

ON LOAD GEARS

INSTALLATION, OPERATION

&

MAINTENANCE
INSTRUCTION

TAPCHANGER TYPE RMV

M40 085/R1

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TAPCHANGER RMV

INTRODUCTION:

Tapchanger type RMV is a single compartment, selector switch type, high speed resistance transition On Load Tapchanger which employs a single rotary switch for selecting taps, and simultaneously switching on current. The live parts are enclosed in an oil tight Contact Cylinder Vessel. The entire Tapchanger is suspended from a head plate which is mounted by the Transformer manufacturer on the top roof of the Transformer.

This manual covers the installation, operation & maintenance aspects of Tapchanger type RMV. It is meant to assist the Transformer manufacturer, and the final user of the Transformer. Some paragraphs below are of particular importance for the Transformer manufacturer, while others are of particular importance to the final user. The paragraphs of particular importance to the Transformer manufacturer are Paras A2, A3, A4, A5, B1, B2, C and D. Even though these Paras are meant mainly to help the Transformer manufacturer, we recommend that the final user reads thorough the entire manual, inclusive of the Paras mentioned, so that he is thoroughly familiar with the equipment.

Please take note of “CAUTION” Note under Para A5 for any Installation & Maintenance work.

1. INSTALLATION INSTRUCTIONS

A1 : GENERAL DESCRIPTION OF THE STRUCTURAL PARTS OF TAPCHANGER TYPE RMV.

Fig.1 shows the general structure of Tapchanger type RMV.

In certain applications, the Transformer may be provided with a Tapchanger arranged in two columns, or even in 3 columns. The following description applies to Single Phase, Two Phase, and Three Phase units.

The Tapchanger type RMV is intended for mounting into the main transformer tank. The current making and breaking contacts of the tap selector are enclosed in an oil tight Contact Cylinder Vessel. The vessel prevents mixture of the oil in the Tapchanger, which may be contaminated after some use, and the relatively clean Transformer oil. It has several sealed contacts for establishing connection between the Transformer and the Tapchanger. These seals do not need maintenance for life.

The contact cylinder vessel is attached to the Tapchanger head, which is of steel and fixed by fasteners and gaskets. These gaskets do not need replacement for life.

The Tapchanger head contains the Energy Storage Mechanism, and other parts of the drive. The moving contacts are mounted on a removable insert. The Insert, and the Energy Storage Mechanism of the drive are accessible after removing the head cover. The details for this follows in Para I.

A2 : MODE OF DESPATCH

The Tapchanger is despatched from our Works to the Transformer manufacturer in packing cases containing the following parts.

01. The Tapchanger unit.
02. The Drive Mechanism
03. The horizontal and vertical Drive Shafts, complete with vernier couplings made of aluminium.
04. Fasteners and “O” Rings for the Couplings.
05. Bevel Gear
06. Pressure Relief Device.
07. Oil Surge operated Protective Relay.

In some cases, in response to clients wishes, some of these parts may be pre-mounted together.

All items are individually sealed in plastic bags to prevent ingress of the moisture.

While breaking open the crates, please make sure that the equipment is not damaged.

A3: INSTALLATION IN TRANSFORMER

The Tapchanger unit is installed into the Transformer through a single cut-out. The gasket between the Tapchanger head of the Transformer plate is not supplied by OLG, but must be provided by the Transformer manufacturer.

Please note that while the Tapchanger can be lowered into the Transformer tank through a single cut-out, the clearance between the outer most diameter of the contact circle, and the cut-out is quite small. Therefore, care must be taken to ensure that the Tapchanger is properly centered & lowered gently without striking the cut-out. The Tapchanger is retained in position by M12 studs on the Transformer roof plate.

The Drive Mechanism is to be mounted on the external vertical wall of the Transformer . The Bevel Gear is to be mounted on a bracket on the same vertical wall, and in line with both the output Shaft of the mechanism, and the input shaft of the Tapchanger head. For this purpose OLG recommends that the Transformer bracket holes are slotted, so that the Transformer manufacturer can adjust the position of the bracket in assembly. Better alignment will lead to longer life, and noiseless and vibration free operation.

The method of coupling the mechanism, and the Tapchanger is described in Para C below.

Fig.2 shows the complete installation schematically.

A4: CONNECTIONS:

After the Tapchanger is installed, connections between the Tapchanger and the tap winding must be made in accordance with the specific connection drawing pertaining to the particular job. Please note that in the case of Tapchangers with Pre Selector, the connections between the Pre-Selector and the Selector, as also from the Pre-Selector to the Transformer winding lie in the scope of responsibility of the Transformer manufacturer.

In the case of application where the star point is made in the Tapchanger, it is the responsibility of the Transformer manufacturer to connect the output points of each phase of the Tapchanger to form the star point.

The Contact stem of the Contact Cylinder Vessel are fastened by special round nuts with M24 thread. These are tightened by OLG with a special tool, and torque wrenched. In the remote possibility of your finding any contact loose, please do not try to tighten them yourself. It is better to call OLG to attend to this work. Severe tightening may lead to cracking of the Contact Cylinder Vessel.

A5. FEATURES ON THE HEAD & COVER :

The only parts of the Tapchanger itself that are visible outside the Transformer Tank are the Head & Head Cover. Fig.3 shows the features available on the Head and Head cover.

The Pipe Flanges, for Oil Surge Relay, and Filtration Pipes are fully orientable through 360°, by loosening their holding clamps. If this facility is used, the clamps must be fully tightened afterwards to prevent leakage.

In this context, a general note of caution.

CAUTION :

In general all fasteners are locked with chemical thread sealant. Wherever possible there is additional mechanical locking with a locking plate. These locking plates can be re-used.

Because of the thread sealant, you will find all fasteners are very tight when you try to remove them. This is in order. The fasteners can be forced against thread sealant safely.

We recommend the use of thread sealant like LOCTITE Make Grade No.242, or ANABOND 122 when re-installing the fastener in position. For this purpose, the remainder of the thread sealant applied earlier may be removed, using a Tap or Die, as the case may be. All the detritus must be blown out with compressed air, so that it does not get into the Tapchanger again.

The Head cover gasket may shrink a little on long storage. Before filling with oil, please re-tighten all M 10 Bolts, BUT WITH FEEL, so as not to over-tighten and strip off threads. Torque wrench value : 4 kgf.m

Please note that there is a Glass Window, with a spring loaded Weather Cap on top, for showing Tap No.

B: TRANSFORMER MANUFACTURE

B1 : PROCESSING THE TRANSFORMER :

The Tapchanger may be processed along with the active core and coil assembly as in normal Transformer practice. The Mechanism Box, Bevel Gear, and Oil Surge Protective Relay should not be processed in any case.

When the Transformer manufacturer specifies it, all internal Gaskets are made of Viton, to suit Kerosene Vapour Phase Drying. Otherwise, Gaskets are Nitrile, which can safely withstand Transformer drying process upto 100°C.

Always equalise one of the two Pipe Flanges on the Head to the Transformer Tank, so that

the Contact Cylinder compartment, and contents are thoroughly processed.

In case of kerosene vapour drying, the condensate must be drained from the Contact Cylinder. For this purpose, two plugs are provided on the bottom flange. One is operable from the top, and the other from the bottom. For cover suspended Transformers, it may be easier to use the drain plug provided on the bottom side of the bottom flange. Re-tighten the kerosene drain plug after draining all kerosene.

After processing, fill with processed Transformer oil at a temperature of not more than 90°C. It is desirable that oil BDV (at room temperature) should not be less than 50 kV in IS Cell. The differential temperature between the Tapchanger and the oil must not exceed 30°C.

It is necessary to air release, both from the Head Cover, and very importantly the Suction Pipe to ensure that all Contact Cylinder spaces are truly oil filled. Finally release air from the transformer space under the Head, using the Head mounted Air Release provision.

B2.COMPLETION OF INSTALLATION OF THE TAPCHANGER:

After the Transformer is processed, and the Tapchanger filled with oil, release air from the two Air release screws on the Head, and Head Cover. Top up oil if necessary.

Please remember to release air from the Suction Pipe. It is done through the air release screw provided on the top most point of the suction take of pipe.

Observe that the Air Release screws are captive. There is a gasket under the Brass Air Release screw, and another under its Weather Cap. Tighten both gaskets to ensure that no oil leaks.

Pipe connections can now be made to the Oil Surge Operated Relay Flange, through a gasket. (not part of OLG supply).

Install the Bevel Gear, and the Drive Mechanism Box (See Para C also below).

C : INSTALLATION OF DRIVE SHAFTS

C1. ALIGNMENT OF SHAFTS :

The Drive shafts are so designed, that they can be installed in position, after fixing the Tapchanger, the Bevel Gear, and the Drive Mechanism in their assigned position. (see Para C2 below).

Even though the drive shaft system tolerates a small degree of mis-alignment, it is best to set the Head, Bevel Gear, and Mechanism in good alignment, to minimise noise, and enhance leak free life.

For this purpose, it is best to adopt the following technique.

- a) Align the shaft of the Worm Gear Box on Head with the Bevel Gear shaft, by adjusting the Bevel Gear Housing in its slots.

b) In Tapchangers with more than one column, it is essential to align all three Worm Gear Shafts.

c) Now align the Mechanism shaft exactly below the Bevel Gear Shaft, by adjusting the position of the Mechanism Cabinet.

If the Transformer manufacturer intends to remove the Mechanism and the Bevel Gear for Transport, it is recommended that after alignment, they are dowelled in position by at least two 8 dia. pins, so that they can be reset again correctly at site.

C2. INSTALLING THE DRIVE SHAFTS :

Fig.4 shows the manner in which the Drive shaft has to be installed.

All the heavy components, viz. The Tapchanger Head, the Bevel Gear, and the Mechanism Box may be installed on the Transformer in the final service condition, without reference to the Drive Shafts. The design of the Drive Shaft permits that the shafts can be installed easily between the fixed heavy mechanical parts.

The Drive arrangement consists of a square stainless steel tube with vernier couplings at each end. One half of the vernier couplings is attached to the end of the round shaft of the major component, namely the Head, the Bevel Gear, or the mechanism. The other half of the vernier coupling takes on the square drive tube. The drive tube is clamped on to the vernier coupling by means of removable triangular shaped clamping pieces which are bolted on to the vernier coupling by means of stainless steel fasteners. All these items are sent fixed in their respective positions at the time of despatch of the Tapchanger from our factory. But we do not fully tighten the fasteners, so that you can take them off easily, install the square drive tube in position and then tighten.

After installing the Tapchanger parts, the Transformer Manufacturer must measure the exact distance between the vernier couplings and cut the stainless steel tube to suit. (We normally send the Stainless Steel tubes about 100mm more than required). The tube can then be installed in position and clamped.

In case of re-installation at site of Drive Shafts which may have been taken off for transport, there is no need for further length adjustment of shafts. This would have been done already at the manufacturer's works.

C3. NOTE FOR THE TRANSFORMER MANUFACTURER :

For despatch of the Transformer to site, you may remove the drive mechanism and the vertical drive shaft for transport. You may also remove the Bevel Gear and the horizontal drive shaft depending on your convenience.

We request you to kindly ensure that all the vernier couplings, drive shafts and loose fasteners are properly accounted for and forwarded to site. We strongly recommend attachment of the couplings and their fasteners at respective shafts ends, as we do for despatching the Tapchanger to you. This will ensure that no mechanical detail is lost.

In order to compensate for likely loss of small items on the shop floor, we send sufficient extra quantity of stainless steel fasteners and split pins with our despatch.

C4 INSTALLATION OF HORIZONTAL SHAFTS FOR MULTI COLUMN UNITS :

It is important that the horizontal drive shafts between the individual phase units are installed in such a manner that all the divertors definitely change over and, thereby complete a Tapchange, before the common mechanism cuts off at the end of each Tapchange. A small divergence between individual switchings of the divertors is however unavoidable and does not harm the equipment in any way.

To ease this job, OLG despatches all Tapchangers in a synchronized condition with the mechanism. However, it is very likely that during Transformer erection, both at the works and at site, the relative positions may be inadvertently disturbed.

It is therefore safer to always follow the procedure described below.

Turn each Tapchanger by inserting a rod in the hole of the Worm Gear Box, or the Aluminium Vernier coupling. Bring each Tapchanger to tap No.7, **from lower Tap Nos.** (Tap Nos. are visible through the Glass Window on the Tapchanger Head). Stop turning immediately as you hear the divertor discharge at Position 7 in each case.

Having brought all the three divertors to this position, you can install the horizontal drive shafts now, without disturbing the relative positions of the Worm Gear Shafts. Use the Vernier coupling to allow installation of square tube drives.

You must counter – check before completing this work that all the three divertors change over each time before the mechanism gets cut off by its own termination point. If you find any of the divertors is left behind, you must isolate the corresponding Worm Gear Box on both sides and charge the divertor in the required direction and re-couple. Provision of a Vernier arrangement in the coupling greatly eases their work.

If the mechanism cuts off before the Divertors, you can uncouple the vertical coupling, and adjust, using the vernier arrangement provided here also.

C5 : SETTING TAP NUMBERS IN SYNCHRONISM :

The basic principle in coupling the Tapchanger to the Mechanism is to ensure that the Divertor Switch of the Tapchanger changes first, and only thereafter, the Mechanism should complete its operation. This should happen on both Raise and Lower direction.

It is necessary, while coupling the Mechanism to the Tapchanger Head, to ensure that the Position Indicator on the mechanism shows the correct Tap Number. This necessity arises

- i. At the Transformer Manufacturer's works, when first installing the Tapchanger on the Transformer.
- ii. At site, if the Mechanism is detached for Transport.
- iii. During service if any part of the Drive system is disturbed, accidentally, or for maintenance (e.g. re-painting).

The following procedure may be adopted.

1. Set Tapchanger at Position 7. Observe the Tap No. of the Tapchanger, through Glass Window at Head.
2. Before coupling the Mechanism to shafts, set the Mechanism to the same Tap No.7. Make sure the Green marking on the Timing disc is inline with the pointer. (Fig.8).
3. Couple Drive Shaft, and rotate handle clockwise manually, till the Divertor change over. It requires approximately 23 – 24 Turns / Tapchange.
4. Observe how many turns of Crank Handle are required after changing over of Divertor to obtain the Green Marking on the Timing disc.

Say X (this may be fractional)
Turns of Handle.
5. Now rotate Handle Counter-clockwise till Divertor changes over again. Observe how many turns of Crank handle are required after Divertor changes over to obtain the Green Marking on the Timing disc.

Say Y
6. If $X = Y$, the Mechanism is synchronous already, and no further adjustment is required.
7. If not decouple mechanism, by removing M8 fasteners on vernier coupling to the mechanism shaft.
8. Calculate $X - Y/2$
 - a) If positive, turn Manual Handle $X - Y/2$ in clockwise direction, without allowing the rest of the Drive Tube to rotate.
 - b) If negative, turn Manual Handle $Y - X/2$ in counter-clockwise direction, without allowing the rest of the Drive Tube to rotate.
9. Re-assemble M8 fasteners, to align pre-drilled holes. Place Flat Washer, and tighten Nut. Insert split pin.
10. Take mechanism through all Tap Nos. by manually turning the handle, carefully noting that at each position, when the Green marking is inline with the pointer, the Tap Nos. at the Head, and the Mechanism are same.
11. **CAUTION** : Approach both ends of the Tapping Range with caution. Check that both Electrical and Mechanical Limit Locks are operational.
12. It is advisable to repeat step 10 & 11 each time, for whatever reason, the Head and Mechanism become decoupled and have to be re-coupled. Electrical operation should be restored only after checking step 11 above.

C6 : SETTING UP ELECTRICAL OPERATIONS AT MANUFACTURER'S WORKS :

For instructions on setting up the Electrics, please see Para G1.

D : SUGGESTIONS ON TRANSPORT OF COMPLETE TRANSFORMER :

Since the components mounted on the Head Cover are at the highest part of the Transformer Tank, it is very likely that they may be struck by low tree branches during road transport from the Transformer manufacturer works to site. Transporter may be cautioned regarding this.

For greater safety against damage on transport, we recommend the use of a steel transport cover around the Head..

We recommend that the Pressure Relief Device is always removed and despatched separately.

Most probably, you may want to take off the Drive Mechanism, Bevel Gear, and Drive Shafts for transport.

In order to ease the job of re-installing all items removed for transport, and to make these instructions easy to follow, we recommend that both the Tapchanger, and the Mechanism are set at Position 7 for despatch. Shafts & Couplings may be match marked before taking off.

In order to take care of oil expansion during transportation and delivery, it is recommended that oil is drained to an extent of almost 100mm from full level. This is an extremely important precaution as otherwise during transport oil may leak out of the pressure relief device due to expansion.

2. OPERATING INSTRUCTIONS

E: ON RECEIPT OF TRANSFORMER AT SITE:

For greater safety against damage we recommend to the Transformer Manufacturer to use a Transport Security Cover on Top, bolted to the Lifting Hooks of the Head cover. This may be removed first, and stored away separately, for future use.

Examine to see that the items on Head and Cover, and particularly the Drive Shafts, have not been damaged in transit. Then complete installation of items (i) to (v) listed below.

It is possible that the Transformer manufacturer may remove, for the purpose of transport, some items from Head, and Head Cover (Fig.3). Items removed will depend on the distance, and type of transport, as well as the Transformer Manufacturer's decision on safety of equipment. These are :

- i. Pressure Relief Device, (Fig.5)
- ii. Oil Surge Operated Relay (Fig.6)
- iii. Bevel Gear (Fig.7)
- iv. Drive Mechanism (Fig.8)

These will then be packed and despatched to you separately. They may be installed in position, after removing temporary blanking plates. In this context, see "CAUTION" Note under Para A5.

Items (i), (ii) and (iii) need Gaskets / "O" Rings underneath.

In case the Drive Shafts have also been taken off, they may be re-installed following carefully the procedure outlined in Para C2, C5. Please see also Para F below.

The Transformer manufacturer is likely to have drained at least a small amount of oil to take care of possible expansion during transit. It is necessary to top up this oil.

In case oil has been completely drained from the Divertor compartment, this will have to be filled, and Air released. Please use oil with a BDV of not less than 50 kV in IS Cell.

F : SETTING IN OPERATION AT SITE:

If the Transformer manufacturer has observed our recommendation, you will receive the Tapchanger, and the Mechanism set at Position 7.

Before connecting the Electrical Drive, it is better to use the Mechanical Handle, and take the Tapchanger to both end positions once. At each position, ensure that the Tap Number shown in the Window on the Tapchanger Head is the same as that on the Mechanism.

Tap Numbers on the Mechanism appear in a Window provided for the purpose of observing Tap Numbers (Fig. 8). Tap Numbers are inscribed on the edge of the Tap change in Progress Wheel, inside the Mechanism Cabinet.

You will also observe that the Timing disc has a painted Green marking. When operating the Tapchanger, always keep turning the handle till the Green marking is inline with the pointer. It is at this position that you must read Tap Number.

At the end positions check that the Electrical Limit Switches have operated. Make a note of which switch operates at the “Raise Limit”, and which at the “Lower Limit”. Turn the handle further on, after the limit switches have operated. After about 3 to 5 turns of the handle, the Mechanical Limit system operates, and cuts off drive to the Tapchanger. This system re-sets automatically, when you reverse the handle.

G1 : ELECTRICAL OPERATION :

Set the Tapchanger in Position 7.

The operation of the Drive Mechanism has been fully tested at works before despatch. You should therefore have no problem of commissioning the equipment at site. We however recommend that you push in all the Fuse Carriers, Links, and the Terminal Blocks firmly home before commissioning, as they may have worked loose in transit.

Connect 3 Phase, 4 wire, 400 ... 415V supply to the corresponding terminals on the Terminal Block, taking care to see that the Phase sequence is correct.

In certain cases, on customer specification, a separate Single Phase 220V supply is needed for working the Auxiliaries such as the Heater and Lights and Plugs. In such a case, connect the auxiliary supply also.

In case of an execution with Remote Tapchanger Control Cubicle, where the latter may not have been installed, certain temporary connections are to be made at the control wire Terminal Blocks. You will find a Label affixed on the inside of the Mechanism door giving you these details. After these links are complete, the Tapchanger is ready for Electrical Operation.

Switch on the Tapchanger supply Isolating Switch, and Heater Switch. Reset the Motor Protective Relay.

If the Local / Remote Control Selector Switch is provided in the Drive Mechanism Box (this is not always the case; it is sometimes provided in the RTCC) set it to “Local”.

By pressing the Operating Button marked “Raise” the Tapchanger will automatically run and complete one Tapchange and stop. Make sure “Raise” button causes Tap Number to increase, and “Lower” button causes the Tap Number to decrease. Otherwise, reverse the Phase sequence of the supply immediately.

Return to Tap No.7. Press the “Raise” button again but this time, while the Tapchanger is still running operate Limit Switch for Raise manually, which you would have already noted, according to the Instructions of Para F. Please take care of your fingers at that time. The Motor should now stop. Release the Limit Switch, and press “Raise” to complete the Tapchanger. Repeat corresponding procedure for “Lower” direction. This proves the Limits are working properly before you actually go to the limits.

G2 : A NOTE ON MECHANICAL END POSITION LIMITER :

This mechanism is equipped with a very advanced concept torque sensitive slip device for end position cut off. At the end positions, the motor may be safely run, without any damage being caused. When reversed, the slip mechanism automatically resets.

In some cases, during motor operation, the slip mechanism may make one or two “thud” noises before completely disengaging. This is acceptable, and does not represent any failure.

The slip mechanism is set to a required torque. In case, when the torque in the shaft increases above the set limit (due to misalignment of shafts & other reasons) the mechanism slips, terminating the drive to the Tapchanger from the motor.

G3 : HANDLE RESET :

For manual operation (FIG.8) push the yellow knob to engage the hand drive.

After manual operation push the green ring to reset to motor drive. An electrical interlock switch is provided in the hand drive to cut off the supply to motor. **Failing to reset will cause the mechanism not to function electrically.**

3. MAINTENANCE INSTRUCTIONS

H: MAINTENANCE SCHEDULE:

During routine checking of Transformer oil condition, visually examine the oil of the Contact Cylinder, through the Tap Position Window, or by bleeding from the Air Release Screw on Head Cover. If it is too black, oil may be checked in IS Cell. If BDV is less than 20kV we recommend Filtration/Replacement of oil.

Contacts of the Tapchanger are subject to wear by arcing in the normal course. Examination of these contacts involves pulling out the insert (See Para I). We recommend physical verification of contact condition once in every 3 years, or 12000 operations, whichever is earlier.

I: REMOVAL OF INSERT:

For the purpose of inspection and maintenance, the Moving Contacts, and Transition Resistance assemblies are made in the form of an Insert, mounted on the central switch shaft. The insert must be taken out of the Tapchanger for maintenance and inspection.

It is recommended when removing the insert for the first time that you take the help of OLG staff.

Even though gaskets, and O ring seals are re-usable if the dismantling is done carefully, it may be advisable to start with spare gaskets for the head cover, and 30 diameter x 2.5 cord Nitrile O ring for the suction pipe before commencing the overhaul work detailed in this paragraph. If you suspect you may need Contacts, or transition resistances, these may also be kept ready. These parts can be supplied by OLG on request.

For lifting the Insert easily, and without risk of damage to it, we recommend use of the Lifting Attachment shown in Fig.9. This can be easily fabricated by the user, or supplied by OLG if required.

The Insert is a live part. It can only be removed when the Transformer is switched off and grounded.

Before attempting to lift the insert, check if any external pipe work etc. of the transformer crosses overhead the Tapchanger. These have to be removed to make way for pulling the Insert out.

The weight of the Insert is approximately 85Kg. The Insert length (maximum) is 2000mm. (Fig.10). The Insert, when lifted out, must clear the top most point on the Head by at least 100mm. The lift must take care of these dimensions. It will be convenient if the lifting device is so arranged that the Insert, after being taken out of the Tapchanger can be swung around, without fouling with other fixtures of the Transformer, and lowered to ground. It will be more convenient to work on a bench on the ground, rather than on top of the Transformer.

Before removing the Insert, always place the Tapchanger in Tap No.7. Ensure that Tap No.7 appears on the tap position window, before commencing dismantling operations. Do not operate the Drive Mechanism during the whole procedure.

Removal of the Insert consists of the following stages, which are detailed in the following paragraphs.

- a) Removal of Head Cover. (Para I1)
- b) Removal of Main Operating Spring (Para I2)
- c) Disconnecting and Removal of the Suction Pipe. (Para I3)
- d) Removal of the Energy Storage Device.(Para I4)
- e) Removal of the active part (Para I5)

I1: REMOVAL OF HEAD COVER:

Remove the earthing connection attached to the earthing boss on the Head Cover (M8 bolt fastener).

The Head Cover is removed by taking off the 20 Nos. M8 nuts and bolts securing the head cover to the head (Fig.3). The gasket underneath is made of nitrile rubber, and therefore comes off cleanly without damage. The weight of the head cover is approximately 30 Kg. After removing the fastening nuts and bolts the head cover can be removed by lifting vertically up.

I2: REMOVAL OF MAIN OPERATING SPRING:

The main spring end plate pivots on a pillar fixed to the Energy Storage Plate. (Fig 11). Remove the M8 fastener and washer, and push the plate up to release from pivot.

It may be convenient to work with the free end of the spring swung back, and temporarily tied by a piece of string or wire to the body of the large gear housing of the energy storage device. This will prevent the spring from swinging from side to side and getting in the way during other work.

I3: DISCONNECTING AND REMOVAL OF THE SUCTION PIPE:

The Suction Pipe is located centrally on the Tapchanger, and goes right down to the bottom. (Fig.1) On the top end, it is connected by metal end pieces to the suction flange on the Tapchanger head. This assembly must be removed before the Insert can be taken out.

The 1" BSP lock nut at the coupling between the head, and the pipe work is first loosened. The coupling itself is then loosened by a plumber's pipe wrench. This disconnects the suction pipe assembly from the head. The pipe is now lifted vertically up, along with suction pipe.

I4: REMOVAL OF THE ENERGY STORAGE MECHANISM:

The worm drive shaft of the energy storage device is coupled to the input drive shaft by a tubular coupling. (Fig.11). The coupling is pinned to the shaft by 8 diameter Cotter pin, which in turn is secured by a 2,5 split pin. Remove the split pin and Cotter, at the worm shaft end and release the coupling, free of the input shaft.

In case of 2 x RMV, 3 x RMV, you will have to release the Coupling Tube at both ends of the worm shaft.

The Energy Storage Device is fixed on the head by 10 Nos. M8 fasteners marked in Fig.11. On removal of these fasteners, the energy storage device is ready for lifting off.

The Energy Storage Device may now be removed by lifting vertically up. The weight of the Energy Storage Device is approximately 45 Kg. Take care to lift the Energy Storage Device vertically without rotating for at least 30mm before moving in any other direction, or rotating. This ensures that the couplings are fully disengaged. Ensure that the switch shaft does not change its position during the lift off procedure.

I5: REMOVAL OF ACTIVE PART:

If the Tapchanger had been placed in position No.7 before commencing the operations so far described, you will observe that the following match marks co-incide.

- i) A **RED** arrow on the coupling flange of the switch shaft stands opposite a red mark on the top flange (fixed part of the Tapchanger) of the Contact Cylinder.
- ii) Another **RED** arrow on the Pre-Selector Drive Flange stands in the same alignment.

Further, please remember that the shaft is running without a bearing at the top, and must be carefully guided by hand to remain central.

Do not remove the Insert before this alignment is made.

It is important to make a note of these arrows, as the same procedure must be reversed when re-assembling.

You will find a set of Star shaped packing pieces residing in the jaws of the switch shaft coupling. Do not disturb these.

The coupling flange has 3 M8 holes on which the jig shown in Fig.9 can be attached for lifting the Insert. As soon as the insert is pulled by about 60mm, pull it away from the center so as to disengage the contacts. The Insert can now be pulled vertically up. This operation however needs some degree of skill, and feel, so that parts of the Insert do not strike the fixed parts within the Contact Cylinder vessel. For this purpose, you can look through the annular space between the Insert, and the oil container, and position the Insert by hand to avoid obstacles.

J: INSPECTION AND CONTACT REPLACEMENT:

The Moving Contact Rollers, which are fixed on the Switch Shaft, can now be inspected freely. The Fixed Contacts can be inspected from the top of the Tapchanger by shining a light. In the normal course, these contacts do not need replacement.

The Insert as well as the Contact Cylinder Vessel may now be washed down with oil to remove all the black deposit, and metal detritus. The oil collected at the bottom of the Contact Cylinder Vessel should be pumped out.

When the Tapchanger has done a large number of operations, and if the contacts look particularly worn out, it may be desirable to replace the contacts. (See following paras).

J1: REPLACEMENT OF MOVING CONTACT ROLLERS:

When the moving contacts rollers appear very worn out (diameter less than 15), it is desirable to replace them.

Replacement of individual contact rollers of the Switching Element (Fig.12) is again a skilled operation. While the procedure is described in the following paragraphs, we suggest it may be better to replace the complete pre assembled switching element.

Both complete switching element, and individual contact roller assemblies, are available on order from OLG.

J 1.1: REPLACEMENT OF COMPLETE SWITCHING ELEMENT

Remove the six M6 fasteners, attaching the switching element to the aluminium clamp on the switch shaft (Fig.12). This releases the element. Replace with new.

J 1.2: REPLACEMENT OF INDIVIDUAL ROLLER ASSEMBLIES:

The rollers are carried in a steel carrier arm, on which a long current collector pin is riveted. The rollers rotate on this pin. This is a skilled construction, which may not be easy to reproduce at site. It is therefore recommended that the roller contacts are replaced complete with the carrier arms (Fig.13, 14). Contact arrangement, and the method in which the carrier arm is held between the top and bottom plates of the switch elements is shown in Fig.12.

From each auxiliary contact arm (auxiliary contacts are mounted one on either side of the Central Main Contact), a flexible copper braid runs to the M5 fastener, which connects to the transition resistance. Release the braid at the transition resistance end for both auxiliary contacts. Now remove the contact compression springs (these are located behind each Steel Carrier Arm – there are two springs for the main, and one for each of the auxiliaries). You may find that the spring end caps of nylon may fall off when the springs are removed. Collect them and keep ready for re-assembly.

Please remember to store the auxiliary contact, and main contact springs separately in well marked pouches, as they look alike, but are **NOT INTERCHANGEABLE**.

By taking all the 3 M6 Fasteners holding the top plate to the aluminium clamp on the central switch shaft, and the 3 further M6 fasteners attached to the bracket between the top and the bottom plates, the top plate becomes free. It can now be gently shaken and lifted off exposing the contact roller assemblies. These can be replaced one by one. Please note that in the case of the right-hand side contact, a common hinge pin serves as a pivot for both the main contact roller, and one of the auxiliary rollers. Fig.15 shows the details of the insulation components on the pivot pin. The assembly must be done exactly according to Fig.15 so as to provide the necessary insulation between main and auxiliary contacts. After completion of this work, the top carrier plate can be re-fastened on to the switching element. Please make sure that all the hinged contacts are completely free to swing on their pivots.

Now replace the contact compression springs, and insulated end guides carefully. Check once again free swinging of Contact arms

It is desirable to do a 2kV “Flash” in air, between the contact pairs.

Re-connect the Transition Resistance flexible braids to the Auxiliary Carrier arm.

J3: REPLACEMENT OF TRANSITION RESISTANCE:

The Transition Resistance Assembly per phase is made up of two resistance units, one connected between each auxiliary contact and the central aluminium clamp (Fig.16). The aluminium clamp itself is connected to the slip ring roller, and through it to the main contact roller.

In the normal course, an examination of the Transition Resistance units, particularly the connection between the bobbins, and between the bobbins and the auxiliary contacts (this is a flexible copper braid) will suffice.

In the unlikely event of any damage to the Transition Resistance unit, it is possible to replace either the complete unit, or individual bobbins. Spares will be supplied by OLG when ordered.

Each Resistance unit consists of 4 or 5 individual resistance bobbins. These bobbins are held between two insulated Resistance Rings at the top and bottom. The bobbins are

located between the resistance rings by a threaded insulated rod, insulated nut, and sealing thread. The arrangement is shown in Fig.16.

The resistance unit assembly is secured to the aluminium clamp of the switch shaft by 4 M6 fasteners shown in Fig.18. To take off the resistance unit, first release the end of the resistance wire by taking off the M5 nut marked out in Page 18. Now by loosening the 4 M6 fasteners securing the ring to the aluminium clamp, the resistance unit is released. Note that one of the 4 securing bolts also clamps the other end of the resistance wire to the aluminium clamp. Therefore, removal of the fastener will automatically release the resistance wire completely from the assembly. The resistance unit may now be withdrawn and replaced by a new unit. When fastening the new unit, remember to clamp one end of the resistance wire (OLG supplies spare Resistance Units with the two free ends of the resistance wire longer than required. The ends may be trimmed on to suit assembly) to one of the four holding down fasteners as before. Complete the installation by reconnecting the other end of the Resistance Wire to the auxiliary contact braid terminal (M5).

If it is desired to change only the individual bobbins, disconnect the two ends from the adjacent bobbins. To remove the bobbins, it is necessary to take out the central pultruded bolt and nut. These are secured together by a thread sealant, and a piece of thread, in order to make sure that this will not get loose during service. Therefore, it may be necessary to destroy the central bolt in the process of trying to loosen the nut. The new bobbins supplied by OLG come with a new central thread, and bolt. After replacing the bobbin, and securing it in place with a new threaded rod, and nut (see next para for a practical advice), the ends may be reconnected to the adjacent bobbins. OLG leaves the resistance wire ends longer than required so that you can trim them as required during assembly.

Two points are to be observed if any work is done in replacing either individual bobbins, or the complete resistance unit. Firstly, please note that the bobbins are made of porcelain, which is a brittle material. Replacement of bobbins must therefore be done gently, so as not to crack the bobbins. Secondly, the central holding rod of individual bobbins is made of pultruded rod which does not take too much load on the threads. The holding down nuts should be put on hand tight, or with light spanner pressure, and then retained with a thread sealant. As an additional precaution, you may wind a piece of cotton twine on the remaining threads, and stick it in position to prevent the nut working loose.

J4: REINSTALLATION OF INSERT:

When the maintenance procedure undertaken is fully over, the Insert must be in-installed. The following checks may be carried out before hand.

- (i) Check that all contacts swing freely.
- (ii) Measure the resistance between each main and auxiliary contacts of each phase. An ordinary general purpose meter will do. The resistance value is variable depending on the application, and will be in the order of a few ohms. It should not however be zero, because this shows a short circuit, which must be located and corrected.

- (iii) Make sure all fasteners are tight and properly locked.

Now attach the lifting attachment Fig.13 to the top of the Insert, lift, and lower carefully into the Contact Cylinder. Guide the Insert by hand so that it does not strike components of the Contact Cylinder.

When the Insert is down to a level, where the Coupling flange is level with the Contact Cylinder flange, align the three yellow marks respectively on the Switch Shaft, Pre Selector Flange, and the Cylinder Flange. Thereafter do not allow the Switch Shaft to rotate. This is very important, as otherwise the Contacts will be damaged as you lower further.

The Insert can be further lowered in this alignment, and the Contacts will engage properly.

Rotate the Switch shaft to align the three red marks (See Para I5). This brings the Tapchanger in line with the Drive Mechanism position.

J5: RE-INSTALLATION OF ENERGY STORAGE DEVICE:

Take the lifting attachment off. Centralise the Switch Shaft by hand.

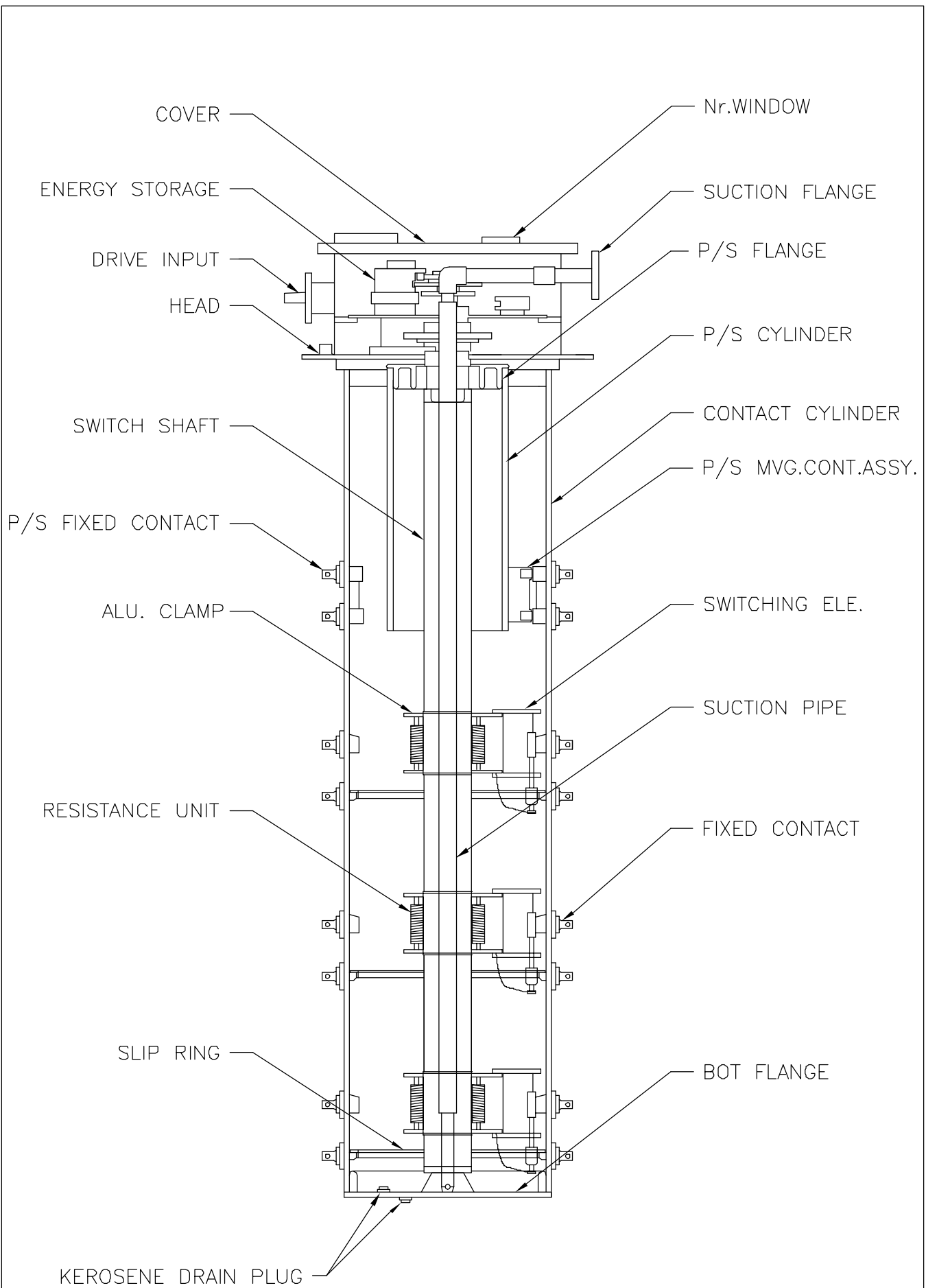
Check that the Energy Storage Device is set to Position 7. Lower on to the Switch Shaft, engaging the Switch Shaft Coupling, and at the same time ensuring that the Pre-Selector operating roller sits within the guide on the Pre-Selector Drive Flange. This engagement is not visible. You may however check the engagement by inserting fingers in the slots of the Energy Storage Plate, and by feeling.

J6: RE-INSTALLATION OF OTHER ITEMS:

Fasten the Energy Storage Device by 10 Nos. M8 fasteners. (Fig. 12)

Now replace, by reversing the procedures of Paras J1, to J5, the following:

- i) Coupling between Worm & Input Shaft.
- ii) Suction Pipe
- iii) Suction Pipe metal fillings, between the Pipe and the Suction Flange on Head
- iv) Main Spring.
- v) Head Cover and gasket.



On Load Gears	STRUCTURE OF RMV	440 041
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FIG.1

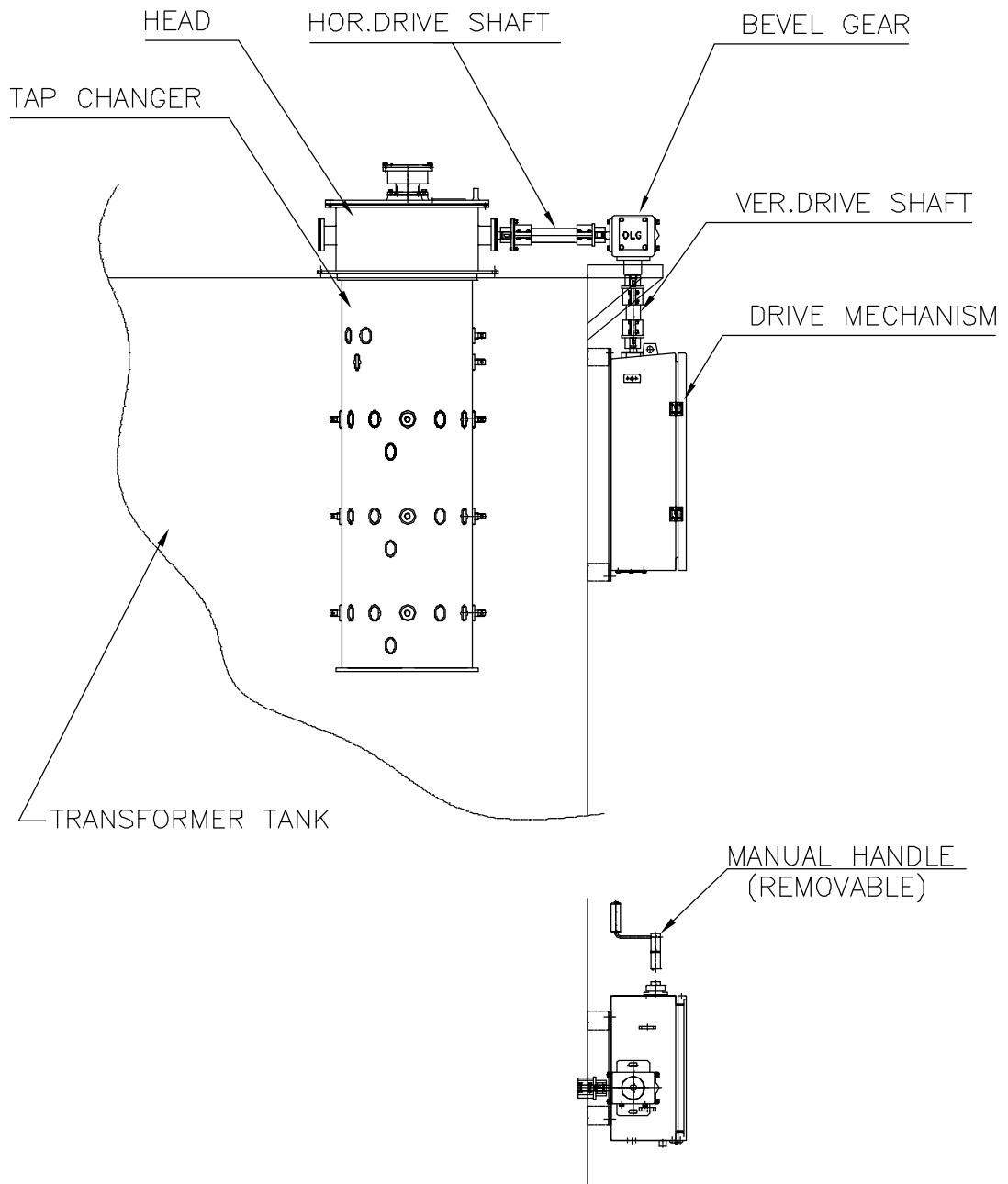
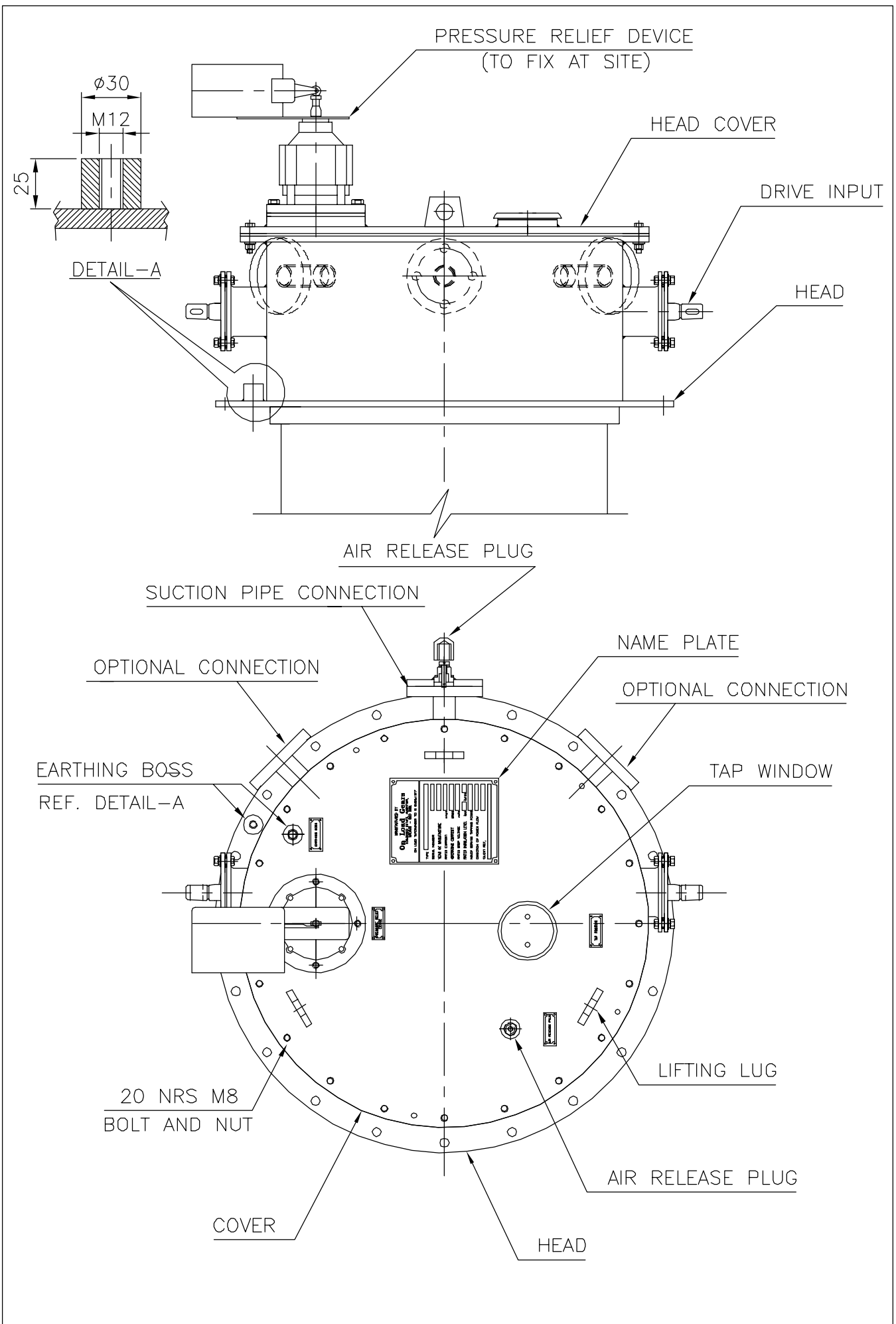


FIG.2



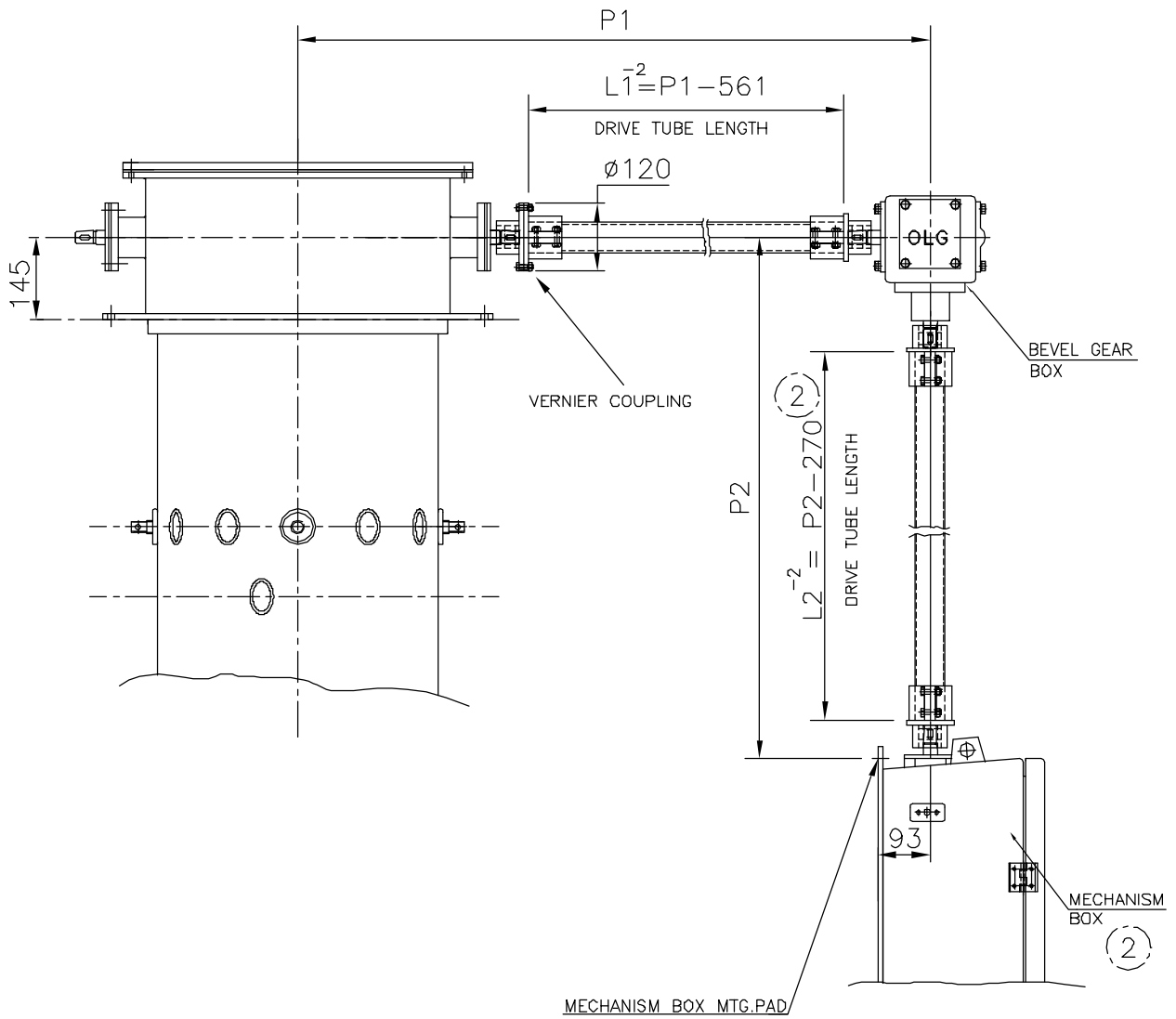
On Load Gears

HEAD ARRANGEMENT

440 043

RO

FIG.3



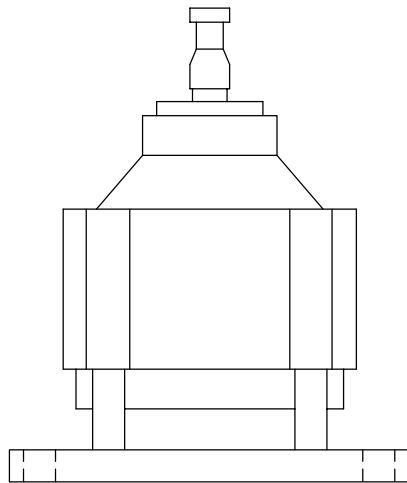
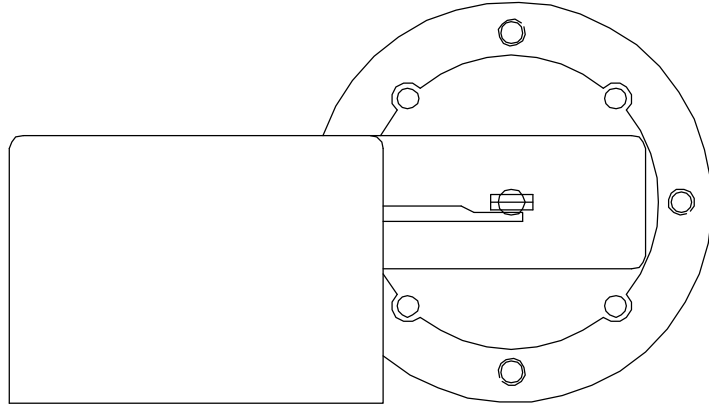
	MIN	MAX
P1	773	3000
P2	410	3000

(2)

NOTES
 1. ALL DIMENSIONS ARE IN MM.

On Load Gears	INSTALLATION OF DRIVE SHAFTS	440 037	R2
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FIG 4



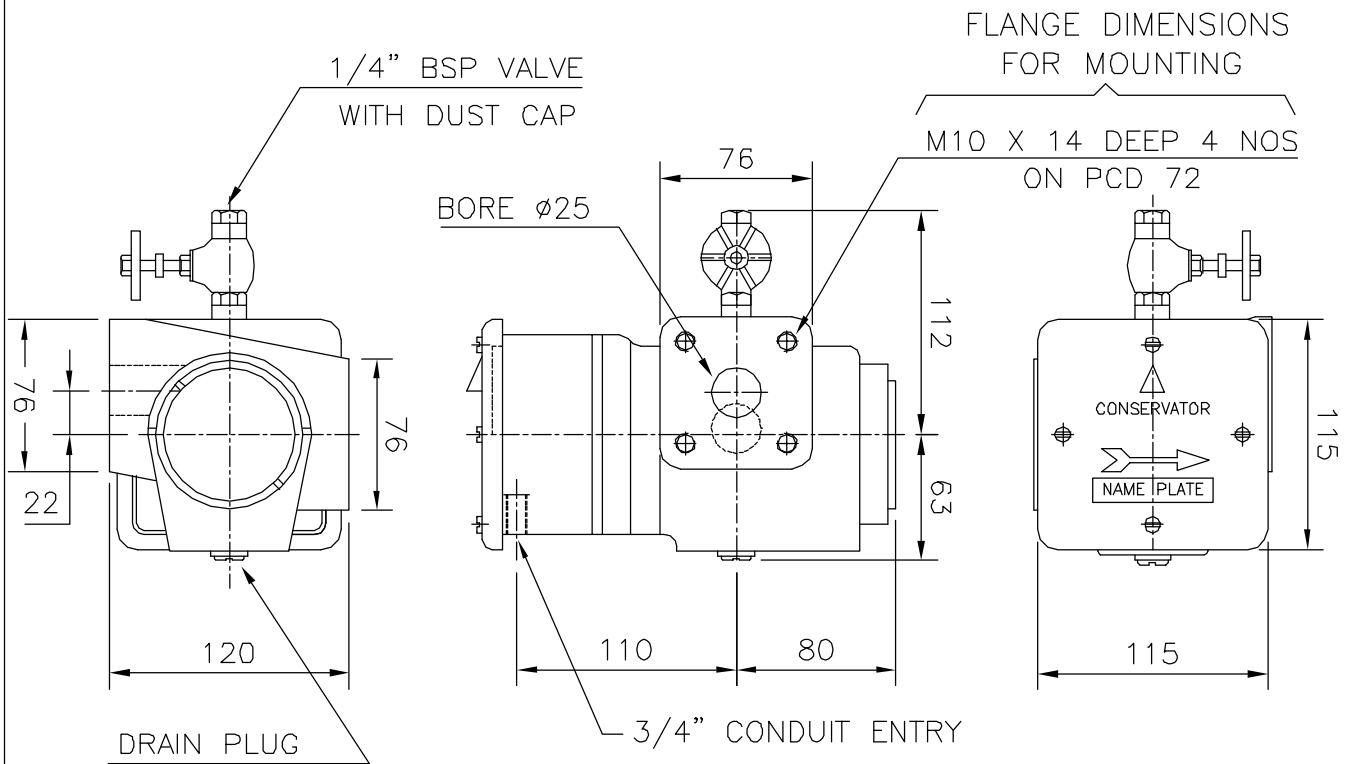
On Load Gears

PRESSURE RELIEF DEVICE

410 056

R
1

FIG.5



NOTE

1. ALL DIMENSIONS ARE IN MM.

WARNING:—

CARE MUST BE TAKEN TO ENSURE THAT BREATHER VENT & DRAIN HOLES ARE NOT OBSTRUCTED INCASE RELAY BE PAINTED AFTER INSTALLATION

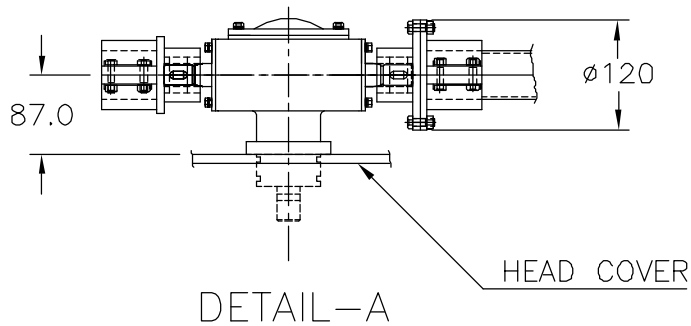
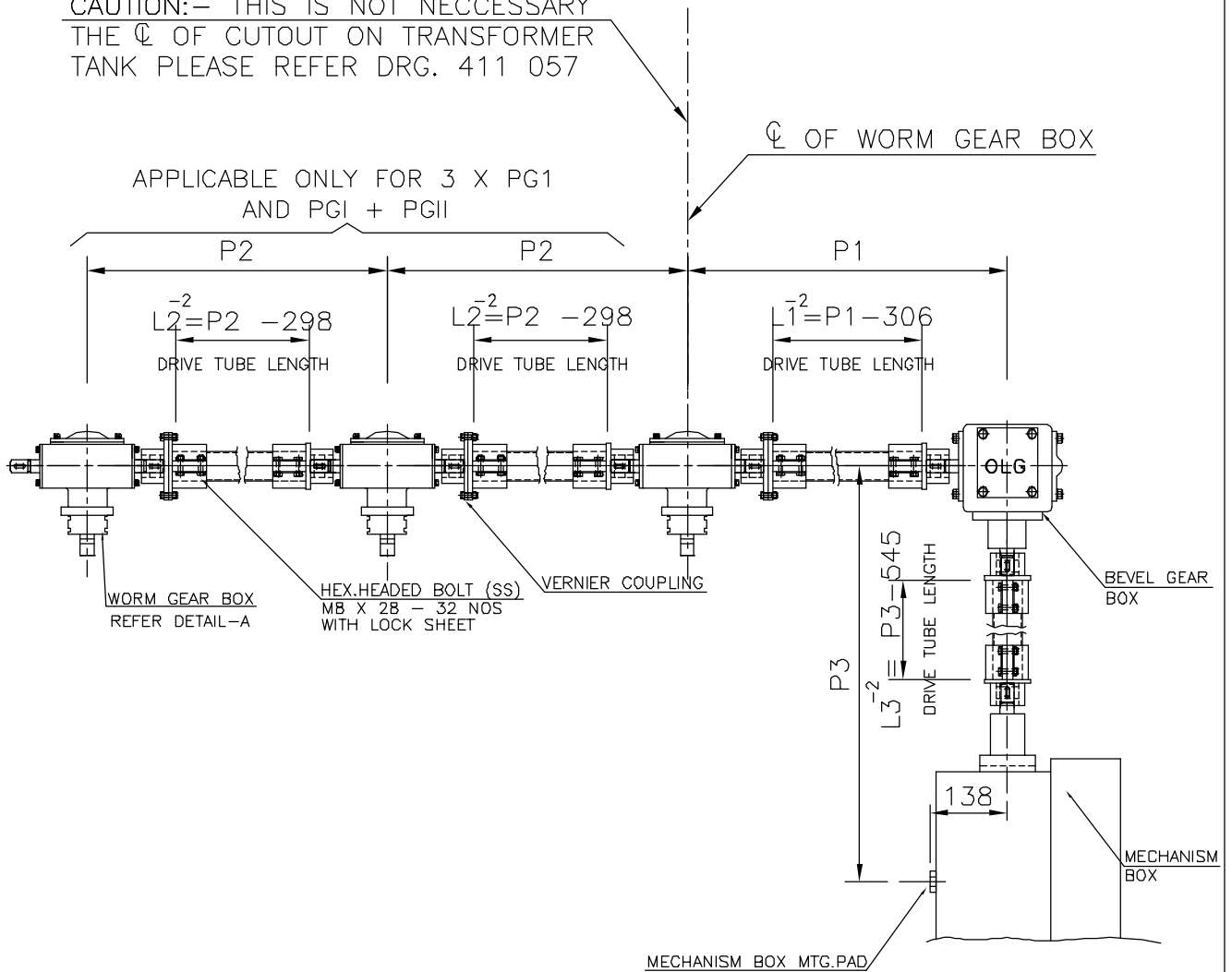
MERCURY SWITCH RATING:—

THE MERCURY SWITCH IN THIS RELAY IS SUITABLE FOR MAKE AND BREAK 2 AMPS AT 250 VOLTS 50 C/S AC .OR DC.

On Load Gears	OIL SURGE OPERATED RELAY	410 086	R1
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FIG-6

CAUTION:- THIS IS NOT NECESSARY
THE ϕ OF CUTOUT ON TRANSFORMER
TANK PLEASE REFER DRG. 411 057



	MIN	MAX*	NOTES
P1	518	3000	1. ALL DIMENSIONS ARE IN MM.
P2	760	3000	2. L2,P2 NOT APPLICABLE FOR SINGLE COLUMN CASES
P3	685	3000	3. HEAD PITCHES NEED NOT BE SAME

* BEYOND THIS LENGTH AN ADDITIONAL BEARING SUPPORT TO FIG23 IS REQUIRED.

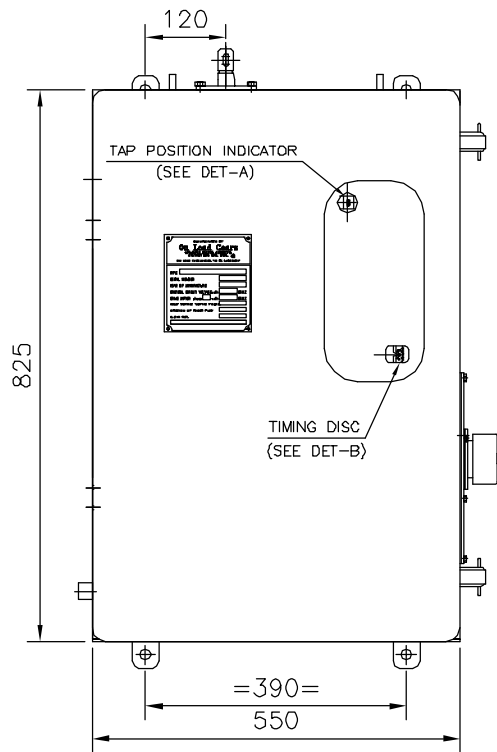
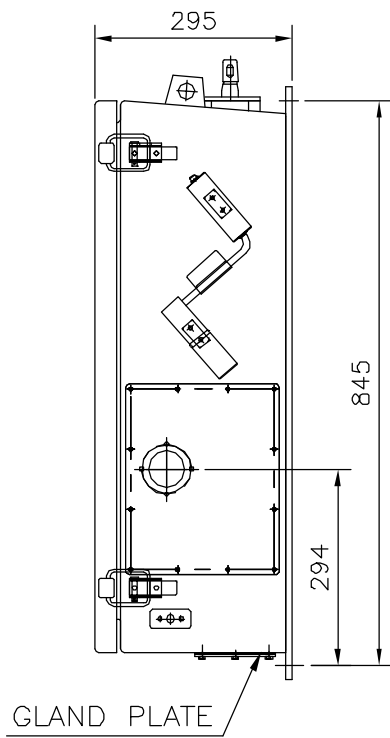
On Load Gears

INSTALLATION OF DRIVE
SHAFTS

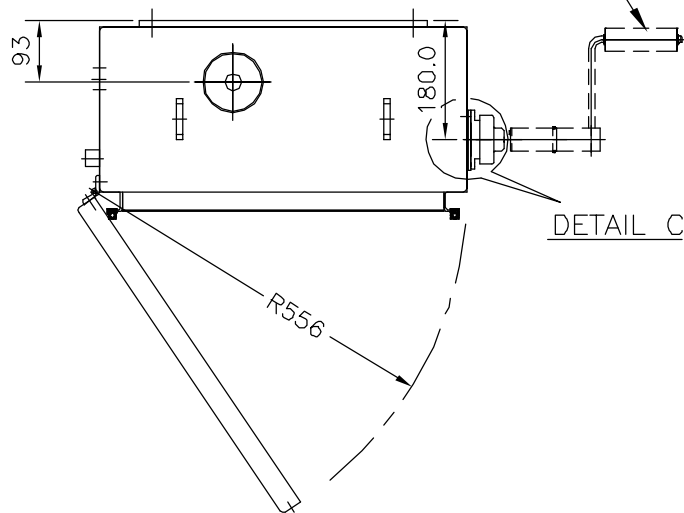
410 070

R2

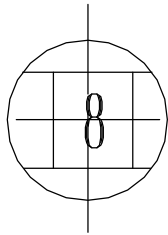
FIG 7



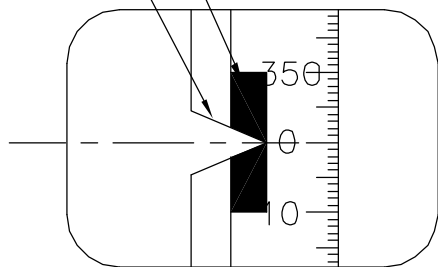
REMOVABLE CHARGING HANDLE



TAP POSITION WINDOW
DETAIL - A

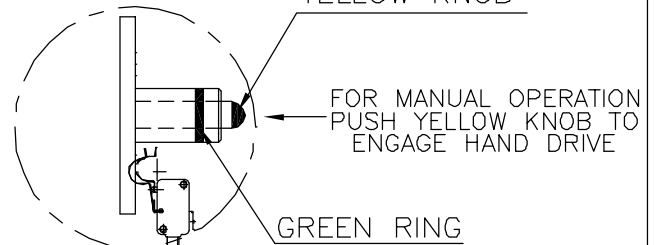


GREEN MARKING
POINTER



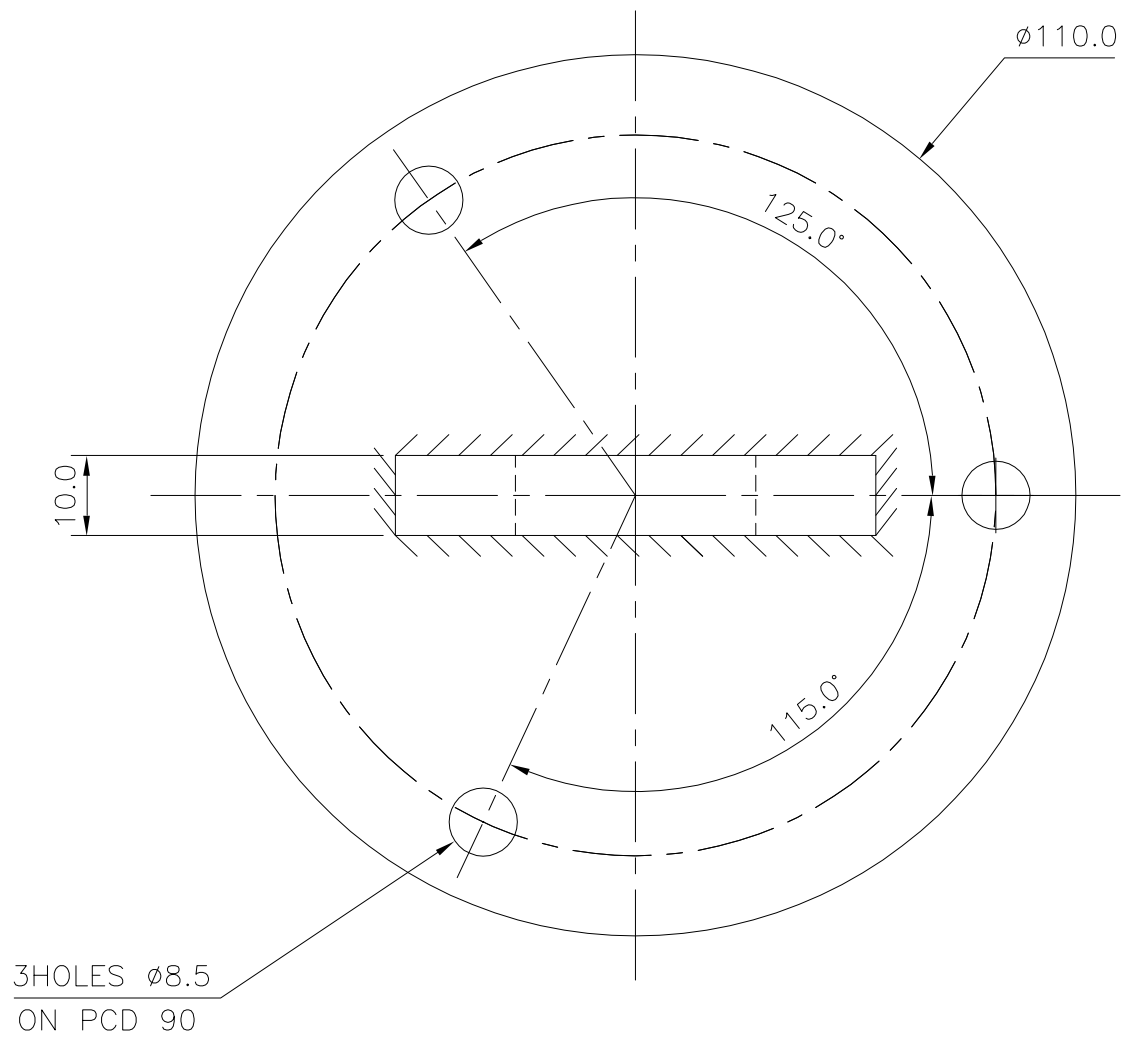
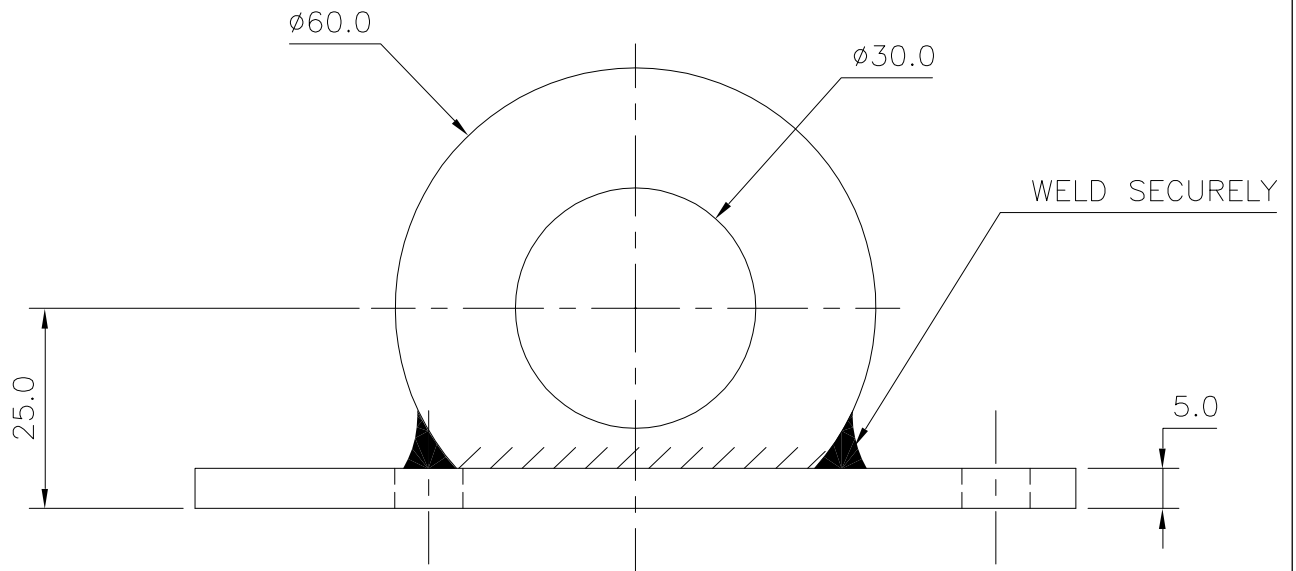
TIMING DISC
DETAIL - B

YELLOW KNOB



AFTER MANUAL OPERATION
PUSH GREEN RING TO
RESET TO MOTOR DRIVE

HAND DRIVE RESET
DETAIL C

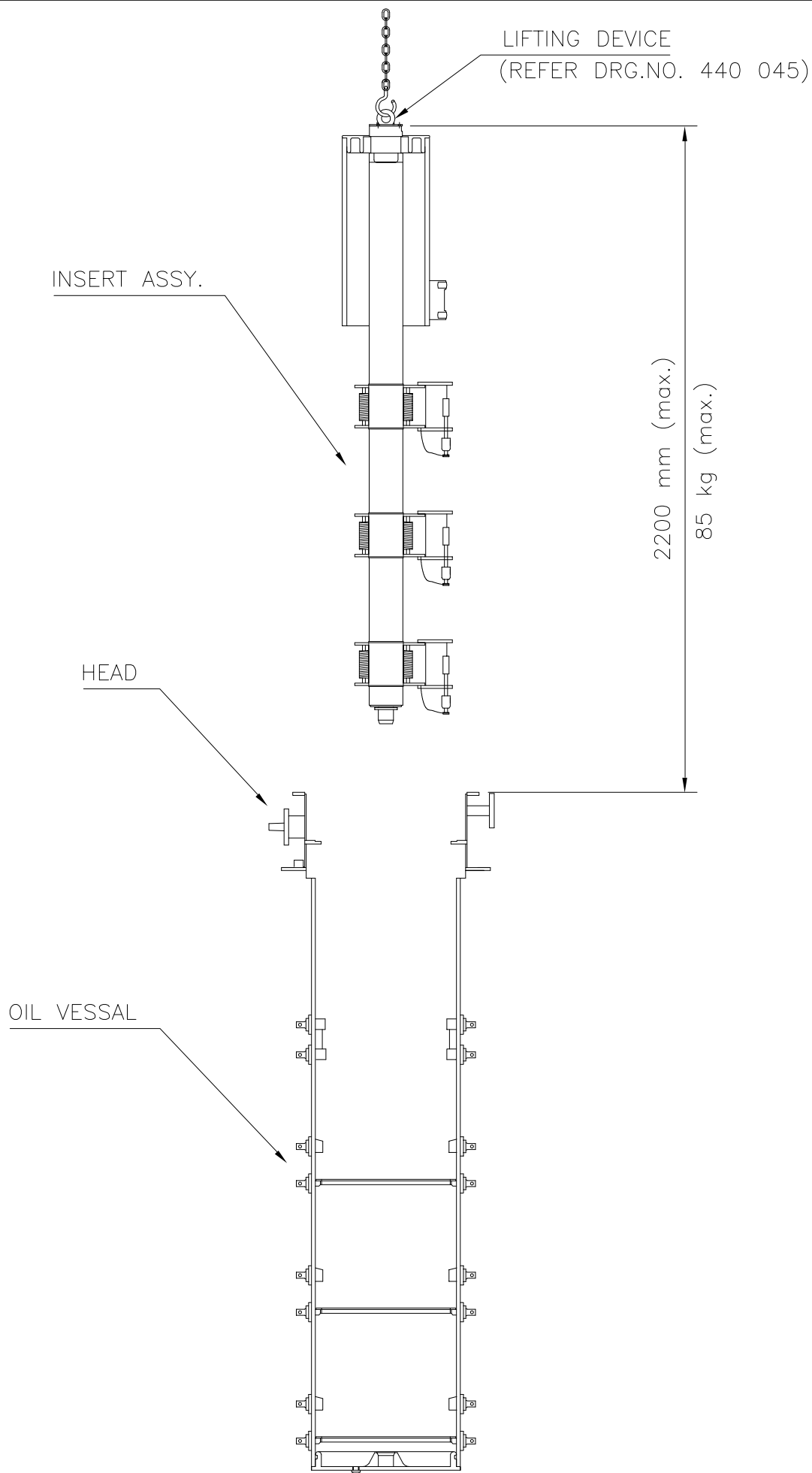


On Load Gears

LIFTING DEVICE

440 045

FIG.9

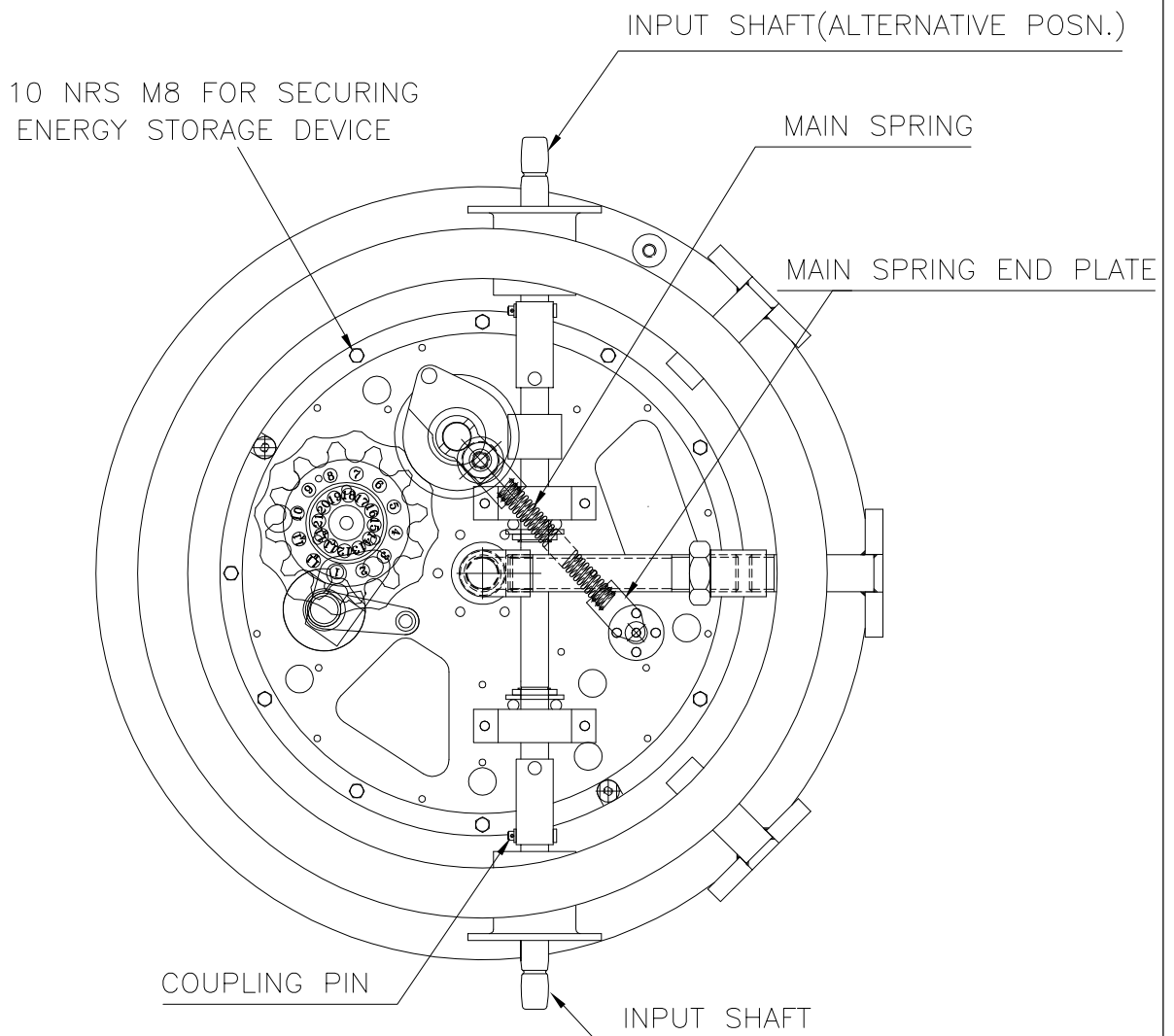
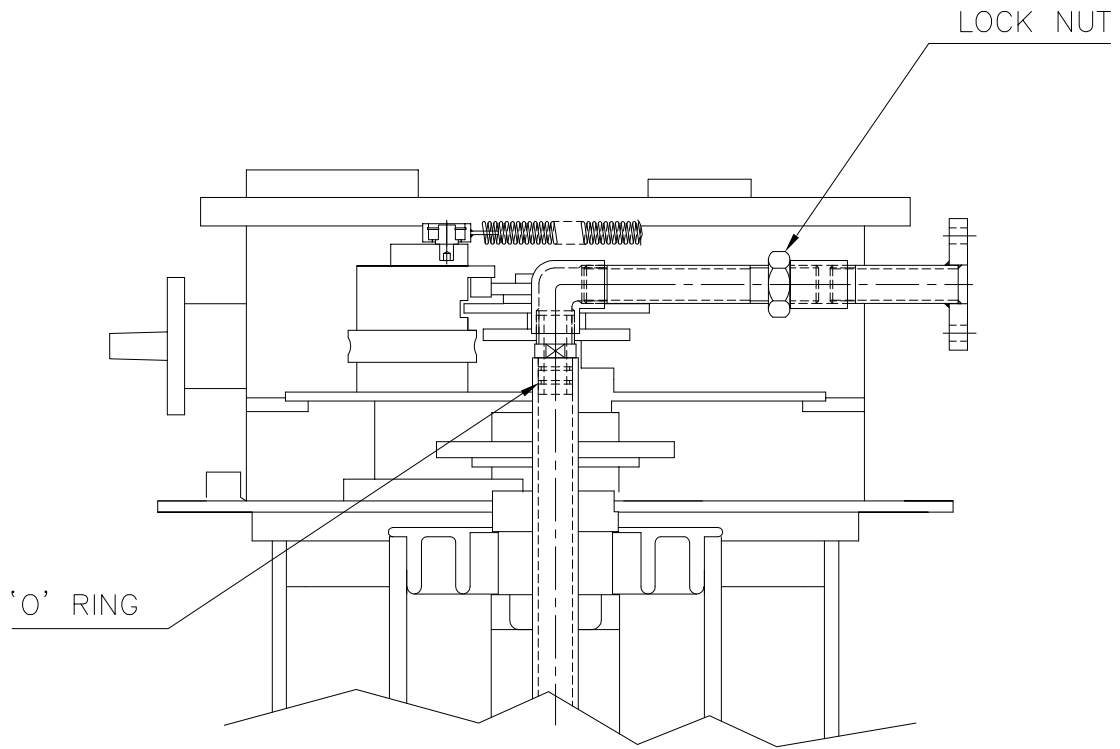


On Load Gears

INSERT REMOVAL

440 044

FIG.10

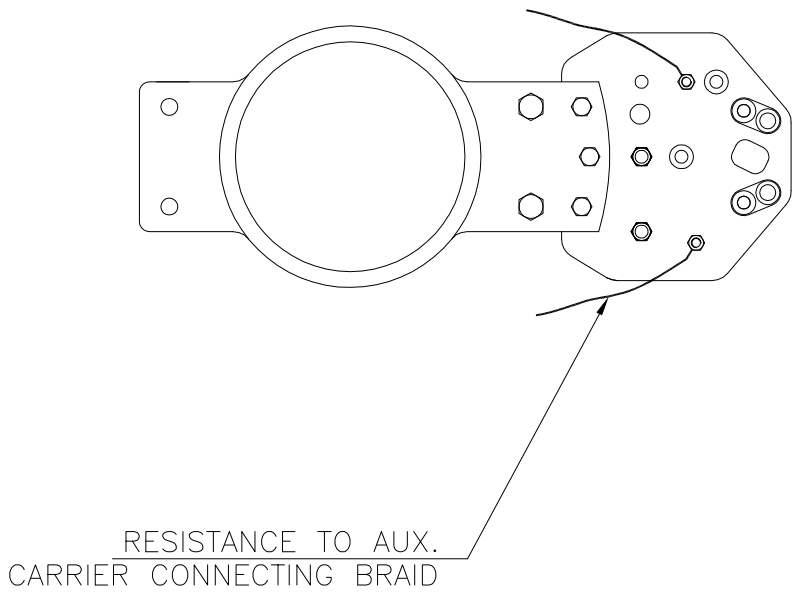
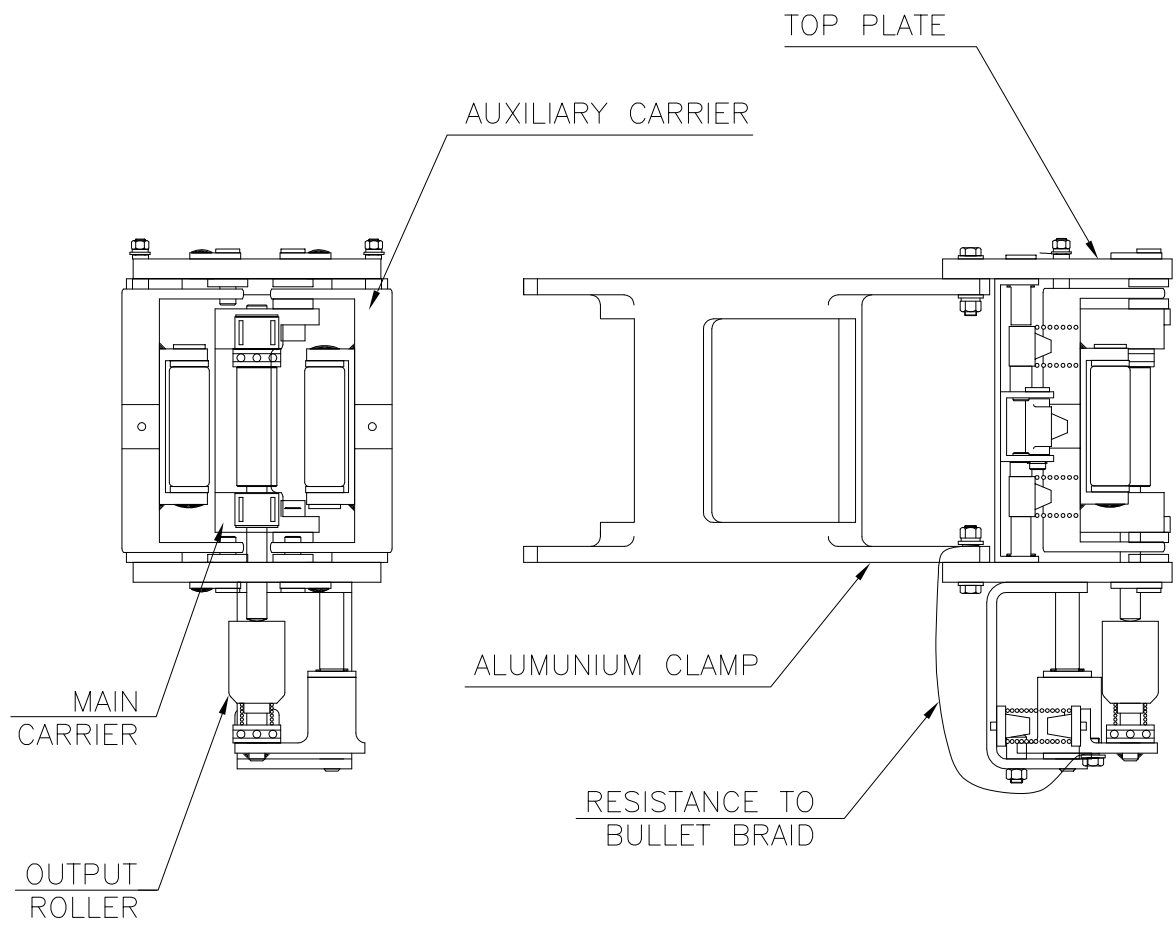


On Load Gears

SUCTION PIPE REMOVAL

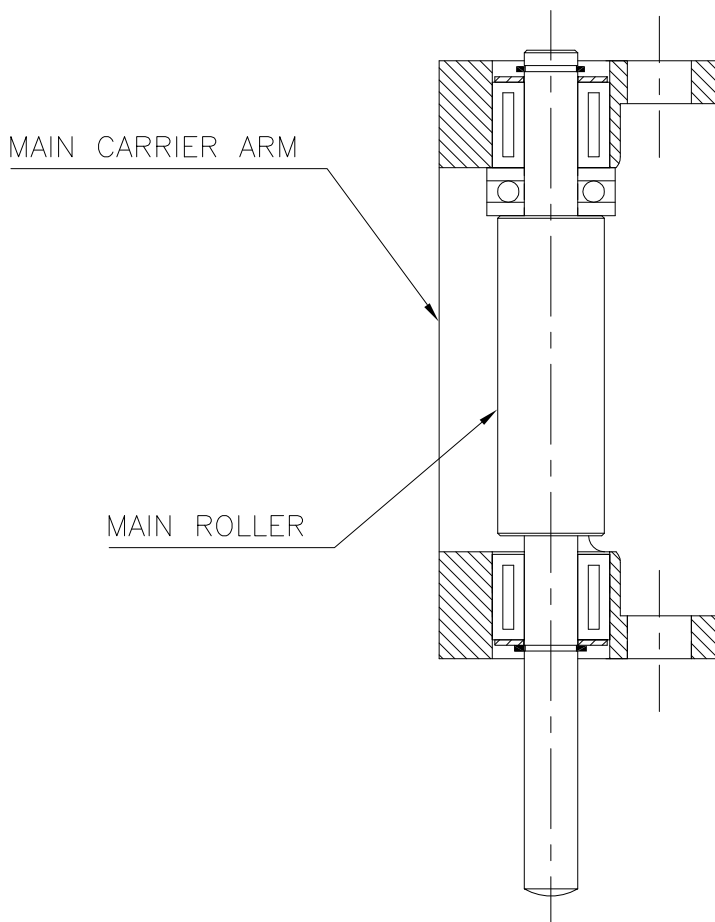
440 050

FIG.11



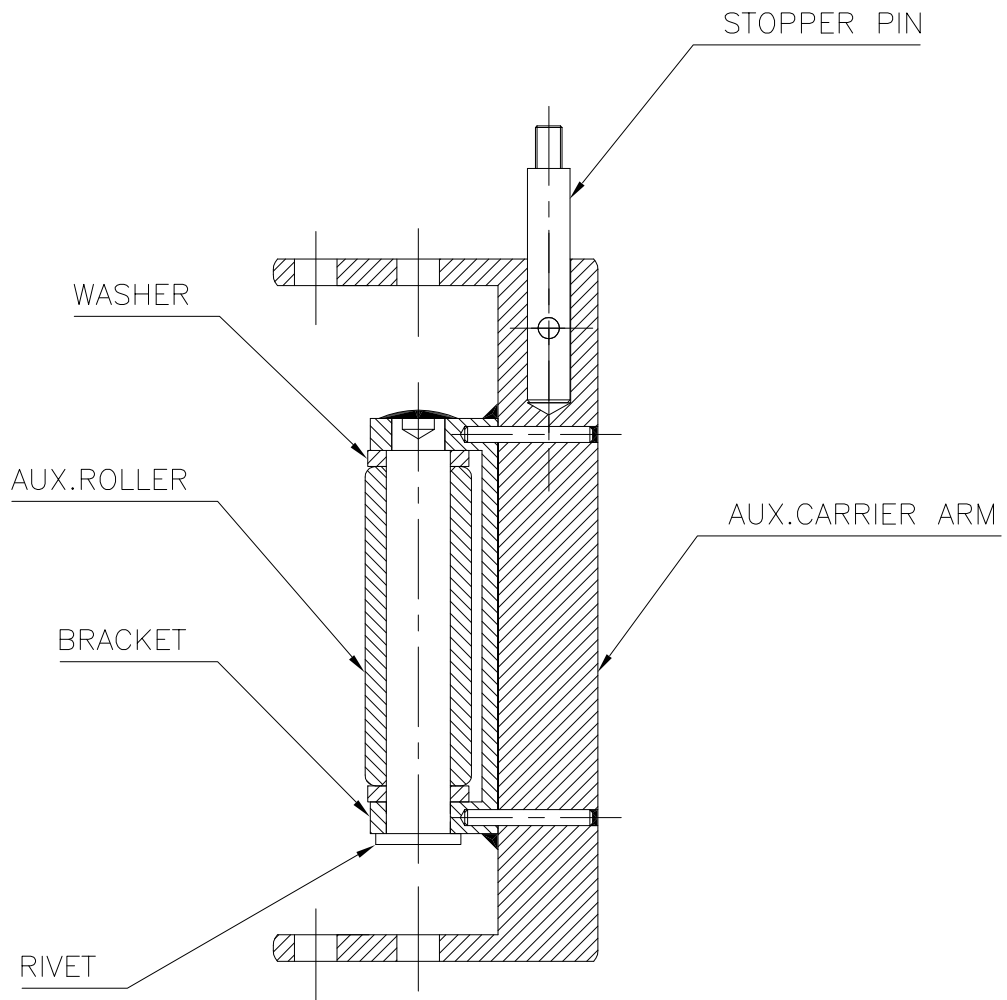
On Load Gears	SWITCHING ELEMENT	440 046
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FIG.12



On Load Gears	MAIN CARRIER ARM ASSY.	440 052	R0
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FIG.13



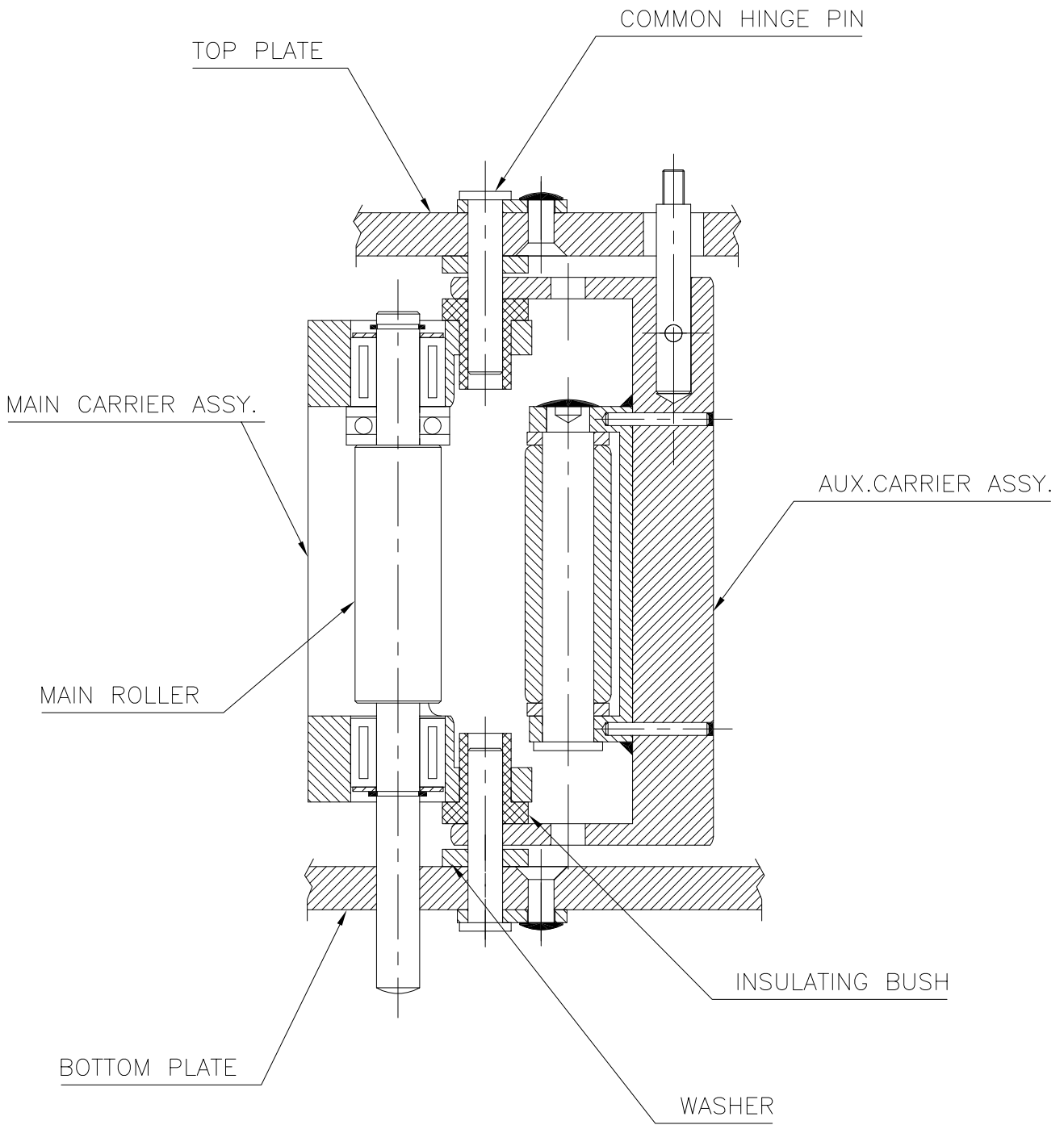
On Load Gears

AUX.CARRIER ARM ASSY.

440 053

R0

FIG.14



On Load Gears	COMMON HINGE ASSY.	440 047	R0
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FIG.15

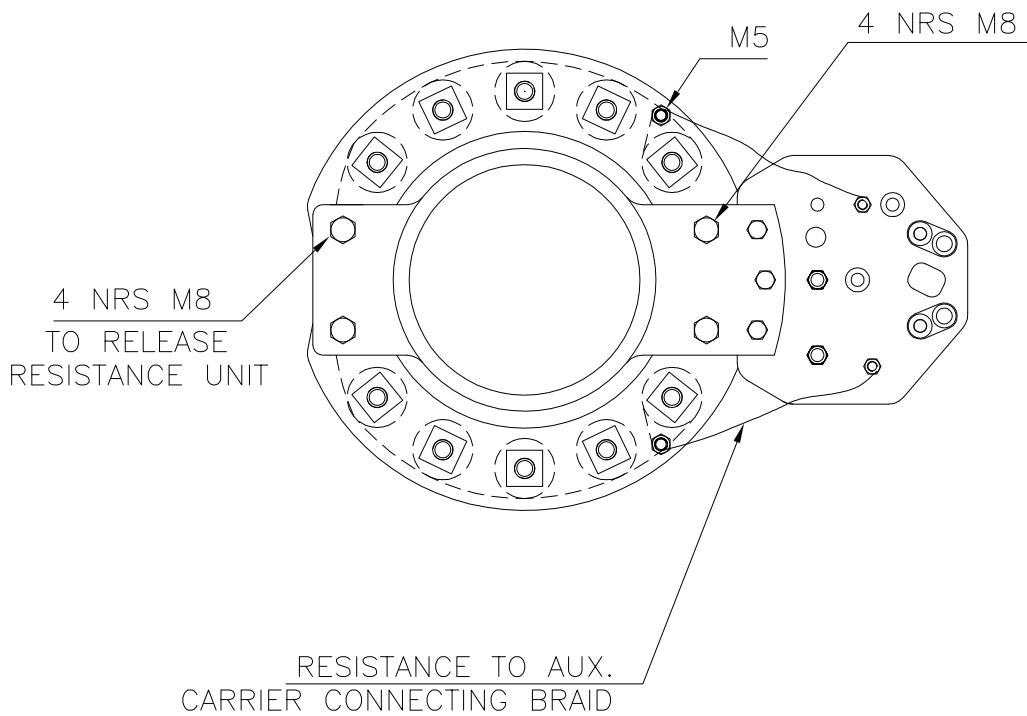
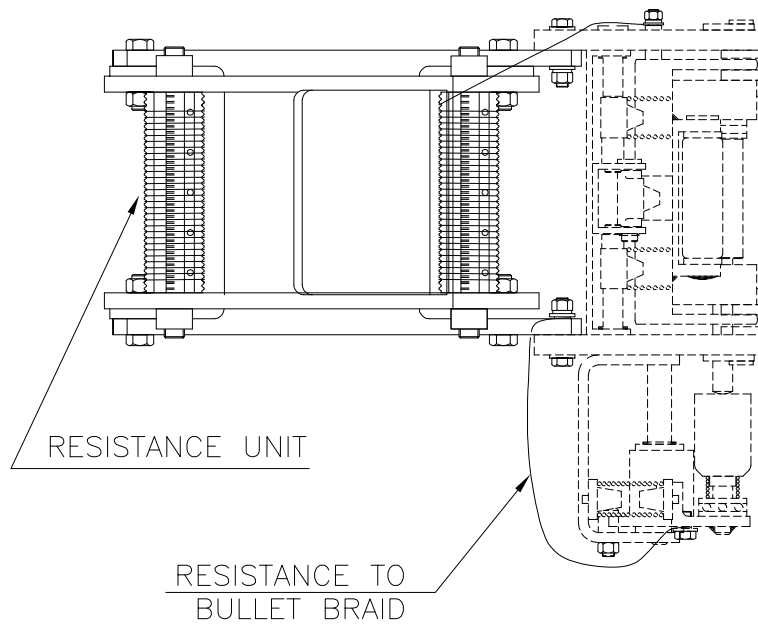
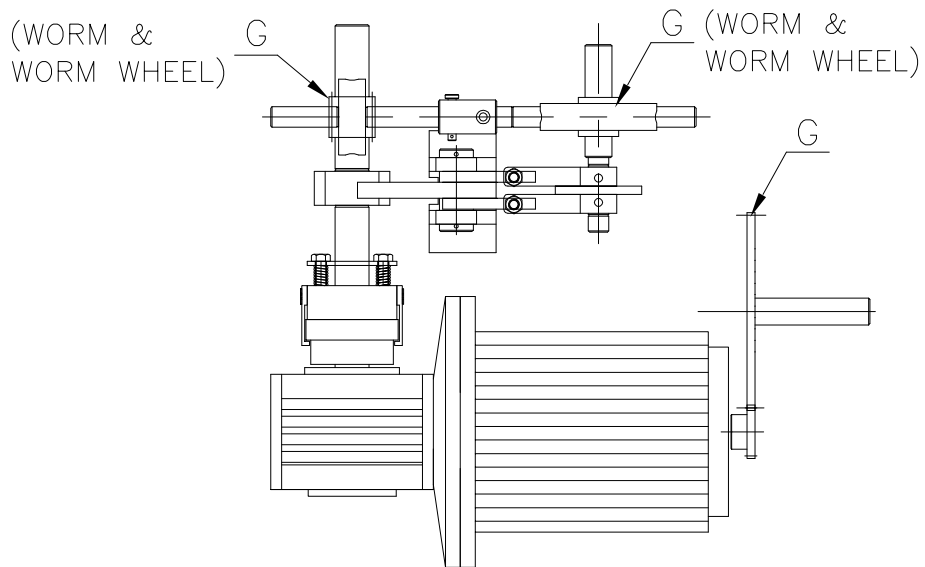


FIG.16



On Load Gears

LUBRICATION INSTRUCTION



ONCE IN A YEAR OR 30,000 OPERATION
WHICHEVER IS EARLIER CARRY OUT THE FOLLOWING:

LUBRICATE THE GEARS , BOTH WORM & WORM
WHEEL AS SHOWN BY 'G' WITH EITHER LITHIUM
GREASE OR MOLYBDENUM-DI-SULPHIDE
(COMMERCIAL NAME MOSIL BRB-500)

FIG.17