Electrolytic Condensers

MANY correspondents have at different times made inquiries regarding the construction of electrolytic condensers, and the following details are given for the benefit of those who wish to experiment with such.

The theory of the electrolytic condenser is as follows: When an electrolytic cell consists of an aluminium and a lead plate and a suitable electrolyte is connected to a direct-current line, with the aluminium plate as the positive terminal, a uniform film, without pinholes, is formed over the entire surface of the aluminium plate. This film is a very good insulator and reduces the direct current almost to zero. In this case there is no leakage current caused by sparking as happens when the cell is used for rectifying purposes. The small leakage current at the point where the aluminium electrode leaves the solution can be reduced to an almost negligible amount by carefully insulating the aluminium plate where it enters the liquid. A cell of this type forms a very good high-capacity condenser, with the gaseous film acting as the dielectric.

This condenser is limited to a certain voltage at which the film breaks down, allowing current to flow again until a new film is formed. Because of this fact, the electrolytic condenser is not injured by breakdown, since it takes only a short time to form a new film. Various electrolytes have different critical voltages, and for high-voltage work some are more suitable than others. The critical voltages of some of the common electrolytes are as follow:—

Sodium sulphate, 40; potassium permanganate, 112; ammonium chromate, 122; potassium cyanide, 295; ammonium bicarbonate, 425; solium silicate, 445; ammonium phosphate, 460; ammonium citrate, 470; sodium biburate ("borax"), 480.

The critical voltage is approximately correct when aluminium plates and the electrolyte formed by a 1 per cent. solution of one of the respective chemicals shown above are used. The approximate capacity obtained per square inch of condenser plates depends upon the formation voltage.

Condensers for Direct Current.

THE construction of a condenser which may be used for "B" power units can be accomplished as follows:

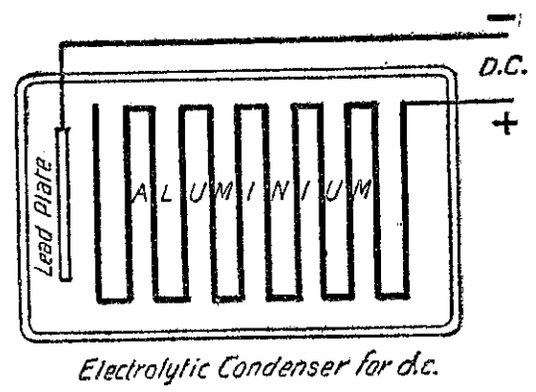
A piece of extra pure aluminium sheet about six inches wide should be cut. The length of this aluminium sheet depends upon the capacity of the condenser and the size of the container. It should be bent back and forth as shown in Fig. 1. A lug should be left on the end of the plate, so that a contact can be easily made to this plate. The lug should be bent upwards and provided with a tight-fitting rubber tube generously covered with vaseline, to prevent sparking at the point where it leaves the solution. This lug can be cut as shown in the diagram, so that it will not be necessary to waste very much material in order to get this connection.

"Forming" the Plates.

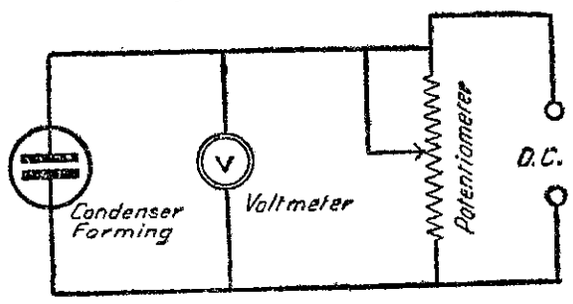
THERE are two types of electrolytic condensers, one for use with alternating and the other for direct current. Where a rectifier is included in the circuit, direct current is being dealt with, for although it is pulsating before it is smoothed, it is one-way only.

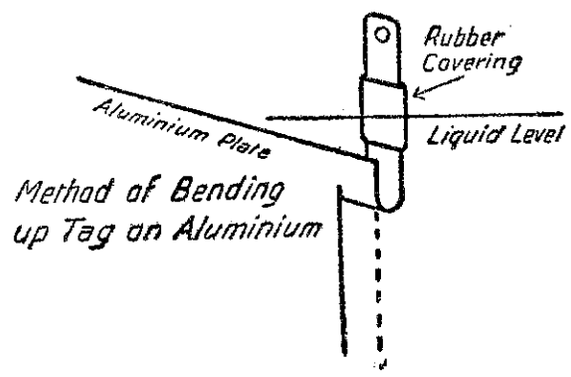
The d.c. type, which is the one under consideration, contains one set of aluminium plates and a lead plate. The lead plate serves only to make an electrical contact with the electrolyte, and should always be used as the negative terminal. This is the type of condenser to be used in "B" power units and other circuits supplied with direct current. An ordinary glass Leclanche battery-jar or a large mason jar can be used as a container; although if the latter is employed it may be necessary to have more than one cell in order to obtain sufficient capacity for the circuit. When used in "B" power units, these condensers must be "formed" with voltages higher than the output voltage of the rectifier tube, so that the condenser will not break down. Because of this, the capacity obtained is not as great as that of a condenser used for low-voltage work.

To "form" the plates of the condenser, it should be placed across a direct current supply of suitable voltage—higher than that in which it is to be used, and should be left in the current for about 24 hours. A forming voltage should be applied which is somewhat above the maximum voltage that is to be applied to the condenser.



Electrolytic Condenser for d.c.





Method of Bending up Tag on Aluminium

When low-voltage condensers are to be made, a system such as the one shown in Fig. 2 should be used. The potentiometer should have rather high resistance and be capable of dissipating the heat generated through its resistance strip.

Probably the most common electrolyte used is sodium biborate, or borax, as it is commonly called, though ammonium phosphate is on the whole more reliable. A saturated solution of the chemical should be made and a small amount of glycerine should be added.

One of the main reasons why chemical condensers and rectifiers have not become more popular is because of the sloppiness and the necessity of renewing the water in the solution. At different times experiments have been made with a number of so-called "jelly" electrolytes, including fused sodium phosphate and several other chemicals. However, these jelly rectifiers have not been successful because, as the water evaporates, the jelly falls away from the electrodes, thus stopping the action.

The zig-zag plates are bent so that there is a space of about 3-16 in between each adjacent surface.

Another Low-Voltage Type.

THERE is another type of electrolytic condenser that is used for A elimination, but only the following particulars are to hand regarding them. These have a capacity of several hundred thousand microfarads, obtained by virtue of the usual arrangement of nickel and steel plates immersed in a non-acid caustic solution which constitutes the condenser. The plates form one side of the condenser, and the solution the other. When an electric current is passed through the unit, films of hydrogen and oxygen form over the entire surface of the plates. This film is infinitesimally thin and forms the dielectric of the condensers.

Because a condenser increases in capacity as the thickness of the dielectric decreases, this extremely thin film is entirely responsible for the tremendous capacity obtained. It is necessary to use a two-stage filter, using a choke coil and the two large condensers, which smooth and filter the pulsating direct current, changing it to pure, hum-free direct current necessary for "A" power.

The alternating compound of the pulsating direct current is reduced to less than one three-thousandth of its original value. This is far below the point of audibility, and cannot be detected with headphones, even when the output is passed through a 210-type power amplifier.