Mainly about Construction

BY "MEGOHM"

A Variometer Crystal Set.

NOVEL CONSTRUCTION

This is a variation from the solenoid method of tuning a crystal set, good volume and compactness being its principal features. Variometer tuning is not particularly selective, but it offers a satisfactory method of getting good volume from the local station with a smooth control equal to that of a tuning condenser at much less cost, though it entails a little more work than the making of a plain solenoid, but those who care for construction will find this an interesting piece of work that with a little care and patience will give good results.

The panel 4½ inches wide by 6 inches high, may be of ebonite or 3-ply, and the base of ⅜in. rimu, is 4½ by 4½ inches. This part of the construction is similar to that of the selective crystal set, only dimensions are all smaller. A cover can be made in the same way.

THE VARIOMETER.

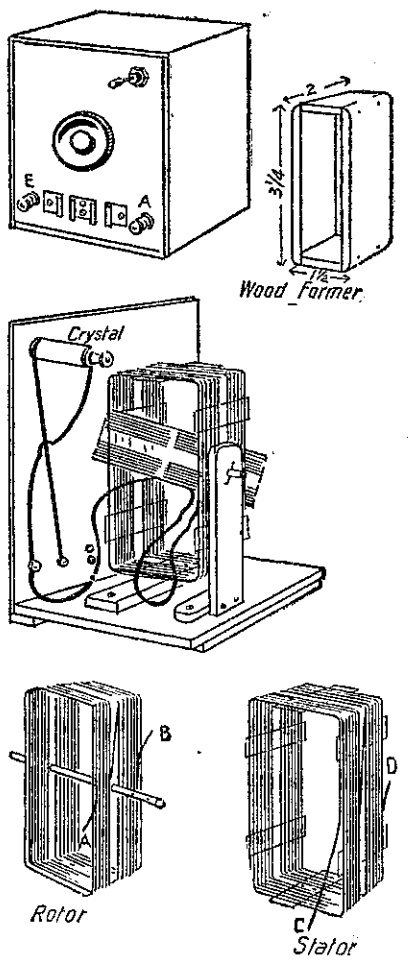
The essential part of this set is the variometer, which consists of two parts, the stator or fixed portion, and the rotor or moving portion, which is provided with a spindle fixed in such a way that the rotor may be turned round within certain limits, inside the stator. Turns of wire are wound upon both the rotor and stator, a space being left in the centre of the windings on each, to clear the spindle.

The first construction is a former for the rotor, and this is made of wood to the dimensions shown, the corners being neatly rounded off. Now a strip of thin celluloid (about 20 mils) is required not less than 11 by 1¾ inches. This is placed round the outside of the former, pulling tight, and overlapping in the centre of one of the long sides. The overlap is cemented with celluloid cement made by dissolving small chips of celluloid in liquid acetone, which may be obtained at the chemist's. The celluloid dissolves in about two hours. A very small bottle may be used, which should be kept corked. The cement is applied with a thin stick. When the joint is made, the whole should be tightly bound with many turns of twine and left a few hours to set.

WINDING THE WIRE.

The lap joint being set solid, the twine is removed and winding proceeded with. The wire recommended is 22's enamelled, but 24's may be used, a turn less being wound upon each of the four groups of winding. A small hole is made at the edge of the celluloid, which should be slid off the former ⅛in. at one side. With this edge to the left, the end of the wire is passed through this hole and turned sharply back to hold during the winding. The turns are now put on in the direction shown in the diagram of rotor, commencing at A and winding in the direction of the arrow. It should here be mentioned that the spindle to be used may be a straight wooden penholder about 4½ inches long and a little over ¼in. thick. Fourteen turns of 22's wire are wound on with the turns close together, then a space equal to the thickness of the spindle is left, the wire crossed over this diagonally, and the winding of 14 more turns proceeded with, the finishing end being cut off with five inches to spare, and temporarily secured with twine. The turns of wire are now to be secured with celluloid cement, especially the outer and inner turns of each group, as these will hold the others. When this work has set, a small amount of cardboard is required. Sixteen-ounce strawboard, about 18 to the inch, will suit. A number of squares of this are cut, 1⅝in. by 1⅞in., to make two lots each ¼in. thick. Two pieces are to be cut 3⅜in. by 1⅜in. The ¼in. lots are placed one at each end of the rotor, resting on the windings, and a single piece is placed at each side over the wires. The whole is now bound together with a couple of turns of twine in the same direction as the windings, but outside the cardboard, the twine to be exactly over the centre of the space between the two windings.

Six pieces of celluloid are now to be cut about 1⅜in. by 2in. One of these is slipped under the twine at each end of the former, and the winding of the



stator proceeded with in exactly the same way as for the rotor, the beginning of the wire being temporarily secured to a small nail driven into the wooden former. Fifteen turns are wound on each side, the space for spindle to be quite free, being left in the centre Now two of the remaining pieces of celluloid are slipped under the twine and windings, one above the position of spindle and one below on each side. The turns of wire are now cemented to each of the celluloid strips and left to set.

Now the formers have to be removed, and the easiest way to do this is to chip away one of the small ends of wooden former with a chisel. Then this will come away and the cardboard packing may be removed. The two parts of the variometer are now separate. The central position of the spindle must now be marked on each side of the rotor, and the holes made to be a tight fit for the spindle. One end of the spindle should now be thinned to fit the knob or dial to be used.

FITTING THE VARIOMETER.

Then the rotor is inserted into the stator with the commencing end A near the end C on stator, and the spindle is pushed into place, through the spaces in the stator and through the celluloid of the rotor. At the same time a washer of cardboard or other suitable material not less than 1-16in. thick is to be put over the spindle to separate rotor and stator at each side to keep them from touching. Two ⅛in. holes for small screws have to be made in the celluloid between the two windings at what is to be the bottom end of stator. Now the whole is stood on a piece of wood ½in. thick on baseboard, and the best working position found and spindle height marked on back of panel for drilling. The back bearing for spindle is now made of wood as shown, the height 3 inches or so, 1 inch wide, screwed to a small cross-piece to screw to baseboard. The back end of spindle is drilled 1-16in. to take a small nail as a cotter on each side of the bearing. When this has all been got into smooth working order, the last part is to get the stator into place so that it allows the rotor to move freely. The stator is screwed to the stand-piece by two ½in. brass screws through the celluloid. It may be necessary to pack the stator up with strips of card, to get the necessary position, and when all is O.K. the stator stand-piece can be screwed into position.

FINAL DETAILS.

Panel arrangements are the same as for previous crystal sets, 28's brass sheet being curled up for telephone clips if terminals are not used. The terminal on the left is the earth connection and that on the right for the aerial.

Ends A and C of variometer windings are connected together by five inches of thin flexible wire, and end B is connected inside to a short piece of the same flexible, which is brought through the rotor and connected to the back of the aerial terminal, which also connects to back or one end of crystal. End D of stator connects to earth terminal, and is continued to connect to 'phoe at that side. Be careful to thoroughly scrape off all enamel from wires where a connection is to be made. Soldered joints are best, using resin-cored solder.

Any type of crystal can be used, but if a cat's-whisker type is preferred it could be placed on the baseboard.

Tuning is accomplished by turning the knob until full volume is obtained. The fewer the turns of wire put on, the lower the wavelength that can be received, but lowering the range in this way cuts off higher wavelengths. The construction allows of turns being easily taken off both sides of stator and rotor if found necessary. The following materials are required, approximate cost being given:—

	s.	d.
½lb. 22's enamelled wire	1	4
Crystal from	1	6
Knob or dial ..... 1s. to	2	3
2 terminals	0	8
Wood, celluloid, brass ...	1	9
	7	6

ANSWERS TO CORRESPONDENTS

CRYSTAL QUERIES.

W.G. (Wellington).—For local reception only, space-winding is not very important, but for distance-getting and selectivity it is of value. Any motor-car trimmer will supply a piece of celluloid for a few pence. The cement is made by dissolving chips of celluloid in liquid acetone, obtained from the chemist's. In crystal double-detector circuits the two crystals should be as much alike as possible. In diagram No. 3 the 001 fixed condenser is probably not essential.

A correspondent at Paraparaumu gets Australian stations faintly upon crystal and two amplifying stages, and wishes to know how the strength of signals may be strengthened. Probably the audio amplifier could be improved by increasing plate voltages and putting a power-valve in the last stage, but the time appears opportune for a valve detector to take the place of the crystal, or the addition of the first two stages of Browning-Drake to make it a real set. It is possible to add an R.F. stage before the crystal, but the better way is as already mentioned.

E.T. (Auckland) wishes to know if a stage of R.F. can be added to crystal and two audio stages. It is quite feasible, but not very widely adopted in New Zealand, as more volume is usually obtained with a valve detector in place of the crystal, and the R.F. valve can be added at the same time or later. The detector would work off the same batteries as the audio.

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Seeking Pure Reproduction

A STUDY IN COMPROMISE

We are all looking for the perfect receiver, except perhaps the few who think they actually possess it. But such a piece of apparatus does not yet exist. There are certainly many good receivers, some of which might be classed as "nearly perfect," judged by our present standard. Yet a broadcast receiver is really after all a study in compromise.

In the first place, the receiver can only at the best reproduce what is sent out by the transmitting station, which primarily decides just what range of frequencies shall be put "over the air." As a rule the broadcast station is capable of sending out a wider range of frequencies than the average receiver and loudspeaker can reproduce. The highest speech frequencies are about 6400 cycles per second, and the highest note of the piano about 4100 cycles. If we arrange that our apparatus shall cut off frequencies above 6400, speech will be as perfectly reproduced as possible, but if we are content to cut off above the highest piano frequencies at 5000, then the final s in speech will be mutilated or lost, but musical notes up to 5000 frequencies will be received. But at these high frequencies the ear begins to be less sensitive, and the tones are weak. It is generally conceded that a cut-off at 5000 will not interfere with the intelligibility of speech.

A similar compromise has to be arrived at on the low musical notes, speech not entering into the question at this end of the scale. The lowest note of the piano is about 27 cycles per second, and the low pipes of organs may give a 32 or a 16-cycle tone. A modern broadcast transmitter will actually transmit a 30-cycle frequency, but few sets will reproduce it.

Generally speaking, it is the low frequencies of the musical scale that at the moment present the most difficult problem. If the detector valve is followed by an audio transformer with a primary winding of inefficient impedance, the lower musical tones will be under-amplified, and the extremely low notes will not be amplified at all. It is then an impossibility for any device in the second stage to replace the lost frequencies, so it is essential to ensure that the output of the first audio valve shall be as near perfect as possible. The following valve must be able to easily handle the volume passed along to it, and if heavy volume is aimed at this must be a super-power valve, or, alternatively, a pair of such valves operating one stage of push-pull, amplification, one of the best means of obtaining distortionless output with transformer coupling. In any case there is a tendency for the lower musical frequencies to be amplified less than the higher. The use of reaction tends to emphasise the lower frequencies.

It is important to make sure that the detector stage of the set is functioning properly. Find the correct values for the grid leak and condenser, and let them both be of the fixed variety by good makers. A fixed grid leak ensures freedom from any trouble likely to arise from variable contacts. A good valve socket is an important item, as much noise, and sometimes distortion, can be caused by a socket giving a poor fit for the valve pins.

An instrument of great value to the serious constructor is a milliammeter. Connected in the plate circuit of the last valve, it indicates the plate current in milliamps, possibly 20, if a super-power valve. If no distortion is present, the meter reading will be quite steady, but if there is distortion, extra current will be drawn in the plate circuit, and the meter needle will "kick" with an amplitude of, perhaps, two or three milliamps. Such a meter is also useful for many other testing purposes.

As has already been pointd out in this column, tone can be to a great extent regulated by careful adjustment of the values of fixed condensers on the audio side, particularly on the first transformer, if so coupled.

When the output of the receiver is heavy it is impossible to obtain good reproduction and satisfactory volume by attempting to pass through the loudspeaker windings the whole output,

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