INSTALLATION INSTRUCTIONS FOR DRILLING MOTORS AND GENERATORS

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INTRODUCTION

This instruction book includes basic set–up and installation instructions for both AC and DC Drilling Motors and Generators.

These instructions do not purport to cover all details or variations in equipment, nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to GETS.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

Revisions are indicated by marginal bars.

DC EQUIPMENT

SPECIAL SAFETY NOTES

WARNING: Electric shock can cause serious or fatal injury. To avoid such injury, personnel should take and observe proper precautions during system adjustments and maintenance.

AUXILIARY CONTROL SWITCH

There is an auxiliary control switch mounted on the frame of the DC machines. On some systems, this switch may be used to provide a machine "cut–out" function. You must refer to the particular electrical system detail information furnished by the system supplier to learn if a "cut–out" feature is provided and to what extent the machine is electrically isolated when this switch is actuated. **Do not** assume the auxiliary switch mounted on the machine will provide a "cut–out" function.

POWER DRIVE CONNECTIONS

Be sure that all motors which power a common driven element (such as shaft, gear or chain) are electrically disconnected before servicing any one of the motors. Do not assume the activation of one motor "cut–out" device will deactivate all motors powering a common drive.

REMOVING MACHINES FROM STORAGE

A machine which has been stored for an extended period of time should be checked before being placed in service. The fact that a motor or generator checked good when placed in storage does not exempt it from tests when needed for service. Storing location and atmospheric conditions (temperature and humidity) can cause the windings to become contaminated with dirt and/or moisture.

Storage conditions can help in avoiding dirt and moisture accumulation. Where possible, machines should be stored in a clean location where the temperature is kept above 60°F. In a generally high humidity climate, an even higher minimum temperature (70°F) will help keep windings dry. An accumulation of moisture or of dirt and moisture causes electrical breakdown of windings.

Before placing a stored motor or generator in use:

1. Blow dust and dirt accumulation out of windings with clean, dry air.

2. Visually inspect for spring corrosion, sticking brushes in brush holders, and general defects.

3. Check winding insulation continuity to ground with a 500–volt megger. If the megger reading is less than 2 megohms, the winding should be baked or dried until the moisture content is sufficiently reduced to raise the megger reading to 2 megohms. Ship the machine to a competent service shop for baking and drying.

NOTE: Before drying windings, consideration must be given to bearings and lubricants. Not only can bearing lubricants be damaged by heat but they can also deteriorate with age. For this reason, it is usually best to remove bearings before drying and repack with new grease before reassembly.

SHIPPING INSTRUCTIONS

Whenever drilling motors and generators are to be shipped, they must be properly skidded and secured to prevent any damage in transit. The photographs and drawings which follow illustrate a proven method of skidding these machines for handling and shipment.

HANDLING

1. Motors or generators should not be lifted or moved by the shaft extension of the armature.

2. Precautions should be taken to keep the armature from hitting another object when the machine is moved.

3. When assembling a coupling to the armature shaft, tightening of bolts, etc., should not be made with an air wrench. Avoid pounding on a wrench when tightening coupling bolts or bolting the armature to an engine.

4. If the motor or generator is shipped separately, and the armature is free to rotate, no locking of the armature

is necessary. However, if the motor or generator is connected to an engine or other apparatus during shipment, the armature end play should be removed by blocking axially only.

5. No attempt should be made to load the armature radially for shipment; that is, do not strap down the armature during shipment.

6. When aligning generators to a customer's engine, etc., the armature should not be pushed to obtain proper alignment.

CLEANING AND SLUSHING

Before skidding the machine for shipment, all exposed finished surfaces not already painted should be cleaned and slushed as follows:

1. Remove all corrosion.

2. Wipe off the surface with clean rags wet with petroleum spirits.

3. Follow this with a clean rag wet with methanol, and wipe dry. **DO NOT** touch the cleaned surface with bare hands.

4. Immediately after cleaning, coat all exposed finished surfaces not already painted with a rust preventative compound (GE D6C6A1 or equivalent) which will offer some mechanical protection and protect the surfaces from the elements of weather.

SKIDDING

Use yellow–pine timbers large enough to support the weight of the machine. Recommended sizes for the particular machines are specified in FIG. 1. and FIG. 2.

BANDING

The GT–558 generator is banded to the skid as illustrated in FIG. 3. and FIG. 4. Apply 0.035 by 3/4–inch steel banding with a banding tool. Pull the band tight and lock it. FIG. 5. shows a GT–558 boxed for shipment.

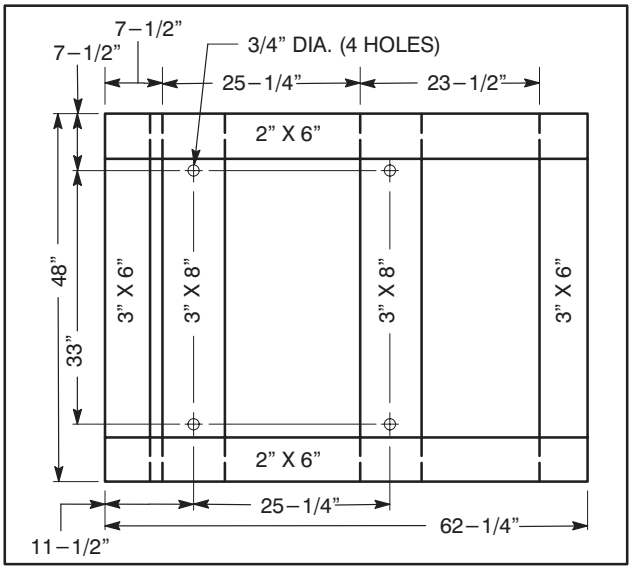

FIG. 1. CONSTRUCTION DETAILS FOR SHIPPING SKID, TYPE–752 MOTOR AND GENERATOR. E–7754

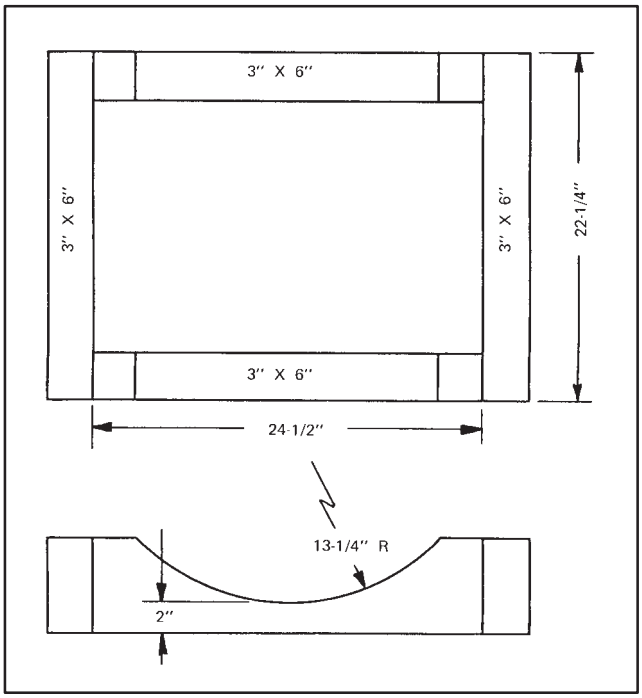

FIG. 2. CONSTRUCTION DETAILS FOR SHIPPING SKID, TYPE GT–558 GENERATOR. E–7755

GENERATOR ARMATURE BLOCKING (NOTE CAREFULLY)

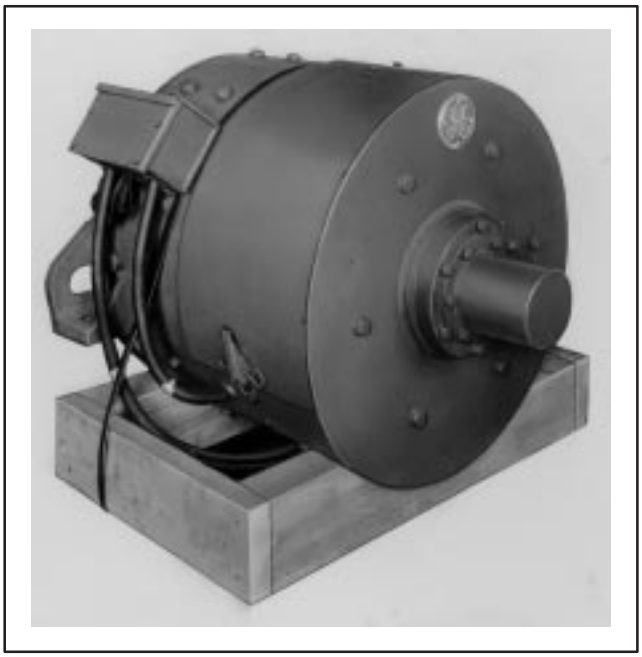

FIG. 3. COMMUTATOR END VIEW OF GT–558 DRILLING GENERATOR SKIDDED FOR SHIPMENT. E–7795

The GT–558 generator must be shipped with a strip of fiber between the fan and the bore of the magnet frame to hold the armature rigid in the frame assembly. If there is a small machined surface adjacent to the fiber strip, it should not be slushed. This will insure easy removal of the fiber strip.

SHIPPING

The GE–752 motor and generator, which is shipped without blocking the armature, should be shipped with the armature shaft at right angles to the length of the car or truck. This will allow the bearing rollers to react against heavy lateral shocks to the vehicle by rolling instead of sliding. FIG. 6. and FIG. 7. show a GE–752 skidded for shipment. When any apparatus is shipped in the open, it should be fully protected from rain, snow, dirt, etc., by covering with some suitable weatherproof material.

SPROCKET HUB MOUNTING AND REMOVAL

HUB FITTING

To prevent a hub from slipping, it should have at least 75% fit on the shaft; i.e., at least 75% of the tapered bore of the hub should be in contact with the tapered fit on the shaft. Before mounting a hub, check and correct the fit as follows:

1. Lightly cover the bore of the hub with a blueing compound such as Prussian blue.

2. Snap the cold hub forcefully on the shaft.

3. Mark the relative angular position of hub with respect to the shaft.

4. Remove the hub from the shaft. A convenient method of removal is by the use of two finely tapered steel wedges (hardened and ground) which are carefully driven between the sprocket hub and bearing seal on the shaft.

5. Inspect the taper fit of the shaft; blueing of the hub bore should now show on the shaft. If at least 75% of shaft surface shows traces of blueing, the fit is satisfactory. If, however, only a few spots of blueing show on the shaft, the fit is not satisfactory.

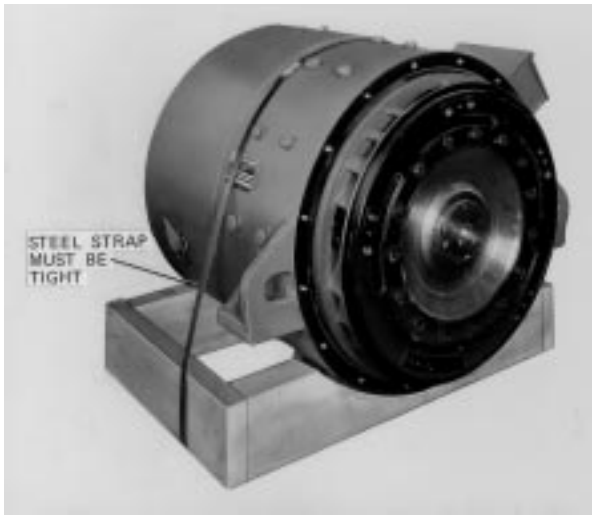

FIG. 4. FAN END VIEW OF GT–558 DRILLING GENERATOR SKIDDED FOR SHIPMENT. E–7796

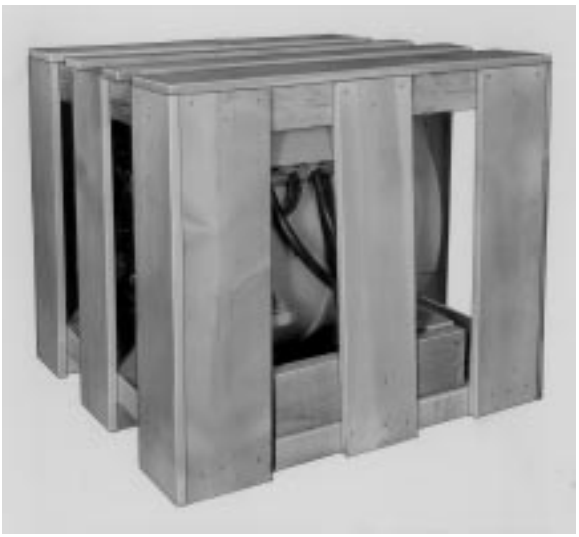

FIG. 5. GT–558 DRILLING GENERATOR SKIDDED AND BOXED FOR SHIPMENT. E–7797

6. Dress down blue spots on the shaft very lightly with a fine emery cloth such as No. 400A Triemite*.

*Reg. trade–mark of Minnesota Mining and Mfg. Co.

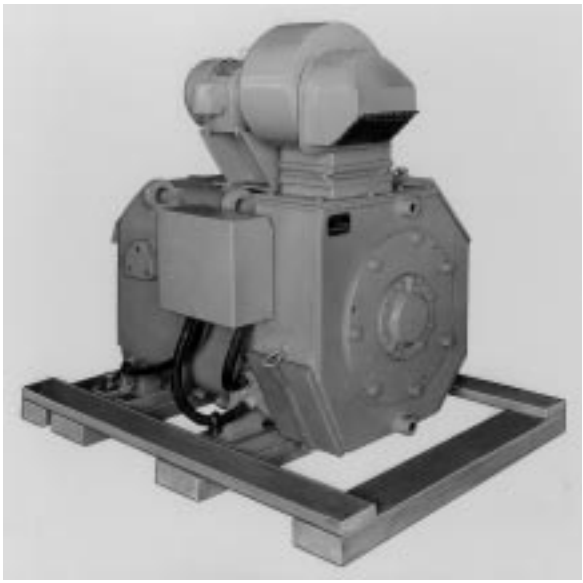

FIG. 6. COMMUTATOR END VIEW OF GE–752 DRILLING MOTOR SKIDDED FOR SHIPMENT. E–7798

7. Blue the hub bore again (See item 1) and repeat items 2, 4, 5 and 6. Be sure to place hub on the shaft in the same position as marked.

Generally, the fit will be improved, but the foregoing procedure may have to be repeated several times to obtain a 75% fit.

Under no circumstances use a lapping compound since lapping will produce a shoulder at the large end of the tapered fit. A shoulder will prevent a perfect fit when the hub is mounted hot; i.e., when it is mounted in the advanced position.

8. After a good fit has been obtained, thoroughly clean the shaft and the hub bore to remove all blueing, oil or grease, then mount the hub.

HUB MOUNTING

Proper hub mounting is essential for successful operation of the sprocket drives.

1. Thoroughly clean the hub fit on the shaft and bore of the hub using a cleaner which will not leave an oily deposit on the finished surface. Remove any scoring on the shaft or hub bore.

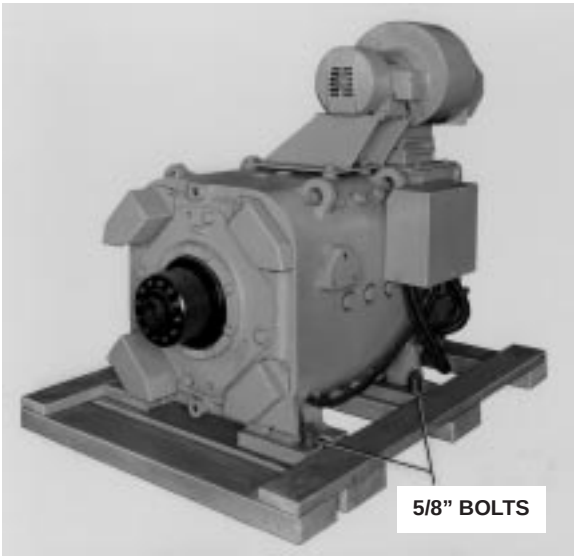

FIG. 7. COUPLING END VIEW OF GE–752 DRILLING MOTOR SKIDDED FOR SHIPMENT. E–7799

WARNING: Cleaning solvents may be toxic and/or flammable. They can cause serious or fatal injury if used without proper precautions. For safety:
1. Do not inhale solvent fumes.
2. Use solvents only in adequately ventilated areas.
3. Avoid contact of solvent with the skin.
4. Do not expose solvent to flame or sparks.
5. Observe caution statements issued by the manufacturer of the solvent

2. Spot the cold hub on the shaft by hand and check for at least 75% fit. See **HUB FITTING**. If necessary, dress the shaft to obtain this fit.

3. Trial mount the cold hub on the shaft. Measure and record the position of the hub with respect to the shaft. Make measurements with a micrometer indicator gage similar to that shown in FIG. 8.

Mark points of measurement, and mark across the end of shaft and hub face so that the hub, when heated, can be mounted in exactly the same angular position,

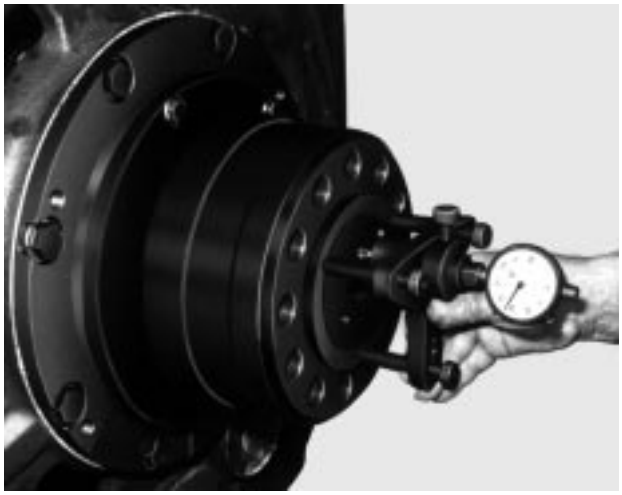

FIG. 8. METHOD OF MEASURING HUB DEPTH. E–5975A

and so the advance measurement can be made from the same point.

CAUTION: Zero settings of advance gage must not be disturbed until all readings on the hub are completed.

4. Mount the hub hot on the shaft so as to secure an advance from the cold position to the hot position along the axis of the shaft as indicated in this section. The ESTIMATED difference between shaft temperature and hub temperature (temperature rise) which will provide this advance is also given. The temperature difference is only an estimate and should be adjusted (if necessary) to maintain the advance within prescribed limits.

CAUTION: The temperature of the hub must not exceed 250° C (482° F); otherwise the hub may become annealed.

Cat. No. of Hub	Advance (in)	Degrees Rise Above Shaft Temp.
493A471	0.120 – 0.130	215°C (387°F)
41A237799	0.90 – 0.100	175°C (315°F)
41A232219	0.95 – 0.105	135°C (243°F)

Heat the hub in an oven until it has reached a uniform temperature (the desired number of degrees above shaft temperature). For example, if shaft temperature is

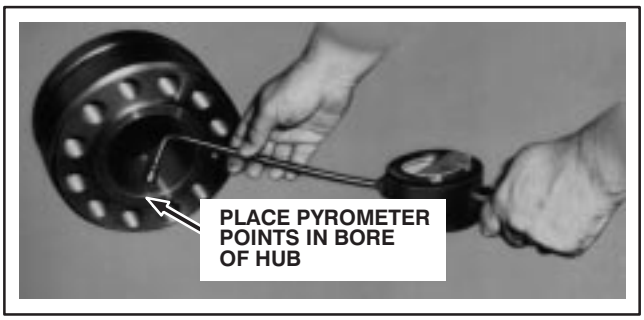

FIG. 9. MEASURING TEMPERATURE OF COUPLING HUB WITH PYROMETER. E–5976

25°C (77°F), heat hub to 25°C (77°F) + 215°C (387°F) = 240°C (464°F). Measure temperature of shaft and hub with the same instrument.

An accurate method must be provided for measuring hub and shaft temperatures quickly before mounting the hub. This can best be done with a hand pyrometer. When using the pyrometer, place points of the gage inside the bore of the hub (See FIG. 8.).

5. With hub bore and shaft taper clean, quickly mount the hot hub on the shaft in the same angular position as when cold. When the hub is nearly in engagement with the taper fit (not in actual contact), snap it forcibly into place with a quick push. It is important that the hot hub be instantly snapped into position before it has cooled; otherwise, it will "freeze" to the shaft and cannot be adjusted further.

6. Check the "hot" or shrunk–on position of the hub on the shaft. The advance from "cold" to "hot" position along axis of the shaft must be held within the limits indicated. Check the actual advance with an indicator gage, located in the same relative position as used to measure the "cold" position in item 3 (See FIG. 9.).

If the advance is not within specified limits, remove the hub and repeat the assembly procedure.

PINION MOUNTING

1. Fit pinions in same manner as outlined for sprocket hubs.

2. After being properly fitted, mount by shrinking on shaft extension, except the advance should be 0.120 to 0.130 inches. The pinion should be heated to approximately 215°C (387°F) above shaft temperature to obtain this advance.

HUB REMOVAL

When removing a sprocket hub, use a suitable puller, similar to Cat. 9949772 (See FIG. 10.). This is a simple, efficient hydraulic puller employing the float method of Blackhawk No. P–228–1 pump kit, a backing plate, an adapter and a felt ring.

Do not heat the hub before pulling it, and do not use steel wedges between the hub and bearing cap.

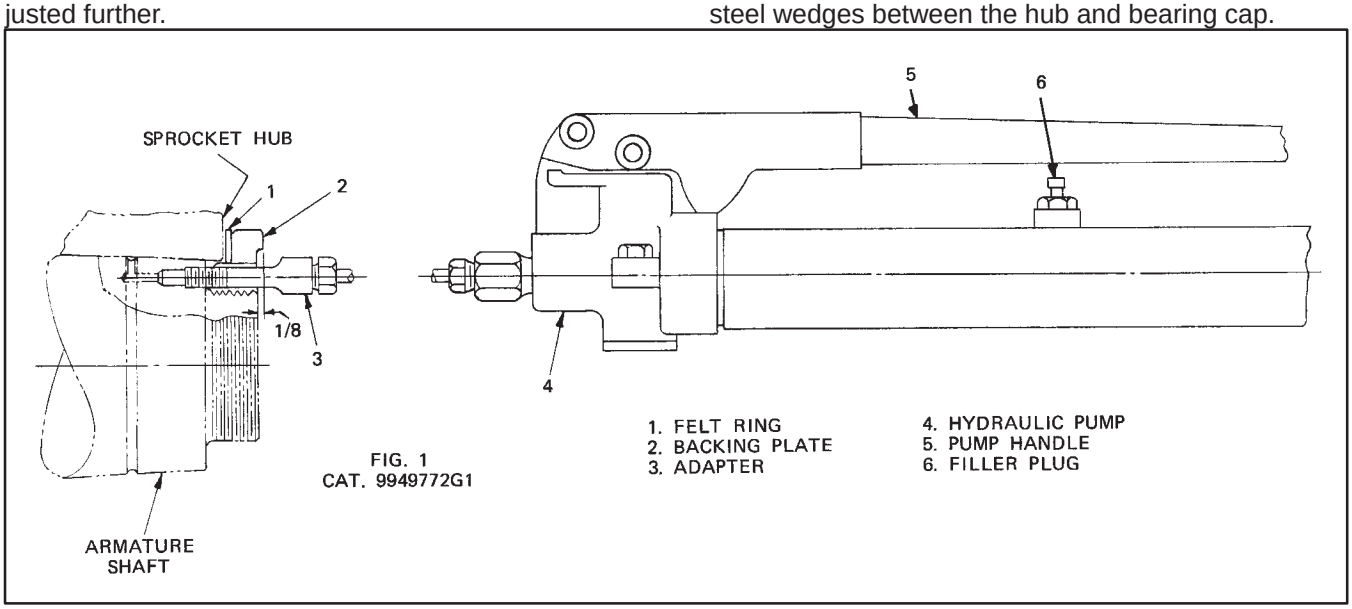

FIG. 10. HYDRAULIC SPROCKET HUB PULLER. E–5425A

1. Remove the set–screw plug from the tapped hole in the end of the shaft.

2. Screw the backing plate, with felt ring in place, to the end of the shaft as tight as possible by hand. Back off the backing plate to line up the slot with the tapped hole in the end of the shaft. This is to provide sufficient clearance for the hub to pop off.

3. Screw the pressure–fitting adapter into the hole in the shaft until it seats at the bottom.

4. Attach the pump by screwing the connector on one end of the pressure tube into the adapter, and the other end into the pump.

5. Close the hand relief valve and work the pump handle to force oil into the groove in the armature shaft under the hub. When sufficient pressure has been built up, the hub will "pop off" the shaft and be stopped by the felt washer and backing plate.

NOTE: Capacity of the pump is 40,000psi. It holds sufficient oil to remove eight to ten hubs; check at each use. Periodically remove the filling plug and refill with SAE–10 lubricating oil.

6. Open the relief valve, disconnect the pump from the adapter, remove the adapter and backing plate from shaft, and lift off the hub. Reinsert the plug to prevent clogging of the hole.

PINION REMOVAL

Remove the pinions in exactly the same manner as outlined for removing a sprocket hub.

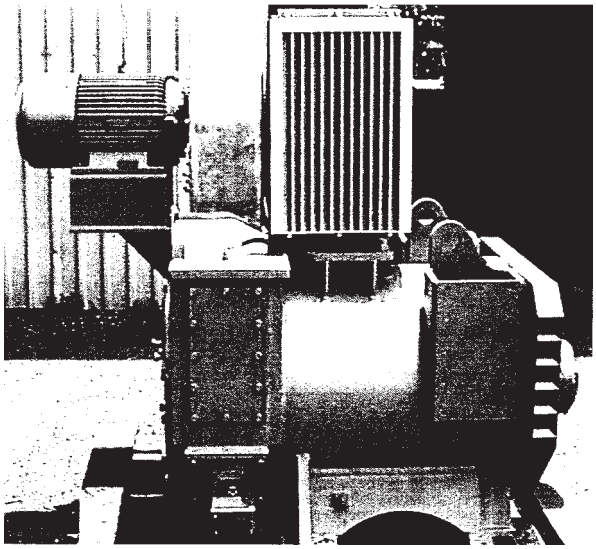

FIG. 11. GEB22 AC DRILL MOTOR WITH ATTACHED BLOWER ON SHIPPING SKID E–44113

AC EQUIPMENT

RECEIVING, HANDLING, STORAGE

RECEIVING

An example of AC equipment is shown in FIG. 11. On its shipping skid is the GEB22 AC drill motor with an attached blower.

The equipment should be placed under adequate cover immediately upon receipt as packing coverings are not suitable for out–of–doors or unprotected storage. This includes adequate protection from construction dirt during and after installation.

Each shipment should be carefully examined upon arrival. Any damage should be reported promptly to the carrier and to the nearest office of GETS.

HANDLING

The individual motors or generators can be lifted by using hooks or slings in the lifting lugs on the frame. These lugs are designed to safely carry the weight of the whole machine, including normal machine mounted accessories. Blowers should be protected with spreader bars as necessary. Ventilating hoods may need to be removed to clear hooks. **Do not** lift the machine by the shaft extensions.

WARNING: Before attempting to lift any machine, check the outline drawing for the lifting points. Unless otherwise specified on the outline drawing, lifting devices are intended to support only the part to which they are attached. Lifting devices on accessories are not suitable for lifting the total weight of the assembled machine. Machine lifting devices are not to be used to lift the machine plus additional equipment such as pumps or other driven equipment. Failure to observe these precautions may result in damage to the equipment, injury to personnel, or both.

STORAGE

If a machine, or any part of a machine, is not to be installed immediately, it should be stored in a clean, dry area and protected from variations in temperature, high humidity, and dust. If possible, sudden change in temperature and humidity should be avoided. If the temperature of the storage room varies to such an extent that the windings and coils are exposed to moisture condensation, the machine should be protected by a safe, reliable heating system such as space heaters, which will keep the temperature of the machine slightly above that of the storage room.

If the machine has been exposed to low temperatures for an extended period of time, unpacking it before it has reached room temperature will cause condensation to form.

If visible moisture is present on machine surfaces, take steps to thoroughly dry the machine prior to operation to avoid the possibility of electrical failures.

All exposed machined steel parts are coated with a rust preventive before shipment. These surfaces should be examined carefully for signs of rust and moisture, and recoated if necessary. Once started, rust will continue if the surface is recoated without first removing all rust and moisture. Rust may be removed by careful use of fine abrasive paper. Slushing compound can be removed by using a solvent such as mineral spirits.

WARNING: Mineral spirits are flammable and moderately toxic. The usual precautions for handling chemicals of this type should be observed. These include:
1. Avoid excessive contact with skin.
2. Use in well ventilated areas, and
3. Take necessary precautions to prevent fire or explosion hazards.

CAUTION: Care must be taken when cleaning to avoid damaging machined surfaces. Extreme care must be exercised to prevent these parts from rusting since it is difficult, and sometimes impossible, to remove rust from these surfaces without damaging or deforming the surface. If burrs or bumps result from careless handling, carefully remove them, using a fine file or scraper.

CAUTION: Machines in storage should have the insulation resistance checked at frequent and regular intervals with an instrument such as a megger. A log should be kept of pertinent data. If the log indicates a decreasing insulation resistance, the motor should be moved to a drier location.

CAUTION: When stored, the rotor must be rotated every three months to prevent loss of grease protection on the bearings and races. Loss of grease protection causes rust. Before rotating, inspect commutator for protective mylar wrapping. Rotate in the direction which will not snag the mylar end. Insure the end of the mylar is taped in place to prevent snagging and rolling up.

DESCRIPTION

All machines are equipped with a tapered shaft extension on the drive end. A shaft extension suitable for mounting a speed tachometer is standard on the opposite end. All motors have class H insulated stator windings.

INSTALLATION

WARNING: Installation should be in accordance with the National Electrical Code and consistent with all national, local, and product specific Codes of Practice, particularly when operation in a hazardous area is involved. Coupling, belt, and chain guards should be installed as needed to protect against accidental contact with moving parts. Machines accessible to the public should be further guarded by screening, guard rails, etc., to prevent the public from coming in contact with the equipment. Failure to observe these precautions may result in injury to personnel.

WARNING: Disconnect power before touching any internal part. High voltage may be present even when the machine is not rotating. Failure to observe these precautions may result in injury to personnel.

LOCATION

Motors and generators should be installed where they will be readily accessible for inspection and maintenance. They should be installed where they will not be exposed to moisture, escaping steam, dripping pipes, paint overspray, acid, alkali, oil, gas, dust, dirt, lint, silicone vapors, or other injurious substances.

WARNING: The use of electrical equipment in hazardous locations is restricted by the National Electrical Code, Article 500–504. This includes locations where fire or hazard may exist due to flammable gases, vapors, or liquids, combustible dust, or ignitable fibers or flyings. Standard motors and generators are not designed to be suitable for use in hazardous locations such as these, and should not be used in such locations. Consult Articles 500–504 and local codes and authorities for details of hazardous locations and application of electrical equipment and motors therein.

VENTILATION

A supply of clean air must be available to the machine during operation. Unless otherwise specified, the temperature of the air entering the machine should be within the limits stated on the nameplate. To avoid collection of condensation in the machine, the dewpoint of the air should be lower than the minimum surface temperature of any upstream air cooler. Contaminated cooling air must be avoided. Moisture and dust contaminants and liquids such as oil are easily recognized and can be eliminated.

THREE–PHASE POWER SUPPLY REQUIREMENTS FOR AC MOTORS

WARNING: If the motor is operated in a potentially explosive atmosphere, the three–phase power supply shall be as specified in the certification document issued for the motor.

The three–phase power supply for the AC motor, whether of normal power frequency or of variable frequency as obtained from an inverter, must conform to the values and limits inscribed on the motor nameplate.

The three–phase power supply for the AC motor shall not allow the motor to be held or operated in the stalled condition for a time greater than that stated on the motor nameplate or elsewhere.

Supply cables from the three–phase power supply to the AC motor shall be properly rated to safely carry the maximum load current at the maximum ambient temperature.

The supply system shall contain all of the necessary control, start, stop and emergency stop functions required for safe operation of the equipment.

PROTECTION

CAUTION: Windings and bearings should be carefully protected during installation to avoid damage from paint spray, weld splatter, welding rod butts, or metal chips from files and grinders. Metal particles which lodge in windings can cause either immediate or premature failures.

MOUNTING

Motors should be mounted on rigid and solid foundations. Level the base (or the machine). Hold–down bolts should be inspected regularly and kept tight. The feet of the machine may be doweled to the foundation plates or base when alignment procedures are completed. Sliding bases, when used, should be securely anchored to the foundation. Jacking holes are located in all motor feet for ease of alignment.

Care should be taken to ensure that the foundation and the mounting are shock and vibration resistant, and that these do resonate or transmit shocks and vibrations to the motor from other neighboring equipment and structures. All applicable national standards, rules and codes of practice shall be followed.

If the motor is to operate in a hazardous area, it's installation and operation must be in full compliance with the latest version of IEC Publication 60079–14.

ALIGNMENT

CAUTION: Be sure to align, or check alignment carefully on either motors or MG sets. Misalignment can cause excessive vibration and damaging forces on shaft and bearings.

Time taken to assure good alignment will be returned in reduced downtime.

COUPLED DRIVES

When a motor and a driven unit together have four or more bearings, flexible couplings should be used to facilitate alignment. Three–bearing construction requires a rigid coupling.

CAUTION: Careful alignment of machines when using either solid (rigid) or flexible couplings is essential to prevent excessive vibration, hot bearings, or shaft failures.

COUPLINGS

Couplings must be properly sized to be capable of driving maximum machine torque. Interference fits should be used between motor shaft and coupling.

V–BELT DRIVE

The driving and driven shafts should be located so that they are parallel and the sheaves aligned. If properly aligned, there is minimum wear on the belts and no excessive thrust on the machine bearings. The sheave should be mounted as close as possible to the motor bearings. The following recommendations should be followed concerning the minimum sheave pitch diameter which can be used for the particular motor. The belt manufacturer should be consulted for the maximum speed ratio and belt for the particular application.

The following formula and data can be used to select the MINIMUM allowable sheave diameter from the standpoint of bearing life and shaft stress. A larger sheave will further reduce the shaft stress and bearing loading. This data is based upon the belts being tightened to a maximum total pull of 1.5 times the required transmission load used in the sheave diameter calculation. Belts should never be tightened more than necessary to transmit this torque.

$$D = \frac{HP}{RPM} \times \frac{189000}{W}$$

Where:

D = Minimum sheave pitch diameter in inches for V–belt application

$\frac{HP}{RPM}$ = Maximum ratio of horsepower, including over loads, to the speed at which that power occurs

W = Maximum allowable radial load

Belt–driven machines may be equipped with sliding rails. Proper and constant belt tension is easily maintained and the replacement of belts is simplified. This reduces the operating cost and increases the efficiency. Sliding rails are to be used for floor mounting only.

Belt idlers reduce the life of the belts and should not be used if any other method is available. The belts should never be forced over the sheaves. When the drive is started and operating at full speed and full load, the take–up should be adjusted until only a slight bow appears in the slack side. If slippage occurs after the belt tension has been correctly adjusted, the belts and pulleys have not been chosen properly for the job.

CAUTION: Over–tightening to avoid this slippage may result in early failures of belts, shafts, and bearings.

Belt tension should be checked and adjusted following the belt manufacturer's recommendations.

There is normally a drop in tension during the first 24 to 48 hours of operation. During this "run in" period, the belts seat themselves in the sheave grooves and initial stretch is removed. Belt tension should be rechecked after a day or two of operation.

Matched belts run smoother, look better, and last longer. Longer belt life results if the belts and sheaves are kept clean and the belts are prevented from rubbing against the belt guards or other obstructions.

GROUTING

On concrete foundations, a minimum of one inch (25mm) should be allowed for grouting.

A rich, non–shrink grout should be used. High–grade grout mixtures are available commercially. If the grout is to be prepared at the site, a cement–sand ratio of 1:2 is recommended. Just enough water should be used to give a stiff mixture. The clean, but rough surface of the foundation should be wet and the grout rammed or puddled under the base.

ALIGNMENT PROCEDURE

Flexibly Coupled Drives

Level all mounting base supports before setting the base in position. Before grouting the base, the alignment should be checked as follows:

1. Remove all coupling bolts and slide the shells back so the hub faces are exposed.

2. Check the coupling hub spacing is in accordance with the outline dimensions with the units in the mechanical center of their end play.

3. Start with the coupling next to the largest unit (usually the motor) or near the middle of multiple units. Check the radial alignment by using a straightedge across the two hubs at vertical and horizontal. Or, clamp a dial indicator to one hub and use the outside diameter of the other member to give indication of the misalignment. Be sure the dial indicator supports do not bend or sag, since this will give inaccurate readings. The maximum variation should not exceed 0.002 inches (0.05mm).

4. Insert feeler gage or use the dial indicator at hub faces. Measure the gap between hub faces at 0, 90, 180 and 270° and record. Rotate both shafts together 90° and repeat the gap readings. Continue rotation in 90° increments until five sets of readings are taken. The fifth set of readings is a check on the first set of readings to assure that data is reliable. The readings should not vary by more than 0.002 inches (0.05mm) between the four readings taken at each coupling position.

5. Correct the horizontal alignment by shifting frames on the base and the vertical alignment by shimming between the machines and the base.

6. Repeat steps 2, 3 and 4 on each coupling, working away from the motor or center unit.

7. Recheck the couplings on long sets after completing the above checks, because shimming when checking subsequent units may affect those already checked. After the set has been aligned within the specified limits, the coupling shells may be bolted together.

The motor feet may be doweled to the base if desired.

THRUST LOADS

Machines are expected to have no continuous external thrust (axial) loads.

OPERATION

WARNING: High voltage electric shock can cause serious or fatal injury. Disconnect power before touching any internal part. High voltage may be present even when the machine is not rotating. Also disconnect power from auxiliary devices. Failure to observe these precautions may result in damage to the equipment, injury to personnel, or both.

WARNING: Ground the machine properly to avoid serious injury to personnel. Grounding should be in accordance with the National Electrical Code and consistent with sound local practices.

INSPECTION BEFORE STARTING

These inspection procedures should be followed before starting the machine for the first time, after an extended shutdown, or after a teardown for extensive maintenance or repair.

BEARINGS AND COUPLINGS

Machines with ball or roller bearings are greased at the factory and will not require attention until relubrication is necessary.

Flexible couplings should be checked to see that they contain the proper amount of lubricant.

Make sure that all oil and grease plugs are tight.

INSULATION

Check and record the insulation resistance of each machine, referring to the **INSULATION** section of the product manual.

CONNECTIONS

All terminal connections should be checked to be certain that the direction of rotation will be correct. Insure bolted connections are tight and that adequate clearances exist between conductors and ground. Bolted connections of flexible cable must be insulated.

PROTECTIVE DEVICES

CAUTION: See that all protective devices are connected and will function properly. Be sure all coupling guards, shaft protectors, grounding connectors, covers, and other safety devices are properly attached.

RTD'S

The RTD (Resistance Temperature Detector) is a protective device. It is not intended to limit motor loading or provide normal insulation life. When supplied, it is mounted between coil sides in six slots of the stator, two in each phase, and equally spaced. The device is especially useful in guarding against loss of normal ventilation air, high ambient temperature, and prolonged operation on overloads.

VENTILATION SYSTEM

Insure that blowers are ready to supply cooling air. Air filters should be in place. **Blowers should be checked for correct rotation.** Verify that all unused motor openings at the air inlet end are covered, including those on the bottom. Separately ventilated motors are shipped with all solid drive end covers. Remove and discard the cover over the intended air entrance. Motor openings at the oposite end should have appropriate covers for the type of air exit intended.

GENERAL MECHANICAL INSPECTION

Check the inside of the machine for tools, metal chips, or any other foreign material that may have accumulated during storage or installation. Make sure that all rotating parts have enough clearance from any stationary parts. Turn the machine over by hand, if possible, and check for scraping noises or any other sign of mechanical interference. Check the tightness of the bolts in the feet, couplings, conduit box cables, bearing housings, and any other bolts that may have been disturbed.

TIGHTENING BOLTED JOINTS

Since loose bolts can cause both electrical and mechanical failures, all bolts and nuts must be kept tight. The maintenance schedules include the checking of bolt tightness.

The following precautions, which apply to the tightening of bolted joints, should be observed in maintenance procedures:

1. Use a torque wrench for tightening only. When necessary to loosen bolts, use another type of wrench.

2. The pressure bearing surfaces and the threads of nuts and bolts should be clean, dry, and free from oil and grease when torqued to the values given. Oiled threads require that torque values be reduced 10 percent.

3. When initially tightening a bolted joint, the final turn must be tightened with the torque wrench to obtain an accurate setting.

Loose bolts will cause serious failures on industrial equipment. Even though all of the bolts are torqued to the specified values during manufacture, they must be checked on site periodically. Experience has shown that bolted joints are subject to loosening during shipping. Both vibration and the heating and cooling of bolted joints cause them to loosen.

For these reasons, the bolts should be checked according to the recommendations below:

1. Before start up, make a visual inspection and spot check bolt tightness with a torque wrench.

2. Then, every six months or as often as experience dictates, check all bolt torques.

NOTE: It may be difficult to use a torque wrench on some bolts due to machine location or mounted accessories. A good method of checking the torque on these bolts is to first get the feel of the desired torque with a torque wrench on an accessible bolt. Then, immediately check the difficult bolt using a normal wrench with approximately the same lever arm.

Most mechanics will come within 10 percent of the desired value.

INSPECTION AFTER STARTING

The following items should be checked after the machine is running

WARNING: Avoid contact with moving or electrically hot parts. When working with rotating electrical machines, avoid wearing loose clothing or jewelry.

Bearings

Place thermometers on all bearing housings so that bearing temperatures can be watched for a few hours. Ball or roller bearing housing temperatures should be not more than 25°C above room temperature or a maximum of 65°C on the bearing housing at the air enlet end. The maximum is 80°C on the bearing housing at the air discharge end. Higher temperatures than this indicate trouble. Check alignment and lubrication. Do not overgrease.

Noise And Vibration

Check for unusual vibration or noises that might indicate rubbing or interference. New machines may smell warm or have the odor of varnish, but should not smell scorched.

Vibration of new machines should not exceed 0.002 inches (0.05mm) at the bearing housings. The most likely cause of vibration in new machines is misalignment due to improper installation, loose foot bolts, uneven shimming under feet, or damage to the machine during shipment or installation. Voltage harmonics may also be a source of vibration, audio noise and EMI.

BEFORE PUTTING MACHINE IN SERVICE

Run at light loads or at no load for a few hours to determine that no unusual bearing temperatures occur, and that no localized electrical heating results.

INSPECTION AFTER SHORT TIME IN SERVICE

After a machine has been operating for a short time, an inspection should be made to ascertain that there have been no changes since installation. Check for increased vibration, signs of change in alignment or foundation settling, bolts that may have loosened, rubbing parts, loose connections, and worsened commutation. Take the proper steps to correct the trouble.

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