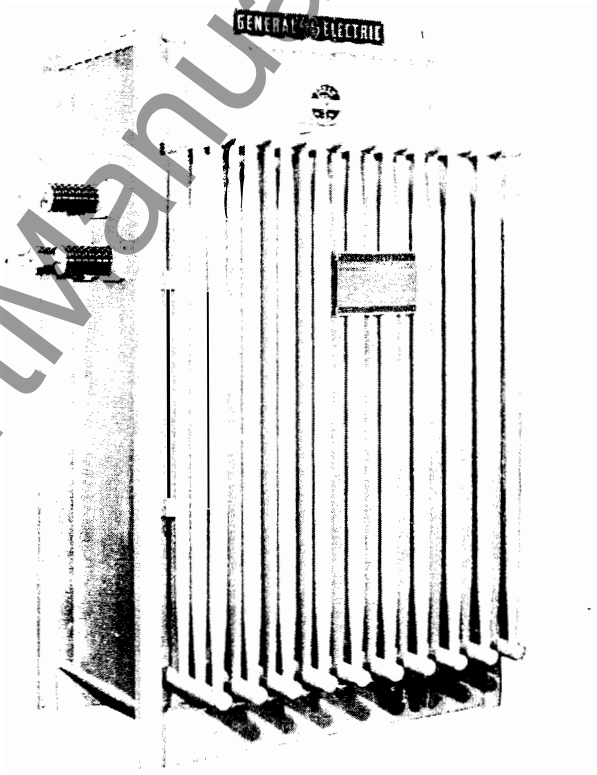
INSTRUCTIONS

GEI-32191C

UNIT-SUBSTATION TRANSFORMERS



PYRANOL® IMMERSED

GENERAL ELECTRIC

UNIT-SUBSTATION TRANSFORMERS

PYRANOL* IMMERSED

CONTENTS

INTRODUCTION

PYRANOL

Briefly, Pyranol is a cooling and insulating liquid which is noninflammable, chemically stable, and nonsludging. Supplied for use in transformers, it is straw-yellow in color and has a Saybolt viscosity of about 54 seconds at 37.8 C (100 F).

Mineral oil is completely miscible in transformer Pyranol and affects its noninflammable characteristics. Since it is practically impossible to separate the two liquids after they have been mixed, it is important that contamination with any petroleum oils be avoided.

Materials which are not soluble in Pyranol have been selected for use in constructing Pyranol transformers. Therefore, no materials should be used in contact with transformer Pyranol except those approved by the General Electric Company.

RECEIVING, HANDLING, AND STORAGE

RECEIVING

Immediately upon receipt of the equipment, examine the packages and parts for any damage that might have been sustained in transit. Inspect the lead seals which were used to seal the valves at the base of the tank. They should be unbroken when the transformer is received. Tighten any parts which may have

*Registered trade-mark for G-E askarel.

worked loose, such as nuts and leads. Check the materials with the shipping memorandum for possible shortage. If injury or rough handling is evident, file a damage claim with the transportation company immediately, and notify the nearest General Electric Apparatus Sales Office promptly.

If a transformer must be opened for inspection outdoors on a damp or stormy day, take proper precautions to prevent the entrance of moisture.

Pyranol unit-substation transformers are pressure-tight and are normally shipped completely assembled in their tanks, filled with Pyranol and ready to be installed.

HANDLING

Lugs are provided for lifting the complete transformer, and where necessary, additional nuts and eyes are supplied for lifting the various parts. Lift the transformer by means of the lugs located on the side of the tank, and use proper spreaders to obtain a vertical lift. The cover of the transformer should be securely bolted in place, when lifting, to prevent buckling of the tank wall.

Jacking space is provided in the base of the transformer to facilitate lifting by means of jacks. The transformer must never be moved or lifted by placing jacks or tackle under the drain valves, radiator connections, or other attachments.

If the transformer is supplied with removable junction boxes, the boxes may be detached to facilitate moving the unit through restricted passages.

STORAGE

Before storing a transformer, check it to see that the Pyranol is at the proper level. Also store renewal coils and insulation under Pyranol in a container that can be sealed from the air. The storage room should be clean and dry, and when possible, without extreme temperature changes. Before a transformer is placed in service from storage, instructions given under "Inspection" should be observed, particularly with regard to moisture.

INSTALLATION

FOUNDATION

The only foundation necessary for the installation of a unit-substation transformer is a level floor strong enough to support the weight.

INSPECTION

If the dielectric strength of the Pyranol, before placing in service, is below 30 kv, filter the Pyranol in accordance with the section on "Filtering and Drying Pyranol." In service, if the dielectric strength gets as low as 25 kv, filter the Pyranol.

If the dielectric strength is very low, or if there is evidence of free water, dry the core and coils as indicated under "Drying a Pyranol Transformer."

Methods of sampling and testing Pyranol are described in the section, "Sampling and Testing Pyranol."

If the transformer is installed at a high altitude (3000 feet or more above sea level), open a fitting above the liquid, either the top sampling valve on the side of the tank or the filling plug in the cover, to equalize the internal and external pressures at approximately 25 C before the transformer is placed in operation.

CONNECTIONS

Do not change connections on a transformer that is under excitation or make any connections, except those authorized by the diagram or nameplate accompanying the transformer.

Tap leads on some transformers are connected to a tap changer for de-energized operation, the handle of which may extend through the cover or side of the tank. Make certain that all leads not in use are insulated from ground and all other leads.

Regardless of the floor or foundation on which the transformer is placed, ground the tank permanently and effectively by connecting to the grounding lug at the bottom of the tank, unless prevented by special operating conditions. A good, permanent, low-resistance ground is essential for adequate protection. A poor ground may be worse than no ground at all, since it gives a false feeling of safety to those working on or near the equipment, and may result in loss of life or damage to the apparatus.

When a transformer is specially designed for use on a system having a solidly grounded neutral, be sure that the neutral lead, as indicated on the nameplate, is permanently and solidly grounded without resistance.

Line connections must not bring any strain on the terminals which will cause the joints or contacts to become loose or bring undue strain on the bushing porcelains.

PRESSURE TEST

Pressure test all sealed transformers before placing them in service. This is done by first subjecting the tanks to an internal pressure of five pounds per square inch when the installation is completed, using dry compressed air or dry nitrogen introduced through the filling hole in the cover. When this pressure has been attained, shut off the supply and allow the transformer to stand for 12 hours. Observe the pressure reading during this period and examine the tank and fittings for leaks. If the pressure holds constant, the joints are satisfactory. Leaks above the liquid level can be located by applying a solution of soap and glycerin to all gasketed joints, pipe fittings, and cable connections.

VAULT VENTILATION

When large, self-cooled transformers are installed in vaults or compartments, it is necessary to ventilate the compartment thoroughly. Provide cool-air inlets in or near the floor and outlets in or near the roof.

The number and size of air outlets required will depend on their distance above the transformer, and on the efficiency and load cycle of the apparatus. In general, provide about 20 square feet each of inlet and outlet opening for each 1000 kva of transformer capacity. If the transformer will be required to operate for considerable periods at continuous full load, the areas of openings should be increased to about 40 square feet per 1000 kva of transformer capacity.

Arrange the air inlets and outlets so that they are permanently open. Do not use as ventilators, windows or doors which may be opened and closed by attendants, because of the danger of excessive heating in case they are inadvertently left closed during periods of heavy load or high temperature.

If forced ventilation is used, supply about 5000 cubic feet of air per minute for each 1000 kva of transformer capacity, and conduct the incoming air directly to the transformers so that it will flow up through and around the radiating members of the tank. If this cannot be done and the air is merely moved through the room, provide about 10,000 cubic feet per minute for each 1000 kva.

Do not let the temperature of the room in which the transformer is installed exceed the temperature of the air entering the room by more than 5 C. The entering air should come from the outside, or at least from a source not much warmer than the outside air.

GASKETS

Three different types of gaskets may be used on these transformers. These are:

1. Hard composition cork
2. Nitrile rubber*
3. Spiral wound

Each of these types of gasket has its own field of application and best results will be obtained if the procedures outlined for each are adhered to.

CORK GASKETS

When necessary to apply a replacement cork gasket, proceed as follows:

Remove all traces of the old gasket material and cementing compound adhering to the gasket surfaces.

Brush the gasket surfaces which are to be joined, and all surfaces, including edges of the gasket itself, with G-E Compound No. 880 and allow to dry.

All surfaces should then be given a second coat of the compound. Bolt or clamp the gasket surfaces together immediately with uniform pressure at all points until they are reasonably tight. Give a second tightening after four hours.

NITRILE-RUBBER GASKETS

These gaskets are made of a special grade of synthetic rubber.

To replace a gasket, the gasket surfaces must be thoroughly cleaned. The gasket may be applied without sticker. In some cases it will be convenient to stick the gasket to one surface to hold it in place during assembly. For this purpose G-E Material A50P68 adhesive may be used.

Compress the gasket approximately one-third or to the stops if provided. No subsequent tightening of the bolts is necessary.

The resilience of nitrile rubber makes pos-

*A synthetic-rubber compounded to G-E specifications.

sible the reuse of these gaskets in forming a seal if the gasket has not been damaged.

Store spare nitrile-rubber gaskets flat and in a dark place away from high temperatures, such as those caused by steam radiators.

Gaskets should be purchased to size from the General Electric Company. If made up by the customer and joints are required, they should be of the scarfed type made up as follows:

Scarf at an angle equal to the rate of one inch of length to each one-quarter inch of thickness. Surfaces must be flat and make a neat fit. Clean the surfaces carefully with Solvatone. Do not touch the surfaces with the fingers after cleaning. To the clean, scarfed surfaces apply a smooth even coat of G-E A50P68 adhesive. Allow to air-dry for seven minutes. In that time the adhesive should have developed a firm aggressive tack, but should not lift off the rubber surfaces. Bring the surfaces together and roll under pressure to displace all air. Do not distort the shape of the gasket excessively. Joints can be cured immediately or any time within a week.

To cure the joint, place the gasket in a heated press or vulcanizer and clamp together. Apply only enough pressure to insure a joint of uniform contact. Avoid excessive distortion of the gasket. Cure the joint in the press for 35 minutes at 130 C, or 20 minutes at 150 C. Do not heat over 160 C. Remove the gasket at the end of the curing cycle, and dip in cold water if needed immediately.

A properly prepared joint is sufficiently strong to withstand sharp bending, twisting, and elongation of 100 percent. There should be no gaps or projections at either end of the scarf and the adhesion should be uniformly good.

Extra gasket material and adhesive may be obtained from the General Electric Company.

After opening a tank or cover for any reason other than the taking of Pyranol samples and resealing it, a pressure test to insure the tightness of the gaskets is recommended. Follow the procedure given under "Pressure Test."

SPIRAL WOUND GASKETS

Preformed spiral wound gaskets are made by winding a strip of V-shaped stainless steel in the form of a single layer spiral and using a synthetic rubber compound between each turn. The ends of the steel strip are spot welded at the start and the finish of the spiral.

To replace a gasket, the gasket surfaces must be thoroughly cleaned. It is very important that these surfaces be clean and smooth. The gasket may be applied without sticker. In some cases it will be convenient to stick the gasket to one surface to hold it in place during assembly. For this purpose G-E Material A50P68 adhesive may be used.

Center the gasket on the gasket surface. Filler rings are furnished when required for this purpose.

Tighten the bolts, drawing each down in small increments. Proceed around the bolt circle until all bolts have been drawn down as tightly as possible.

WELDED COVERS

Welded covers are most easily removed by oxyacetylene torch. For specific instructions refer to instructions GEI-28008, "Removing and Rewelding Covers on Transformers" available from the nearest General Electric Company, Apparatus Sales Office.

PIPE FITTINGS

When assembling pipe fittings, clean the threads thoroughly to remove all oil, grease, Pyranol, old compound, and dirt. Apply a coating of G-E Compound No. 880 to the threads and screw the mating parts tightly in place.

MAINTENANCE

In general, from the standpoint of maintenance, operation, overvoltage protection, and overcurrent protection, Pyranol transformers should be treated the same as oil-filled transformers. Specific instructions on Pyranol transformers are given in the sections which follow.

HANDLING PYRANOL

Transformer Pyranol can be handled in the same manner as mineral oil. Continued exposure to liquid Pyranol may produce local skin irritations. However, cleanliness among workmen handling Pyranol constitutes an adequate safeguard against such effects. Ordinary medicinal washes will remove any irritation caused by Pyranol coming into contact with an open cut or skin abrasion. A drop of castor oil will neutralize any irritation caused

by contact of liquid transformer Pyranol with the eyes. As with most volatile materials, exposure to concentrated Pyranol vapors in unventilated rooms should be avoided.

Pyranol must be handled in containers, pipes, all-metal hose, etc., which are free from oil, grease, pitch, or other foreign materials, since these contaminate the liquid and decrease its noninflammable properties. It is desirable that all apparatus used in storing or transporting Pyranol be maintained for exclusive use with Pyranol, since it is extremely difficult to remove all traces of oil or other Pyranol contaminants from equipment of this type.

All-metal hose must be used in handling Pyranol instead of rubber-lined hose, since rubber is affected by Pyranol.

FILLING TRANSFORMERS

Although all Pyranol transformers are shipped filled with Pyranol, it may be necessary to refill a transformer. If so, make sure that all joints are tight and open all air vents before the transformer is filled. In order to prevent aeration of the Pyranol, it is preferable to fill the transformer through the drain valve with a filter press. Fill to the 25 C mark on the gage. Remove all traces of Pyranol that are spilled or dropped on the outside of the transformer.

PERIODIC INSPECTION

After the first few days of operation, test the top and bottom Pyranol for dielectric strength. (Refer to the section covering "Sampling and Testing Pyranol.")

Draw Pyranol samples and test on the same schedule as transformer oil (after the first six months of operation and annually thereafter). Keep accurate records of these tests. If, at any time, the Pyranol tests below 25 kv at room temperature, a filter press can be used to restore the dielectric strength to above 30 kv.

Keep the level of the Pyranol in the transformer up to or above the proper mark on the Pyranol gage, or up to or above the lower sampling valve.

The condition of the external transformer surfaces should be examined at regular intervals. If it is found that weathering is taking place, the surface should be cleaned thoroughly and repainted with a good grade of durable paint recommended by the General Electric Company.

It is recommended that a pressure test be made once a year, or more often for severe operating conditions, to make sure that a complete seal is maintained. Make these tests as explained under "Pressure Tests."

SAMPLING AND TESTING PYRANOL

In the sampling and testing of transformer Pyranol, as with any insulating liquid, strict attention should be given to the cleaning and drying of sampling and testing receptacles.

Samples of Pyranol which are questionable should be submitted to the General Electric Company, Pittsfield, Mass., for laboratory tests. When the factory analysis of a sample indicates soluble contamination of a character that impairs the serviceability of the Pyranol, detailed recommendations for correcting the situation will be made. Oil is the only contaminant usually found in Pyranol which cannot readily be removed by the combination of fuller's earth and paper filtration described in these instructions. It is essential, therefore, that the operator be particularly careful to avoid Pyranol contamination by oil.

Follow the procedure outlined herewith to obtain consistent results from samples taken either for field or factory tests.

Sampling From Transformers

1. Samples should preferably be taken when the temperature of the transformer is near 25 C and is at least as warm as the surrounding air. If it is necessary to sample when the transformer is appreciably warmer or cooler than 25 C, vent the transformer tank to the air at the first opportunity that presents itself when it is near that temperature. Do this so that excessive pressure or vacuum will not result when extensive changes in temperature take place during operation. For further information, see the section headed "Sampling Valve" under "Accessories." Take samples from outdoor apparatus on a clear day only, and guard against contamination by windblown dust, etc.

2. Use small-neck glass bottles as sample containers. Do not use rubber stoppers or rings. Glass bottles for samples, may be obtained from the General Electric Company, Pittsfield, Mass. See section on "Pyranol Testing Service."

3. To clean the bottles rinse with oil-free

gasoline. Then wash them with strong soapsuds, rinse thoroughly with water, and dry in an oven at 105 C to 110 C for at least eight hours. After drying, the bottles must be tightly stoppered with glass stoppers, or with clean corks protected by clean metal foil. Store them in a dry dust-free cabinet or compartment.

4. Impurities tending to affect the dielectric strength of Pyranol will in general be at the top liquid, and therefore the sample should be taken from the top through the small valve or plug provided for this purpose. Carefully clean the valve or plug and allow enough Pyranol to run out, so that any moisture or foreign material which may have collected in the valve, or plug is removed.

5. Rinse the bottle carefully at least three times with small portions of Pyranol drawn from the sampling valve. Allow the sampling bottle to drain thoroughly between rinses.

6. Draw a sample into the bottle, leaving sufficient air space to allow for possible expansion of the Pyranol. Reseal the apparatus. Carefully seal the container to prevent any exposure of the Pyranol to the atmosphere, using the stopper removed from the bottle. Pack the sample carefully to avoid breakage in transit.

Sampling From Drums

1. Take samples from drums after the Pyranol has remained undisturbed for at least eight hours. Samples should be taken only when the Pyranol is at least as warm as the surrounding air. If drums are outdoors, take samples on a clear day only and guard against wind-blown dust, etc. Take a sample from the top of the drum by means of a chemically clean thief. Observe sampling precautions previously outlined.

2. Clean the glass thieves in the same manner as the bottles are cleaned and store them in a dust-free cabinet, preferably at a temperature not less than 37.8 C (100 F).

Testing Dielectric Strength

For testing the dielectric strength of Pyranol, follow the technique specified by the American Society for Testing Materials in the test method entitled, "The Standard Method of Testing Electrical Insulating Oils." The following precautions and modifications must be observed:

1. Set the spacing of the electrodes at 0.100 inch.

2. Wipe the test cup and electrodes clean with dry, calendered tissue or clean, dry chamois and thoroughly rinse with non-leaded, oil-free, dry gasoline.

3. Fill the test cup with dry gasoline and make a breakdown test under standard conditions of voltage application (3 kv per second rise). If the dielectric strength is not less than 25 kv, the cup is considered suitable for testing purposes. Observe the usual precautions in handling gasoline.

4. Immediately after the final rinsing with gasoline, rinse the test cup with the Pyranol under investigation, and proceed with the test at once.

5. The temperature of the Pyranol when tested should be the same as that of the room, which should be between 20 C and 30 C (68 F and 86 F). Under no circumstances should the temperature of the test cup be lower than the temperature of the Pyranol being tested.

6. After filling the test cup, allow the Pyranol to stand for three minutes before test in order to allow any air bubbles to escape.

7. Make only one test per filling, filling at least five times and averaging the results.

8. Pyranol testing lower than 25 kv should be filtered or replaced. When a low breakdown is encountered, moisture may not be the only factor. Other foreign materials, such as conducting dust, lint or carbonized Pyranol formed by arcing may be present in suspension.

PYRANOL TESTING SERVICE

For convenience in sampling and testing Pyranol, the General Electric Company will, upon receipt of an order covering the actual cost of testing, furnish one-quart sample containers. These will be supplied filled with clean, dry Pyranol to prevent contamination of the bottle and to replace the Pyranol which is withdrawn as a sample. Empty the container into the apparatus, and immediately refill with the liquid to be tested. As reliable tests are dependent on reliable samples, follow the technique outlined under "Sampling and Testing Pyranol."

Send the samples to the Field Engineer, Power Transformer Engineering, Pittsfield, Massachusetts for testing. Pack these samples carefully to avoid breakage in transit. Recommendations for continued use or treatment will be furnished in addition to a com-

plete report covering the following tests:

1. Dielectric Strength
2. Color
3. Acidity
4. Condition

To assist the laboratory in furnishing the most useful recommendations from the results of the tests, supply the following information:

1. State why the tests are considered desirable.
2. Give the serial number and rating of the apparatus.
3. State whether or not the sample represents the Pyranol originally furnished with the apparatus. If not, when was the Pyranol replaced?
4. State the temperature and weather conditions at the time the sample was taken.
5. Give any other information that might have a bearing on the condition of the Pyranol.
6. State to whom the report should be sent.

FILTERING AND DRYING PYRANOL

Transformer Pyranol will seldom require filtration, because the tank of a Pyranol transformer is sealed. When it is necessary to filter Pyranol to remove moisture or foreign material, use a Pyranol purifier consisting of a specially proportioned filter press, a positive-volume gear pump, driving motor, combined drip pan and mixing tank, the necessary piping, valve, strainer, gages, and drying ovens. Any equipment used for filtering Pyranol should first be thoroughly cleaned to remove foreign material, including oil. Avoid oil contamination because oil is completely miscible in Pyranol and cannot be separated by any practical method. It is recommended that, wherever possible, separate equipment be reserved for the exclusive use of Pyranol.

For details of the procedure for drying Pyranol with the Pyranol filter press, write to the nearest General Electric Apparatus Sales Office and request Instruction Book GEH-1031.

DRYING A PYRANOL TRANSFORMER

Use the short-circuit method of drying a Pyranol transformer. This method consists of heating the windings, while under Pyranol, by circulating current in them and removing the moisture by ventilation. If the drying is done indoors, provide good ventilation to exhaust the vapors from the room.

If the Pyranol at the top of the tank tests less than 30 kv between 20 C and 30 C, filter it, using only dry filter paper in the filter press, before starting the short-circuit method. (See the section on "Testing Dielectric Strength.")

Any free water must be removed by opening the top sampling valve before filtering as the filter-press treatment removes only water that is held in suspension in the Pyranol.

After the short-circuit method is started, drying will usually progress satisfactorily with no filtering if thorough ventilation is provided. As the most efficient filtration occurs between 20 C and 40 C and as the higher the temperature the slower the moisture filtration, the filter press will not greatly hasten the short-circuit drying process.

Obtain the desired load by short-circuiting one winding and applying a suitable voltage to the other. Note: Always load the total windings. A voltage approximately equal to the impedance volts of the transformer will be required. The percent full-load impedance of the transformer, if not known or if not found on the nameplate, may be obtained from the nearest office of the General Electric Company upon request. The rating and serial number of the transformer should accompany such a request.

Avoid accidental contact with all circuits.

The success of the short-circuit method depends on thorough lagging of the cover to prevent condensation of moisture; thorough ventilation to carry off water vapor given off by the hot Pyranol; correct loading and Pyranol temperature; and careful tests.

To obtain the desired temperatures, the tank may be blanketed with heavy paper, cloth, or building felt. Regardless of the amount of blanketing around the sides of the tank, thoroughly lag the cover to prevent condensation. Ventilate the air space above the Pyranol by removing the main cover, handhole cover, or pressure relief.

If the transformer is at room temperature at the start of drying, 125 percent load may be used at the start until the top Pyranol reaches 65 C, after which the load is reduced to obtain temperature in accordance with the following tabulation:

Maximum Allowable Short-circuit Amperes in Percent of Full Load	Maximum Allowable Top Pyranol Temperature in Degrees C
50	100
75	90

Do not allow the top Pyranol temperature to exceed the specified value for a given percent load, since the windings are at a higher temperature than the Pyranol and damage to insulation will result.

Take Pyranol samples every four hours from the top of the transformer and test them.

From the records, plot a curve of the Pyranol tests, top Pyranol temperatures and the load current (against time), as this curve will picture the progress of the drying.

A decrease in the dielectric strength of the Pyranol indicates that moisture is passing from the transformer into the Pyranol. Increasing dielectric strength is taken as an indication that the drying of the insulation is complete.

Continue the drying until the Pyranol from the top tests 30 kv or higher between 1.0-inch disks spaced 0.100-inch apart for four consecutive tests taken four hours apart without filtering the Pyranol, and maintaining it at a maximum temperature for the load being held.

After completion of the drying run be sure that the Pyranol added to fill the tank to the proper level is well filtered and of high test value. The hot Pyranol is free from air bubbles, so it is preferable to complete filling the transformer from the top of the tank rather than through the drain valve, as in the latter case air bubbles may be trapped in the winding.

SPARE TRANSFORMERS

Time and expense will be saved, if spare units are kept in readiness for instant use. Inspect the following items during periods of idleness: Pyranol level, Pyranol dielectric strength, relief diaphragms, fan control and conduit. Also, inspect frequently for condensation in all cabinets and junction boxes.

ACCESSORIES

THERMOMETER AND LIOUID-LEVEL INDICATOR

The thermometer and liquid-level indicator have been combined into a single instrument on units 300 kva and above. The thermometer is equipped with a maximum reading hand which can be reset by turning the knurled knob on the front of the case.

This combination instrument may be mounted on either side of the transformer to accommodate either a standard or reversed unit. A gasket is used to provide a seal between the instrument and the tank flange. The opening in the tank for mounting this combination instrument is approximately one inch above the 25 C liquid level. It is possible to remove the instrument without lowering the liquid level. If there is any question about this point the condition may be inspected through the handhole in the cover or the relief-diaphragm opening.

A liquid-level indicator is provided on units 225 kva and below. Provisions are made so that a thermometer may be added as special equipment.

TAP CHANGERS

Tap changers for de-energized operation (ratio adjusters), when furnished with these transformers, are either of the drum type or of the wedge type.

Indicating marks on stationary and rotating parts of all tap changers must be in alignment when the tap changers are on the first position.

THE TAP CHANGER MUST NOT BE OPERATED WHILE THE TRANSFORMER IS UNDER LOAD OR EXCITATION. SERIOUS PERSONAL INJURY OR DAMAGE TO THE TRANSFORMER MAY RESULT IF THIS IS ATTEMPTED.

Drum Type

A change in voltage ratio with a drum-type tap changer is made by a partial turn of the cap. See Figures 1 and 2. Remove the padlock and locking cover. Remove the two hex head screws that hold the cap in place and using a wrench, turn until the indicator points to the desired figure on the circumference of the cap. After the tap changer is turned to the desired position, it should be locked securely by replacing the two screws, the locking cover and the padlock. The padlock, if desired, is furnished by the customer.

Before removing the cover from a transformer that has the operating mechanism brought out through the cover, remove the universal coupling at the top of the insulating tube. Do this by successively removing the padlock, the locking cover, the screws in the cap, the cap, and the split washer around the shaft underneath the main cover. Loosen the packing gland and pull out the universal coupling.

When replacing the cover, be sure the tap

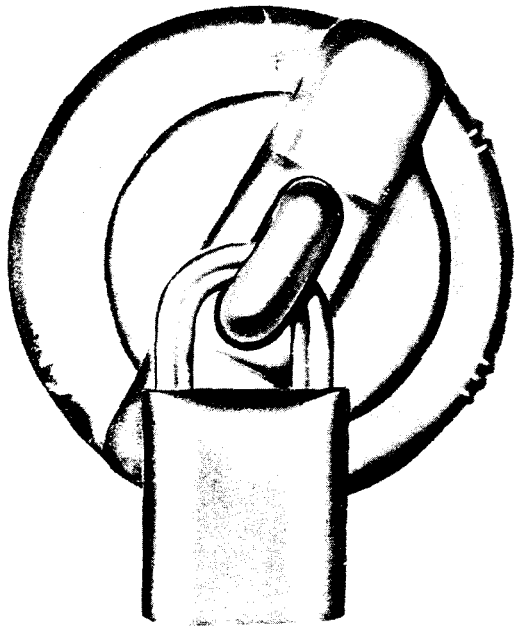


Fig. 1. Operating cap for drum-type tap changer
Padlock supplied by user

changer is on Position 1, then assemble the cover and lower the universal coupling through the opening. Engage the slot in the lower shaft of the coupling with the pin through the end of the insulating tube and finish assembly of the operating mechanism. The slot should fit over the pin in such a position that, when the cap is assembled, the indicator will point to Position 1 on the cap.

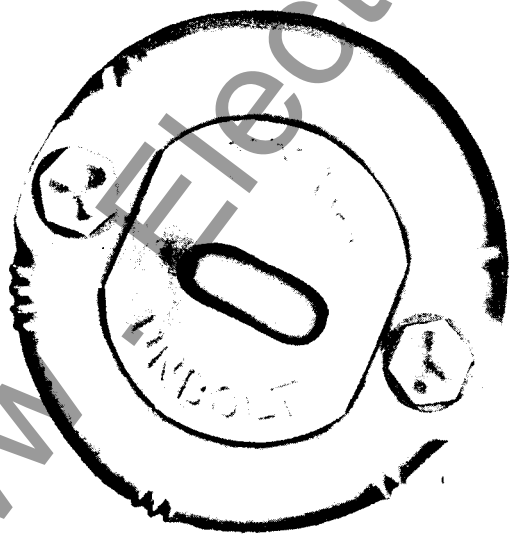


Fig. 2. Operating cap with padlock and locking cover removed

After assembling the cap, make tests in accordance with a subsequent section "Tests on Tap Changers." If these tests indicate improper positioning of the contacts, or if it is desired to test electrically the position of the contacts, one of the tests described in instructions GEI-28046 can be performed. Copies of this instruction leaflet can be obtained by requesting them from the nearest Apparatus Sales Office of the General Electric Company.

The caps and couplings are not interchangeable. The operating cap is stamped with the last three figures of the serial number of the transformer but the universal coupling is not so identified. When more than one control is furnished, the operating caps are also numbered in accordance with the nameplate.

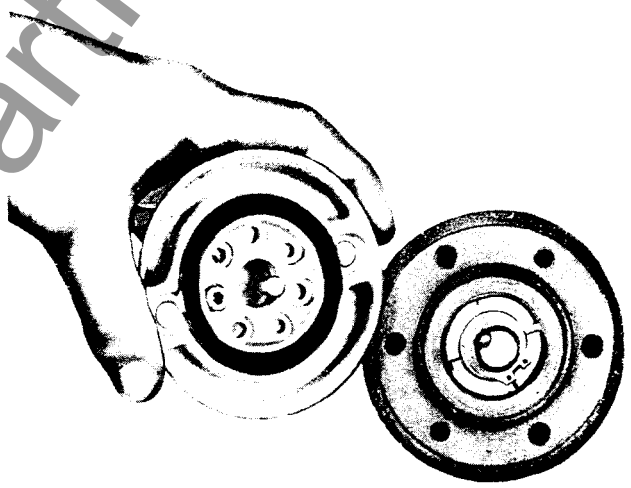


Fig. 3. Operating cap showing vernier coupling

NOTE: In reassembly, it may sometimes be necessary to change the vernier coupling in order to insure proper alignment. The vernier coupling is built into the operating cap. See Figure 3.

Before connecting the transformer in the circuit, operate the tap changer through its entire range and then lock in the desired operating position.

Do not use compound on the gasket between the operating cap and the flange on the cover or on the material around the shaft in the stuffing box.

Wedge Type

This type of tap changer is indicated on a round nameplate on top of the removable cap which covers the operating mechanism. (See

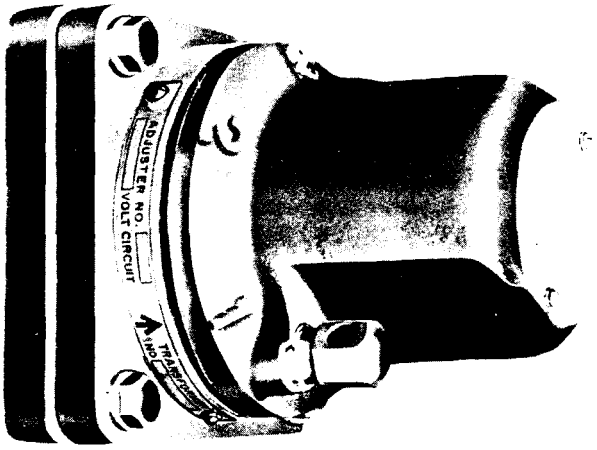


Fig. 4. Folding-crank mechanism for wedge-type tap changer

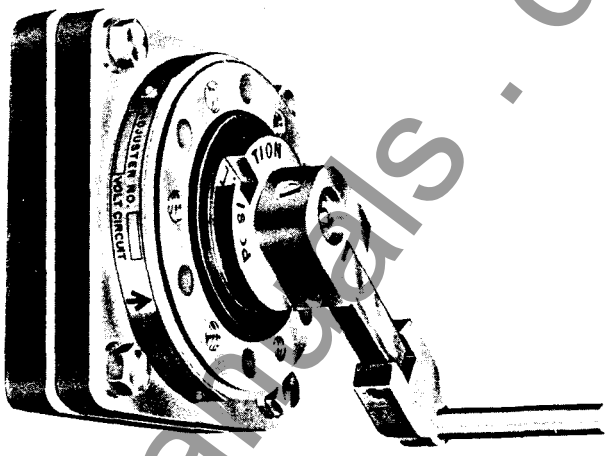


Fig. 5. Operating position of crank for wedge-type tap changer

Fig. 4.) This operating mechanism is usually mounted on the main cover, although in some cases it may be mounted on the transformer tank wall.

Before the tap changer can be operated, remove both load and excitation from the transformer. To operate the tap changer take out the two hex head screws in the mechanism cap and remove the cap. This uncovers the folding crank. (See Fig. 5.) When the crank is unfolded the position number on which the tap changer stands will be observed in a rectangular slot. To change taps in the direction from Position 1 to Position 2, the crank must be moved in a clockwise direction. When turning the crank, the slot in the circular position indicator moves in the opposite direction. Less than one complete turn of the crank is required for one tap change, and each tap position number will be exposed exactly in the center of the indicator slot when the tap changer is on that tap position. When the tap changer has been set on the desired tap position, fold the crank so that the crank-handle pin will fit into the indicator slot. This can be done only if the tap changer is exactly on a tap position. Lastly, replace the removable cap over the folded crank and bolt it in place to lock the tap changer on position. The cap can be replaced only one way, and the two holes in the cap will be in alignment with the tapped holes for the screws only when the tap changer is exactly on a tap position. Be sure the special gasket around the circular position indicator is in good condition when replacing the cap, in order to keep the mechanism weatherproof. Use no sticking compound between the cap and the gasket.

The position indicator consists of: a black pointer on a small nameplate attached to the mechanism flange and position numbers on the rim of the cap.

If it is necessary to reassemble the operating mechanism and insulating rod, (for example, for a cover mounted mechanism, whenever reassembling the cover) couple the insulating rod to the operating mechanism. Insert the assembly through the opening in the tank or cover over the driving pin on the tap-changer shaft. (See Fig. 6.) Operating mechanisms and rods are identified by the tap-changer number and the last three figures of the serial number of the transformer, as shown on the nameplate. Before assembling, be sure that the operating mechanism and the tap changer are both on Position 1. On this position the contact wedge of the tap changer is between the two contact rods A and B. The large ends of the driving pins line up with the wedge in the tap changer and are 180 degrees from the extended operating crank. The operating rod should be suspended entirely

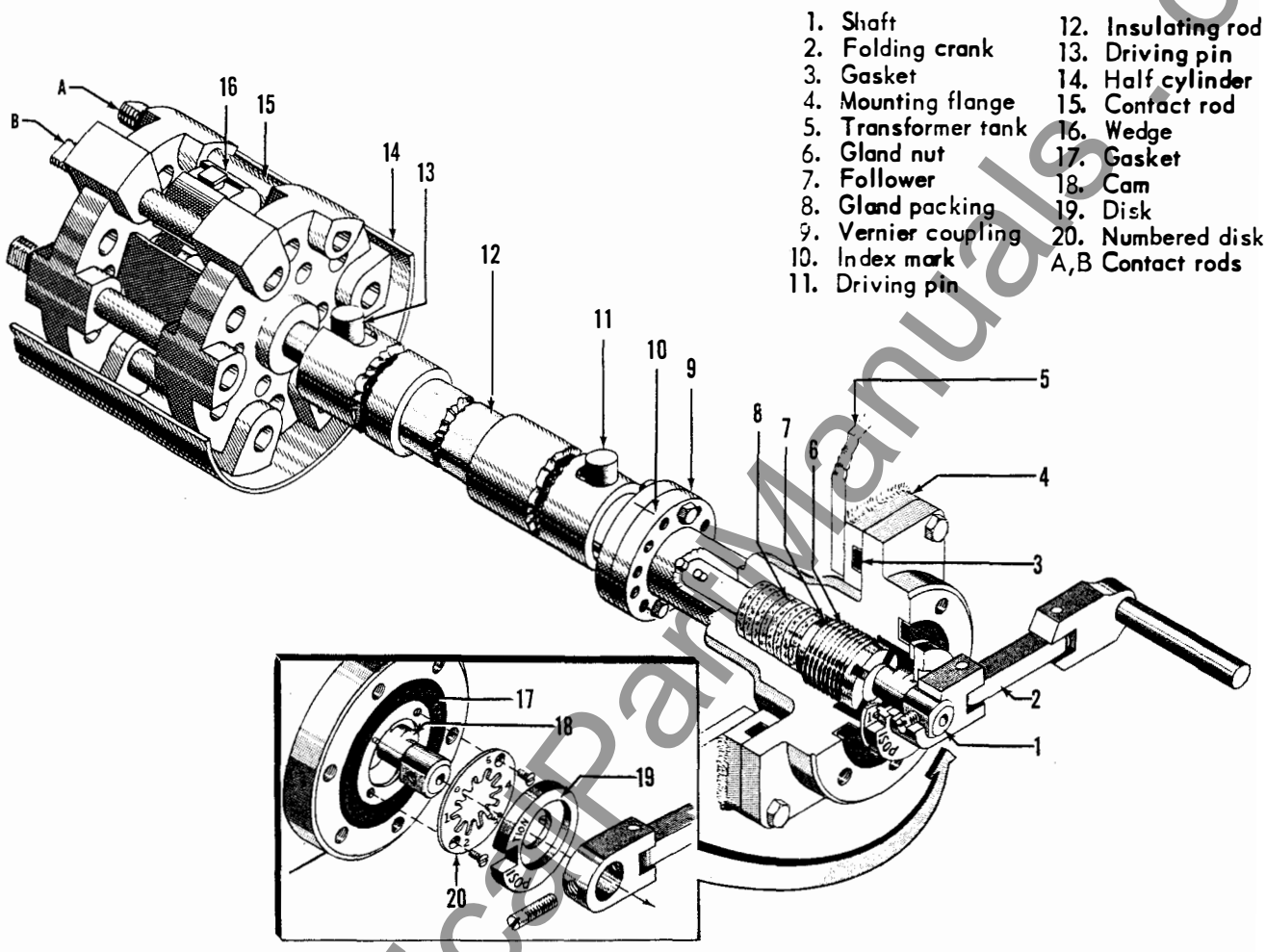


Fig. 6. Operating mechanism for wedge-type tap changer

from the operating mechanism; none of its weight should be carried by the tap changer.

The screw holes in the mechanism flange should line up with those on the mounting flange that is attached to the tank or cover.

After completing assembly, check to see that the wedges make the best contact in each position by observing the torque as the tap changer is operated in both directions into a tap position. Starting from an operating position, the contact pressure is reduced to zero during the first 30-degree movement of the shaft. To shift the wedge to a point entering the next operating position requires about 2/3 of a revolution. As there is little or no friction to overcome, the torque will be noticeably small. A 30-degree movement is then required to drive the wedge home and to build up the contact pressure. The operating shaft rotates 5/6 of a turn for each tap change in the six-point tap changer and 7/8 of a turn in the eight-point tap changer.

If a ratio test indicates improper positioning of the wedge contacts or if it is desired to test electrically the position of the contacts, one of the tests described in instructions GEI-28046 can be performed. Copies of this instruction leaflet may be obtained by requesting them from the nearest Apparatus Sales Office of the General Electric Company.

If it is necessary to realign the control, it can be done by means of the vernier coupling. After making the adjustment, put the screws through the holes that line up and recheck positioning as described above.

After operating the tap changer through its entire range, lock it in the desired position by replacing the cap and screws before energizing the transformer.

One of the screws through the cap is pro-

vided with a hole for a padlock.

Tests on Tap Changers

It is good policy to test each tap changer to make sure that the positions are correct and that the steps are progressive. This can be done by applying a low voltage to one winding and measuring the voltage on the other winding for each position of the tap changer.

BUSHINGS

Two general types of bushings are used on these transformers. The type called externally removable were originally developed for use with transformers with welded-on covers, but are suitable for use with transformers with bolted-on covers. This type can be recognized since the external end of the stud is threaded, parts mounted on the external end of the stud can be removed, and the porcelain removed from the stud without unbolting any connections inside the transformer. The other type of bushing requires access to the tank either by removing the cover or through a handhole to remove the internal connections to the bushing so the complete bushing can be removed.

Fig. 7 shows an externally removable high-voltage bushing. The porcelain bushing can be removed by removing the blade, lock nuts, and washers on the end of the stud, and then removing the clamp bolts and clamp. The porcelain can then be removed and the stud will remain attached to the transformer leads from inside the tank. When replacing a bushing use new gaskets installed according to the instructions under "Gaskets."

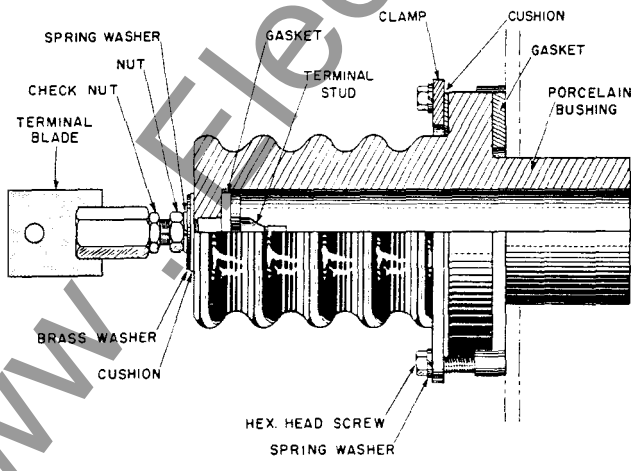


Fig. 7. High-voltage bushing (externally removable) 1/4 section of porcelain removed

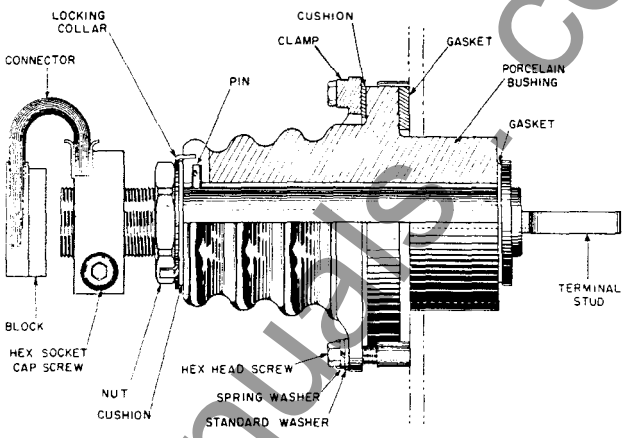


Fig. 8. Low-voltage bushing (externally removable) 1/4 section of porcelain removed

Fig. 8 shows an externally removable low-voltage bushing. To remove this bushing, loosen the clamp screw on the split terminal, unscrew the terminal, and remove the brass nut and washers on the stud. Pull out the locking pin by means of a hooked wire inserted into the small hole in the end of the pin. Then remove the clamp bolts and clamp. The porcelain can now be removed, leaving the stud attached to the low-voltage bars of the transformer. Gaskets should be installed according to instructions under "Gaskets."

Fig. 9 shows a low-voltage bushing which may be removed by disconnecting the transformer terminals from the inner end, and removing the clamp bolts and clamp on the outside. The complete bushing can then be removed.

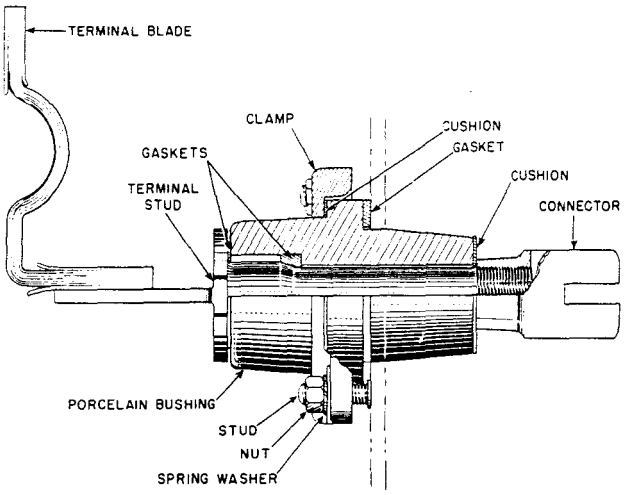


Fig. 9. Low-voltage bushing (internally removable) 1/4 section of porcelain removed

SAMPLING VALVE

Sampling valves for obtaining a sample of the Pyranol at either the bottom or the top of the tank are provided. The top sampling valve is placed in the tank wall at a point about one inch below the 25 C Pyranol level. The bottom sampling valve is located in the drain valve. There are two possible locations for the sampling valve in the drain valve. The one nearest the valve stem is on the outside of the main valve; the other is on the transformer side of the main valve.

The valve is fitted with a knurled nut which can be turned by hand or by the use of a coin or screwdriver.

PRESSURE-RELIEF DEVICE

The pressure-relief device, mounted on the main cover of a sealed transformer, serves to relieve any sudden internal pressure, such as may accompany an arc under the insulating liquid.

Receiving and Handling

This device is usually shipped in place on the transformer and is ready for operation without adjustment.

When the device is shipped separately a temporary cover is placed over the opening, and the diaphragm and free cap are packed separately.

Description

Fig. 10 shows the parts of this device with a plate which represents the tank cover. The relief diaphragm is a thin disk of molded material (G-E Compound 2029B) firmly held between clamping rings with a gasket joint. These clamping rings are the bottom flange on the main cover and the top flange.

Located in the cover opening directly below the diaphragm is a removable spider which supports the diaphragm in case of vacuum in the tank. In the top flange is a crossbar rigidly held in place by a setscrew at each end. The lower side of the crossbar holds a blade with a knife edge a short distance above the diaphragm. A grid, which is restricted in its vertical movement by two screws, is fastened to the crossbar by a relief pin, so that the edges of the grid are located just above the diaphragm. A metal cap fits down over the top flange and is held in place by two spring clips, thus providing weatherproof protection for the diaphragm.

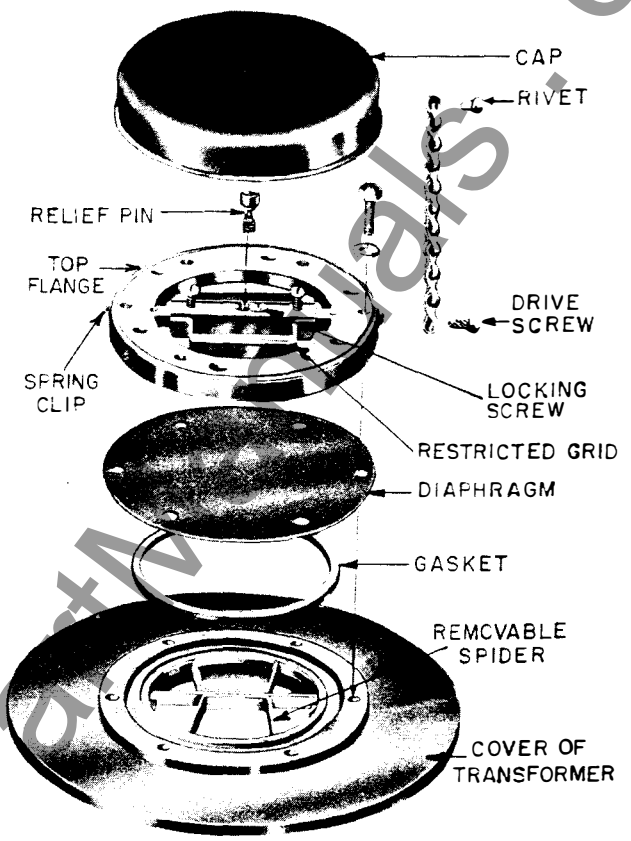


Fig. 10. Pressure-relief device

Should a sudden pressure occur within the transformer tank, the relief diaphragm will be forced up against the bottom edges of the grid, breaking the relief pin and allowing the grid to rise to the top of the screws. This permits the diaphragm to contact the knife edge, which immediately ruptures the diaphragm. The escaping gas raises the free cap and relieves the internal pressure.

The number 15 stamped on the head of the relief pin indicates a diaphragm rupturing pressure of 15 pounds per square inch.

Renewal of Diaphragm

To renew the relief diaphragm after it has been ruptured, it is necessary to take out the six hex head screws holding the top flange and remove the top flange together with the restricted grid. Remove the broken diaphragm. Note that a removable spider is located in the opening below the diaphragm. This spider must be left in place. However, it may be removed if it is necessary to use the opening as a handhole for any purpose. When replacing the spider be sure the notched ends are down.

Make certain the gasket is in place in the

groove in the bottom flange; place a new diaphragm over the gasket. Remove the broken part of the relief pin from the crossbar in the top flange. The bottom part of the relief pin is slotted to facilitate removal. Remove the broken part of the relief pin from the top bar of the restricted grid by removing the small brass locking screw and washer. The new relief pin must have the same number stamped on the top as the one being replaced. Install the new relief pin by inserting it through the central hole in the top bar of the restricted grid and carefully screwing it into place, using a very light twisting effort on the screw. For this reason, the relief pin is designed to be screwed in with the fingers. Replace the washer and small brass screw to lock the relief pin. Assemble the top flange over the diaphragm, bolting it firmly in place. Fit the cap firmly in place on the top flange.

GAS ABSORBERS

When a gas absorber is supplied, a separate instruction book accompanies the apparatus which describes the installation, operation, and care of the device.

VENT PIPES

If it is desired to vent the transformer to the outside, a vent pipe with a special flange can be bolted to the top flange above the diaphragm. Fig. 11 shows details of the diaphragm flange, as well as details of a proposed flange for the vent pipe.

It is recommended that the vent pipe should be made so that its cross section is as large as the clear diameter of the diaphragm. It is also recommended that the thickness of the vent pipe be at least 1/16 inch. If unusually severe corrosive conditions must be met, thicker material should be used. The vent pipe should have the minimum number of bends possible.

RENEWAL PARTS

Renewal parts for the pressure relief and

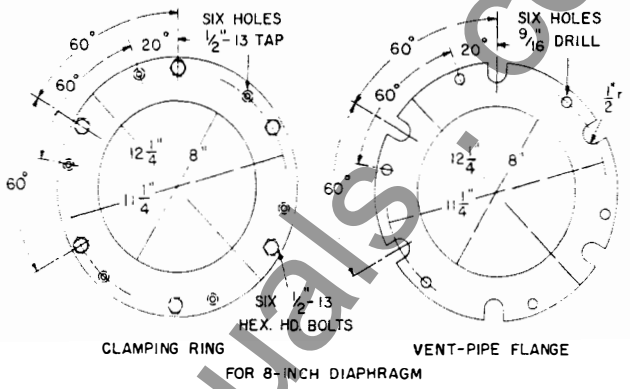


Fig. 11. Vent-pipe flange outline and dimensions

catalog numbers to be stated when ordering are as follows:

Description	Catalog No.
Pressure-relief diaphragm	6828845
Gasket for relief diaphragm	CIP 1220920A
Relief pin, No. 15	8388101P21

Address orders for renewal parts to the nearest Apparatus Sales Office of the General Electric Company.

Whenever ordering supply or renewal parts, or asking for information regarding a particular transformer, always state the serial number. This number, in addition to being on the nameplate will be found stamped on the top core frame, the top band of the tank, and also on the cover directly above the number on the tank band. A sketch showing the exact location of coils, insulation, or other parts required, will greatly facilitate the filling of the order. This sketch must always state which side of the transformer is shown.

Any additional information as to the electrical or mechanical construction, operation, or installation of a particular transformer can be obtained by applying to the nearest local office of the General Electric Company, mentioning the serial number and the rating.

DISTRIBUTION TRANSFORMER DEPARTMENT

GENERAL ELECTRIC

PITTSFIELD, MASS.

7-53 (2M)
10-54 (4M)

Supersedes GEI-32191B
Litho in U.S.A.