ELECTROLYTIC CAPACITORS
100 AND 101 TYPES
DESCRIPTION

1. GENERAL

1.01 This section covers electrolytic capacitors used in various telephone power plants for filtering electrical noise from telephone circuits.

1.02 An electrolytic capacitor is composed of two groups of thin aluminum plates, suspended from a non-conducting porcelain cover, in a glass containing vessel filled with a clear, colorless fluid known as capacitor solution. The plates of opposite polarity of the 101-A and 101-B types are insulated from each other by means of their method of suspension from the porcelain cover and in the later models by porcelain block spacers. A layer of mineral oil is used on the surface of the capacitor fluid to prevent excessive evaporation and creepage of the fluid up the surface of the plate supports and sides of the container.

1.03 The electrolytic capacitors are made in a number of types or sizes with the characteristics shown in Table I.

1.04 An electrolytic capacitor is made up of the combination of the following:

Capacitor Element (Assembly of Aluminum plates Including Porcelain Spacers)
Capacitor Fluid
Container (Glass Jar)
Cover (Porcelain)
Oil

TABLE I

Operating Characteristics of Electrolytic Capacitors

Effective Capacity of Microfarads and Effective Resistance in Ohms at 75° F. for Various Frequencies at Maximum Nominal Voltage*

	D-C. VOLTS	A-C. CAP.	60		400		1000		2000	
TYPE	RANGE	AMP.	CAP.	RES.	CAP.	RES.	CAP.	RES.	CAP.	RES.
100-A	18-33	3.5	1350	.25	1100	.18	960	.16	800	.15
100-B	33-75	3.5	685	.26	620	.20	600	.19	570	.18
100-C	0-18	3.5	2300	.11	2100	.04	2100	.035	2100	.034
100-D	75-150	3.5	350	.40	325	.32	315	.29	305	.27
101-A	0-33	0.5	63	6.0	48	2.3	45	1.8	41	1.6
101-B	33-53	0.5	33	6.0	29	2.0	28	1.8	27	1.7

* The above values are approximate and were measured on capacitors using the filling units usually furnished, i.e., No. 1-A (indoor) on Types 100-A, 100-B and 100-C, No. 2-A (indoor) on Types 101-A and 101-B, No. 1-B (outdoor) on Type 100-C capacitor. Interchange of filling units will affect the values somewhat but the above values will probably be close enough for most purposes.

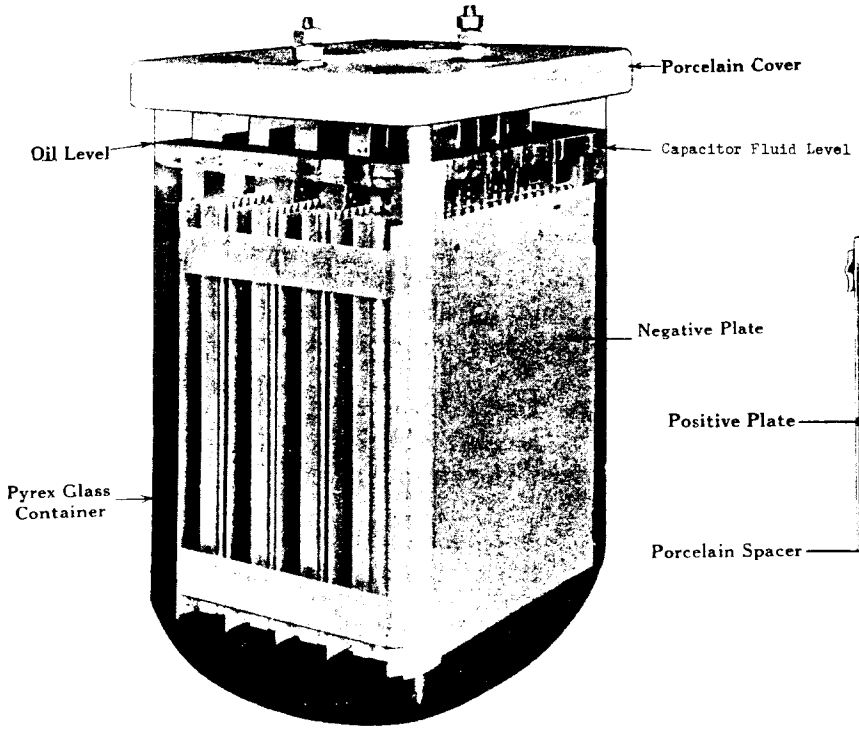

Fig. 1 – 100 Type Electrolytic Capacitor Assembly

Fig. 2 – 100 Type Capacitor Element Mounted on Cover

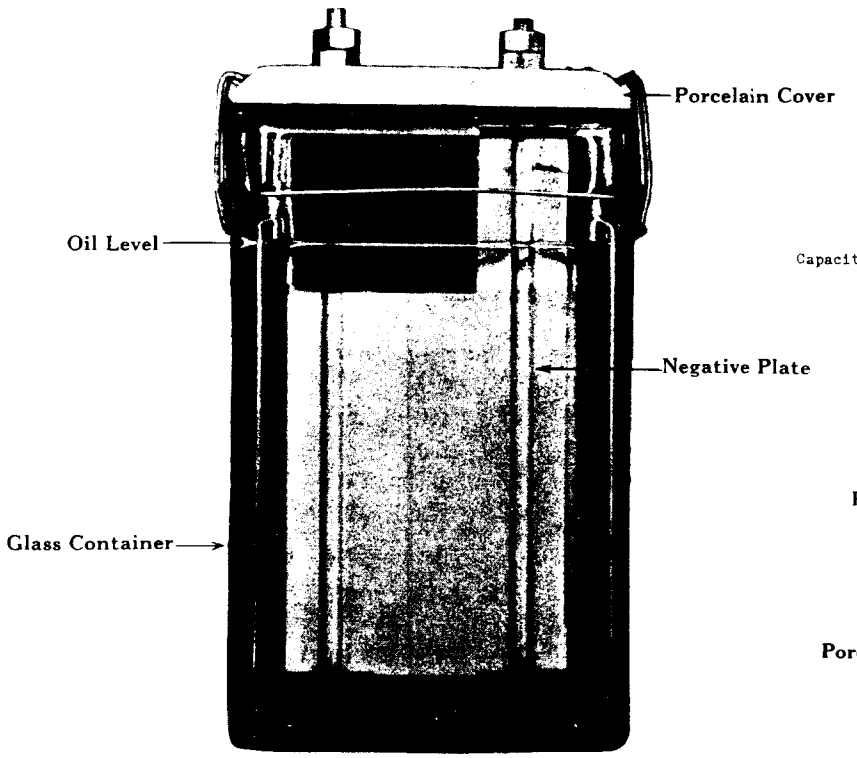

Fig. 3 – 101 Type Electrolytic Capacitor Assembly, Side View

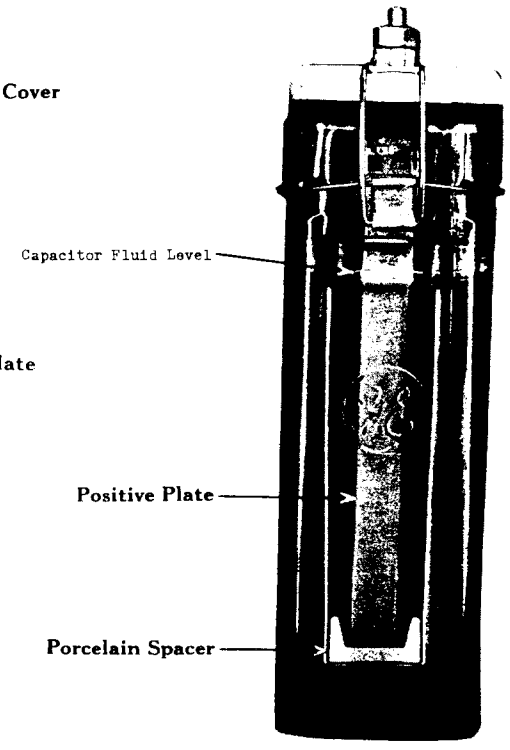

Fig. 4 – 101 Type Electrolytic Capacitor Assembly, End View

2. DESCRIPTION OF APPARATUS

Capacitor Element

2.01 The capacitor element comprises a set of aluminum plates rigidly supported and spaced. The positive plates are corrugated in order to afford as large a surface as possible, and are the plates upon which the thin film acting as a dielectric is formed. The negative plates are flat and serve only as a means of passing current from the condenser solution. Each group of plates is connected in multiple and the group is connected to its associated terminal.

2.02 The plates are made of specially treated aluminum and to insure satisfactory operation should be protected during handling to prevent any injury to the film formed on the positive plates or contamination of the plates, capacitor fluid or inside of the capacitor container. The plates should not be touched by the hands or anything except the clean glassine packing paper at any time.

2.03 Although the assembly is rigid and under normal conditions will prevent short-circuits between the positive and negative plates, white porcelain spacers are furnished in the 101 type and late units of the 100 type capacitors as an added feature to avoid the possibility of a short-circuit by preventing the positive plate from falling against the negative in case some of the supporting straps are destroyed by corrosion. Should corrosion occur, the products are non-conducting and have a negligible effect on the functioning of the capacitor.

Capacitor Fluid

2.04 The capacitor fluid is a weak alkaline solution, clear and colorless in its original state. The fluid of the No. 1-B filling unit may have an amber tint. It is non-combustible and will not injure the skin or clothing.

2.05 Once installed the capacitor requires practically no attention over an extended period. The fluid level will fall only a negligible amount because the decomposition of the solution is at a very slow rate and evaporation is prevented by the layer of oil and the sealed cover. The fluid in operating capacitors should ordinarily remain satisfactory for the life of the capacitor with no attention other than routine inspection, the time varying greatly with the average temperature at which the cell operates. A range of 40° F. to 105° F. is permissible and will not normally be exceeded in power plant equipment or battery rooms. A longer life will, however, be obtained at lower temperatures such as 80° F. When the capacitor fluid has been in service for a period of time it may turn milky-white, or even form a white, jelly-like precipitate in the bottom of the container. This does not harm the capacitor, even though it comes in contact with the plates of opposite polarity as the precipitate is of very high resistance, and as long as it does not heat up, it may be kept in service.

2.06 Capacitor fluid is furnished in a capacitor filling unit consisting of a glass jar holding sufficient fluid to rinse the capacitor parts and fill to the required height, together with certain accessories. The No. 1-A and No. 1-B filling units each provide 3 gallons of fluid, one pint of oil, one aluminum funnel, one cork and one copy of an instruction sheet. The No. 2-A filling unit provides 1 quart of fluid, 1/8 pint of oil and one copy of an instruction sheet. No. 1-A filling units for 100-A and 100-B and the No. 2-A filling unit for the 101 type capacitors are used where temperatures lower than 32° F. will not be encountered. The No. 1-B filling unit must be used where temperatures lower than 32° F. will be encountered. The solution provided in the No. 1-B filling unit starts to freeze at a temperature of approximately 23° F. When subjected to temperatures of this order the salts in solution begin to separate and form a crystalline deposit in the bottom of the container. The fluid is such, however, that even at much lower temperatures it still remains in a slushy state. Even at very low temperatures such as −30° F. it does not freeze solid enough to injure the fluid, container or capacitor elements. Under freezing conditions, however, the capacitor capacity decreases rapidly and the equivalent series resistance rises rapidly. The capacitance of the 100-C capacitor, for example, at 12° F. is about one-half and at 0° F. is about one-fourth that at 30° F., while at −30° F. it is one-fortieth that at 30° F. The equivalent series resistance is over three times at 0° F. and is forty times at −22° F., compared with the value at 30° F.

This reduction in effectiveness, however, exists only during the period of low temperature, the characteristics becoming normal again after the capacitor is warmed up. If it is observed that the ingredients of the fluid are not thoroughly dissolved when received, vigorous shaking will restore it to the normal condition.

Container

2.07 The containing vessels for electrolytic capacitors are rectangular glass jars which are mounted on wall racks or cabinets. The containers for 100 type capacitors have a black rectangle painted on one side and those for the 101 type capacitors have a raised level line to indicate the proper height for the capacitor fluid. Containers for the 101 type capacitors are provided with a wire clamping device to facilitate sealing the cover to the container.

2.08 Pyrex glass is used in the 100 type container to reduce breakage by avoiding expansion and contraction strain, which is often present to a great extent in ordinary glass. Ordinary glass is used in the 101 type container which requires only a small jar.

Cover

2.09 The jar has a white porcelain cover to which are rigidly attached the capacitor elements and terminals. The cover has a wide groove in its underside, which in the 100 type capacitor is partially filled with paraffin, while the 101 type capacitor is provided with a paraffin impregnated pressed cork gasket which maintains a practically air-tight seal for the capacitor. The polarity of each terminal is indicated by an indented symbol in the surface of the cover which also carries the type designation. The cover is provided with a small filling hole and cork stopper in the 100 type capacitor. This permits the placing of the mineral oil layer on top of the capacitor fluid after the capacitor has been assembled and the fluid has been added without removing the cover. The very low rate at which gas is generated by electrolysis makes it possible to provide these relatively tight seals which prevent entrance of foreign bodies with resulting contamination of the fluid.

Oil

2.10 A layer of pure mineral oil is poured on top of the capacitor fluid after the capacitor has been assembled and the fluid has been added to prevent evaporation and creepage of the fluid up the surfaces of the electrode supports and the sides of the jar.

3. THEORY OF OPERATION

3.01 The capacitor derives it high capacitance from a thin dielectric film which is formed electro-chemically on the positive (corrugated) plates. The negative (flat) plates serve only as a means of passing current from the capacitor fluid. If the capacitor is subjected to d-c. potential and is not poled correctly large direct currents may flow and the capacitor will act like a liquid rheostat. If this action continues, a film may be formed on the negative plates and the effective capacitance of the capacitor thereby reduced until reformed in the proper direction. If it is necessary to allow the capacitor to stand off circuit for some time such as for a day or more, the film will start to dissolve, and it is advisable when reconnecting the unit to use a series resistance to avoid the possibility of heavy current.

3.02 Capacitors may be connected in series in circuits having potentials higher than the rated d-c. voltage for a single capacitor provided a resistance is connected in parallel with each capacitor to equalize the voltage drop across each unit. When connected in series the voltage across each capacitor must not exceed its rated maximum since this will thicken the dielectric film and reduce the capacity.