x 50 x 12mm screwed to the baseboard. A drawing pin is pushed home into the block so that its head forms a firm surface for the "hammer" to strike on/
on/

on, and a staple from a paper stapling machine is tapped into the block on either side to form two tape guides. The end of the 6BA bolt is rounded but not sharpened to a point. The normal carbon disc for printing on the tape is pinned to the block with another drawing pin. As indicated above, 4 - 6V AC will drive the vibrator at mains frequency.



Not to scale; dimensions in mm. Other dimensions are given in the text.

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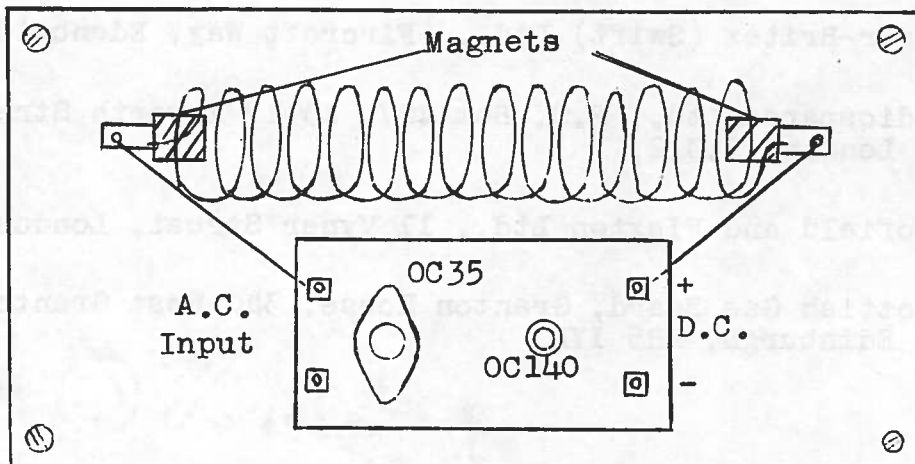
The model described shows resonance in a spiral spring and is constructed for display by an overhead projector. The design was sent to us by the High School of Stirling. A perspex sheet 400 x 200 x 3mm forms the baseboard and is fitted with four cabinet feet from Radiospares. The spring consists of 23 turns of 17 SWG phosphor bronze wire close wound on a 30mm dia wooden dowel which is then stretched on the baseboard between two supporting L-brackets 28cm apart. Brass will do in place of phosphor bronze, and if 17 SWG is not available, a proportionally shorter length of thinner wire would probably serve. Thinner wire will sag more and a shorter coil will be necessary to prevent its fouling the baseboard at the middle. Using a thicker gauge than 17 SWG would prevent the sag, but would reduce the fundamental resonance below 15Hz, which is the lower limit of the signal generators found in most schools.

The spiral ends are soldered into holes drilled in both brackets at a height of 30mm above the baseboard. This is near the top of the spiral, the axis of which is 20mm above the baseboard. Two magnets measuring 24 x 24 x 8mm are held by their own attraction on the brackets so that they are concentric with the spiral. These magnets come from a Carpenter polarised relay (Item 15 of our surplus equipment list) but any other suitably sized/

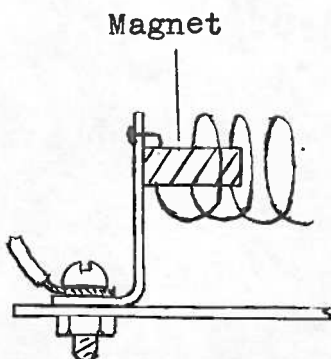
sized magnets would do. With longer bar magnets it may be necessary to cement them permanently to the L-brackets to keep them in position using Araldite.

A current amplifier, the circuit of which is given below, is built on an aluminium sheet measuring 70 x 150mm which is bolted to the perspex sheet using four aluminium pillars as spacers. Aluminium sheet is necessary here because the OC35 power transistor requires a heat sink. Two pairs of 4mm terminals are mounted on the sheet for input and power supply respectively. The two ohm resistor of the diagram is a 70cm length of 22 SWG nichrome wire, wound over a pencil into a coil; the end of this which connects to the OC35 emitter is not soldered directly to the emitter pin of the transistor because nichrome is difficult to solder, requiring a large amount of heat which might damage the transistor. Instead it is soldered to an insulated terminal tag and a copper wire lead used to connect to the emitter. All connections on the circuit, particularly those from the amplifier panel to the spiral, are made in stiff 18 SWG copper wire, as otherwise they might vibrate in resonance with the spring itself. For the same reason the OC140 transistor is pushed into a rubber grommet in a hole in the aluminium sheet. The input required is 4V RMS or greater from a signal generator, preferably but not necessarily from the low output impedance side, i.e. a loudspeaker or vibrator output on e.g. an Advance SG65.

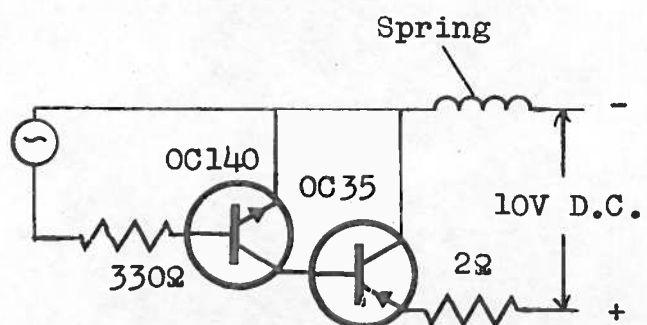
Our own version gave a fundamental resonance at 15.5Hz, and the second harmonic mode was the most easily excited. The response of the spiral is very selective and fine adjustment of the generator frequency control is necessary. The resonant condition is difficult to maintain for more than a few seconds without adjustment because of frequency drift within the signal generator. It was also possible to excite the fourth harmonic mode for brief periods but we failed to establish a third harmonic.



Top view of apparatus.



Bracket detail.



Circuit diagram.

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

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

Avo Ltd., Avocet House, Dover, Kent.

Baird and Tatlock Ltd., Thornliebank Industrial Estate, Glasgow.

Bausch and Lomb Optical Co. Ltd., Aldwych House, Aldwych,
London, W.C.2.

CLEAPSE Development Group, Brunel University, Kingston Lane,
Uxbridge, Middlesex.

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

Grant Instruments Ltd., Barrington, Cambridge.

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

Linstead Electronics Ltd., Roslyn Road, Near Braemar Road,
London, N.15.

Mackay and Lynn Ltd., 30 Marchmont Crescent, Edinburgh,
EH9 1HG.

Pyser-Britex (Swift) Ltd., Fircroft Way, Edenbridge, Kent.

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

Scofield and Flexton Ltd., 11 Vyner Street, London, E.2.

Scottish Gas Board, Granton House, 340 West Granton Road,
Edinburgh, EH5 1YB.