Oil Immersed Current Limiting Reactors

INSTRUCTIONS

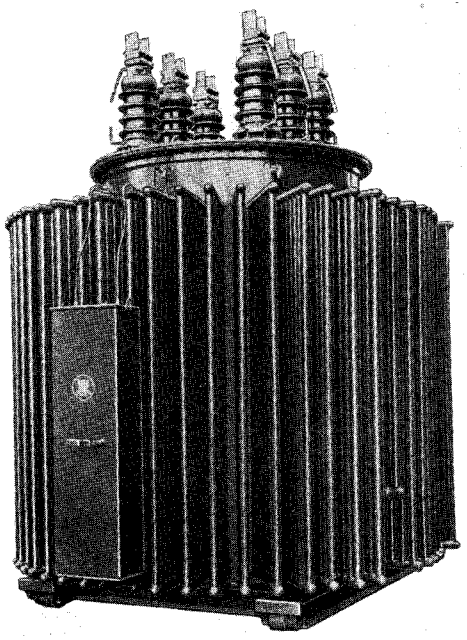

FIG. 1

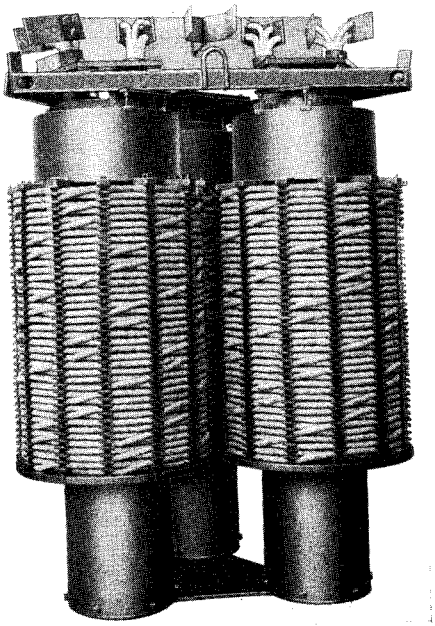

FIG. 2

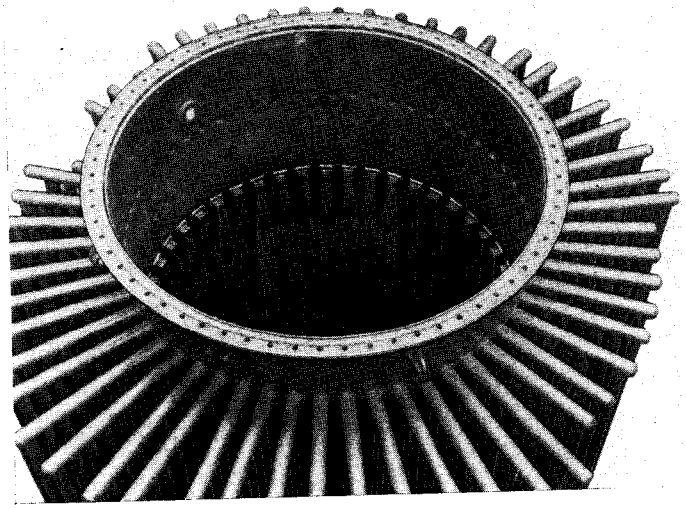

FIG. 3

GENERAL

Fig. 1 shows a typical oil immersed three phase Type CL reactor as it appears after being set up. Fig. 2 shows typical coil construction for cable wound coils. Where current is low enough to permit strap conductors, coils are same as circular transformer coils. Fig. 3 shows how the magnetic shield is distributed about the tank wall. When shipping clearances permit, reactors are shipped with bushings and fittings in place. All bushings on standard reactors are brought through the cover. Condenser or bulk type bushings are supplied depending on the voltage class. For detailed description of bushings, see Instruction Leaflet for bushings.

The type of cooling supplied with any reactor depends on the Kv-a rating and customer's special requirements. Tubular coolers, tubes, fin coolers or radiators are commonly used.

Standard fittings are supplied and standard location is followed except as modified by special requirements. The drain valve is located at the bottom of the tank on a centerline through the phase bushings. The sampling valve is located to the right of centerline; the

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lower filter press valve near the bottom of the tank and to the left of the drain valve.

The upper filter press valve supplied on all reactors is located to the left of the front centerline and slightly below the oil level, unless the reactor is equipped with an expansion tank. The upper filter press valve is then located on the expansion tank. See Instruction Leaflet on expansion tank. Large reactors are supplied with an intermediate filter press valve, located on the side opposite the drain valve, approximately one-foot above the bottom of the tank.

The oil gauge is located on the centerline near the top of the tank. The diagram nameplate is located at eye level on the centerline. The dial type thermometer is located below the nameplate on large reactors. For small reactors the dial type thermometer is located near the oil level since a direct connection through the tank wall is provided. For instructions covering dial type thermometer, see Instruction Leaflet for thermometers.

Fittings found on the cover of oil reactors are a pressure relief device, and a thermometer connection. For description of relief device, see Instruction Leaflet on relief devices.

Certain special fittings are supplied with reactors, depending on the Kv-a. rating. Reactors 1000 Kv-a. and below are Sealedaire construction, above 1000 Kv-a. they are supplied with Inertaire equipment. Another special fitting is the hot spot thermometer furnished when ordered special by customer. Its location is on front of tank to the left of the centerline. See Instruction Leaflet describing hot spot thermometer furnished with all reactors having this special fitting. Hot spot indicators may be supplied with switchboard connection. In this case, consult Instruction Leaflet describing switchboard type hot spot indicator.

SHIPMENT

Methods of Shipment

The method used in a particular case depends upon the size of the reactor, type of case, transportation facilities from factory to destination and convenience in installing. The methods commonly used are:

1. Shipment in oil.
   (a) Assembled in own case.
   (b) Assembled in special shipping tank.
2. Shipment in dry nitrogen.
   (a) Assembled in own case.
   (b) Assembled in special shipping tank.
3. Shipment without oil in air.
   (a) Assembled in own case.
   (b) Assembled in special shipping tank.
4. Boxed and shipped separately from own case.

Reactors are generally shipped by method 1(a) unless shipping clearances prevent.

Reactors equipped with radiators are usually shipped by method No. 1(a) or 2(a), but with some or all of the radiators removed. The radiator flanges on the tank are covered by blind flanges or by radiator valves and blind flanges. The detached radiators are always crated and shipped separately.

When radiator valves are used it is unnecessary to drain the oil from the tank to install the radiators. See Leaflet on radiator valves.

When method No. 2, 3 or 4 is used the oil is shipped in tightly sealed metal drims or tank cars.

Reactors which are too high to ship standing up may sometimes be shipped by methods No. 2 or 3 by laying them down on the car. In such cases special bracing is placed inside the tank. This bracing must be removed when the reactor is installed, unless specified otherwise on the outline drawings.

On the larger reactors the bushings are always shipped separately. The openings in the cover or tank walls are covered with blind flanges. The bushings and all details such as thermometer, oil gauges, hot spot temperature equipment, Inertaire or expansion tanks are always boxed separately and are to be mounted when the reactors are installed.

When methods No. 1 and 2 are not practicable, reactors may be shipped without oil as in method No. 3, sealed with atmospheric air in its own case or in a shipping tank.

With methods No. 1 and 2, it is frequently necessary with large reactors to have a joint in the tank so that the top section may be removed for shipment. Either the regular cover or a special shipping cover is bolted on the top of the lower section of the tank. If a special cover is used it is sometimes a box-like structure which makes room for terminal boards, etc., which extend beyond the top of the lower section of the tank. If shipped in oil, care must be taken to lower the oil to a point below the joint before removing this cover.

UNPACKING

Reactors Shipped With Oil or in Air

When shipped assembled either with or without oil, unpacking is a simple matter. The crating or bracing should be removed and the reactor is then ready for setting in place.

When shipped separate from the case, the reactor should not be unboxed until preparations have been made for drying out or until the case is in place ready to receive it. It should not be opened until the temperature of the reactor is the same as or higher than the air temperature.

During the time that the boxed reactor is stored, it must be kept in a dry place and not allowed to stand where it is exposed to dampness or weather.

All boxes containing accessories must be stored carefully and thoroughly protected against moisture.

When the reactor is unpacked it should be examined carefully to ascertain whether it has been damaged in shipment and whether all parts are in place and in good condition.

INSTALLATION

Location

Accessibility, ventilation and ease of inspection should be given careful consideration in locating reactors. Indoor reactors must be located so that water cannot fall on the case or rain blow into or upon them.

Self-cooled reactors depend entirely upon the surrounding air for carrying away their heat. Therefore, care must be taken to provide adequate ventilating facilities.

For indoor installation the room in which the reactors are placed must be well ventilated so that heated air can escape readily and be replaced by cool air from the outside. If the room is poorly ventilated this exchange of air takes place too slowly and the temperature of the air in the room may become excessively high. At any given load the

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temperature rise of a self-cooled reactor will be a fixed number of degrees above the temperature of the surrounding air. The temperature of the reactor is the sum of the rise and the air temperature; therefore, care must be taken to provide a room sufficiently well ventilated to permit operation of the reactor at a reasonable temperature. The ambient temperature should not exceed 40°C.

Self-cooled reactors should always be well separated from one another and from adjacent walls, partitions, etc., in order to permit free air circulation about the cases. This separation should be 24 to 36 inches, depending on the size of the units.

Fire Risk

While the oil supplied with Westinghouse reactors will not take fire readily, it should be remembered that the possibility of catching fire is ever present and some precaution against fires should be taken. Reactors may be placed on a concrete floor surrounded by a ledge. Suitable means should be provided for drawing off the oil and extingushing the fire.

REACTORS

Caution

Care must be taken in handling and installing reactors particularly those wound for high voltage. As moisture is an enemy of insulation, a reactor should not be allowed to stand so that it can absorb moisture from the air or from any other source. A blow upon any part of the winding, stray pieces of solder or wire, tools, nuts, or foreign matter of any kind dropped into the reactor may cause a breakdown or burnout.

Setting Up

Where a reactor cannot be handled by a crane, it may be skidded or moved on rollers into place but in doing so care must be taken that it is not tripped over. A reactor with a round base is easily tripped over and should preferably be bolted to a temporary wooden frame or base before moving.

For convenience of handling, all cases are provided with lifting hooks or eyes, by means of which the case, reactor and oil may be lifted and handled as a unit Jack lugs are also provided on the base or tank wall for lifting the complete unit. Do not use jacks on any part of the reactor except lugs provided for this purpose.

Before being set up, a reactor should be inspected for breakage, injury, or displacement of parts, during shipment. It should then be tested for dryness and the condition of the oil should be determined.

An outline drawing is furnished showing the relative location of all fittings and this should be followed in setting up. The outline drawing will also list special features requiring attention during installation.

Precaution

When working about a reactor particular care must be taken in handling all tools and other loose articles, since material dropped into the windings and allowed to remain may cause a breakdown.

When a reactor has been shipped in its case with the oil, it should be inspected for breakage, injury or displacement of parts during shipment. This can generally be done without removing any of the oil. A sample of oil should be drawn from the bottom of case and tested. If the inspection and oil tests are satisfactory, the reactor is ready to be put into service. If the oil tests too low, it will have to be filtered and it may also be necessary to dry out the reactor. Whether drying will be necessary can be determined by the Megger test.

In condenser type bushings, the lead is sometimes drawn up through the central tube by means of a piece of string or twine and fastened at the top. Be sure that all bushings and terminals are screwed up tightly so they cannot work loose. When shipped separately the lead is coiled inside the tank and tied to a hook on the under side of the cover.

PLACING IN SERVICE

Operation

General—After a reactor has been set up, full voltage should not be applied to the winding for several hours after the oil has been put in the case. This time is necessary to allow the air bubbles to escape. This is particularly important for line voltages of 88,000 volts and above.

Filing under a vacuum is recommended for large high voltage reactors. For procedure in such cases refer to the manufacturer.

When the voltage is first applied to the reactor, it should, if possible, be brought up slowly to its full value so that any wrong connection or other trouble may be disclosed before damage can result. After full voltage has been applied successfully, the reactor should be operated preferably in that way for a few hours, without load. It should be kept under observation during this time and also during the first few hours that it delivers load. After four or five days' service it is advisable to test the oil again for moisture.

MAINTENANCE

Inspection

Reactors require less care and attention than almost any other kind of electrical power apparatus. This, however, is not a reason for neglecting them. The conditions under which they operate will determine to some extent the frequency with which they should be inspected. A regular program of inspection should be established and rigidly carried out.

The oil should be tested for dielectric strength and the presence of sludge. If there is an indication of moisture or sludge formation, the oil should be tested further and treated as described in Instruction Book on care of oil. If tests show the oil to be in bad condition an inspection should be made on the inside of the tank for possible cause of the trouble. However, if the oil tests satisfactorily the case should not be opened but a careful inspection of all accessories should be made to see that they are functioning properly. Reactors equipped with the Inertaire device cannot have sludge formation since oxygen is excluded. The record of nitrogen gas consumption should be studied and if excessive the case should be tested for leaks as described on the Inertaire nameplate.

Any increase in operating temperature at normal load should be investigated and if the cause cannot be determined the reactor should be taken out of service and given a thorough inspection.

Any symptoms such as unusual noises, high or low oil levels, rupturing

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of relief diaphragm, etc. should be investigated at once.

Reactors which have been subjected to unusually severe operating conditions such as overloads, frequent short circuits, etc. should be inspected internally at least once a year. This can usually be done adequately by lowering the oil level and inspecting with a light through the manhole.

OIL

The oil used with Westinghouse reactors should be that which is supplied with them or an oil specifically approved by the Corporation. Westinghouse transformer oil is shipped either in the case with the reactor, in tank cars or in steel drums provided with screw bungs, which are sealed before shipment. All oil should be carefully inspected and tested before using. For methods of handling and testing oil, see Instruction Book on this subject.

TEMPERATURE READINGS

Oil-immersed, self-cooled reactors or oil-immersed forced air-cooled reactors should not be operated for long periods of time at oil temperatures in excess of 80°C. on account of increased rate of deterioration of the insulations. The oil temperature in these reactors should not be allowed to exceed 90°C. even for short periods of time.

RENEWAL PARTS

It is recommended that a spare set of bushing and handhole gaskets be carried in stock. Other spare parts described in individual leaflets may be carried, if desired.

In writing with reference to any reactor always give full nameplate reading, as this furnishes accurate information for identification.

SERVICE DEPARTMENT

The Corporation maintains a Service Department for the purpose of giving service to customers. It is recommended that questions of installations, operation or maintenance which are not covered in this instruction book, be taken up with the nearest Service Department or Sales Office.

Westinghouse Electric Corporation
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