MAINTENANACE MANUAL
FOR
EOT CRANE

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MAINTENANACE MANUAL

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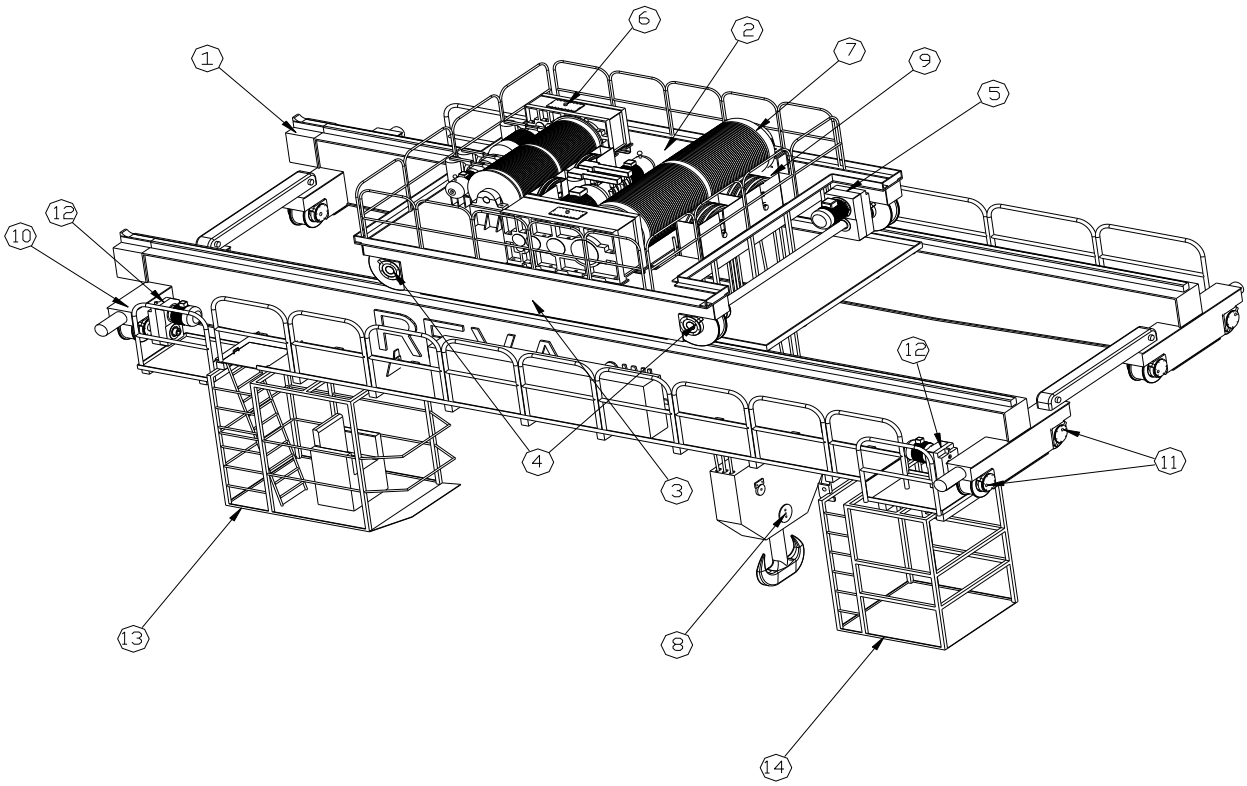
1 REVA EOT CRANES - DESCRIPTION.

The EOT Cranes are manufactured to carry out the following functions:

I. Hoisting, i.e, lifting and lowering of all loads upto the maximum specified working load at different specified speeds.

II. Travelling at specified speeds in both loaded and unloaded conditions;

III. Traversing at specified speeds in both loaded and unloaded conditions.



(Fig. 1)

A typical Double Grider EOT Crane with Auxilliary Hoisting arrangement has following sub assemblies :

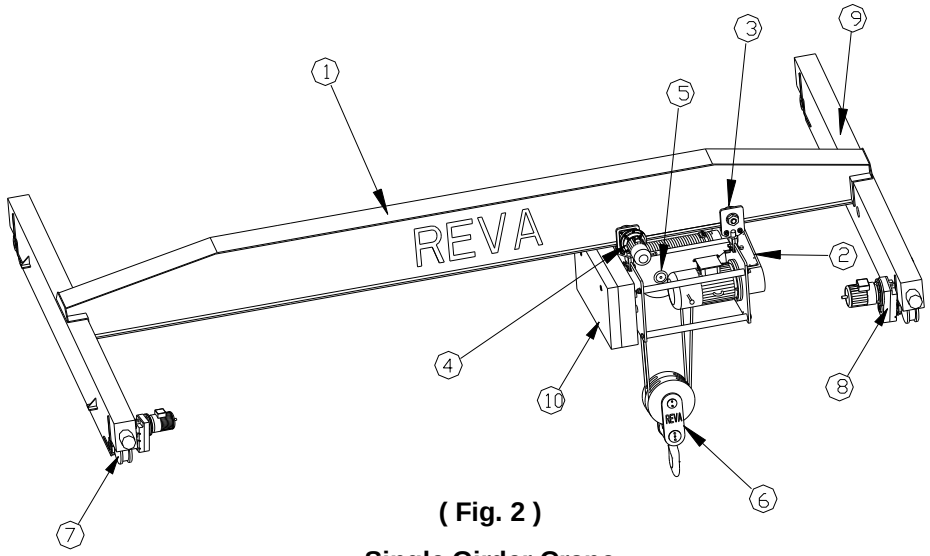
1	Box Girder
2	Crab Assembly
3	CT End Carriage
4	CT Wheel Assembly
5	CT Gearbox Assembly
6	Hoisting Gear Box
7	Rope Drum
8	Bottom Block Assembly

9	Equalising Assembly
10	LT End carriage
11	LT Wheel Assembly
12	LT Gear Box Assembly
13	Driving Cabin
14	Maintenance cabin

SINGLE GIRDER EOT CRANE

1	Bridge Girder
2	Hoist Mechanism
3	CT Wheel
4	CT Gear Box
5	Equalising Assembly

6	Bottom Block Assembly
7	LT wheel mechanism
8	LT Gear Box
9	LT End Carriage
10	Control Panel



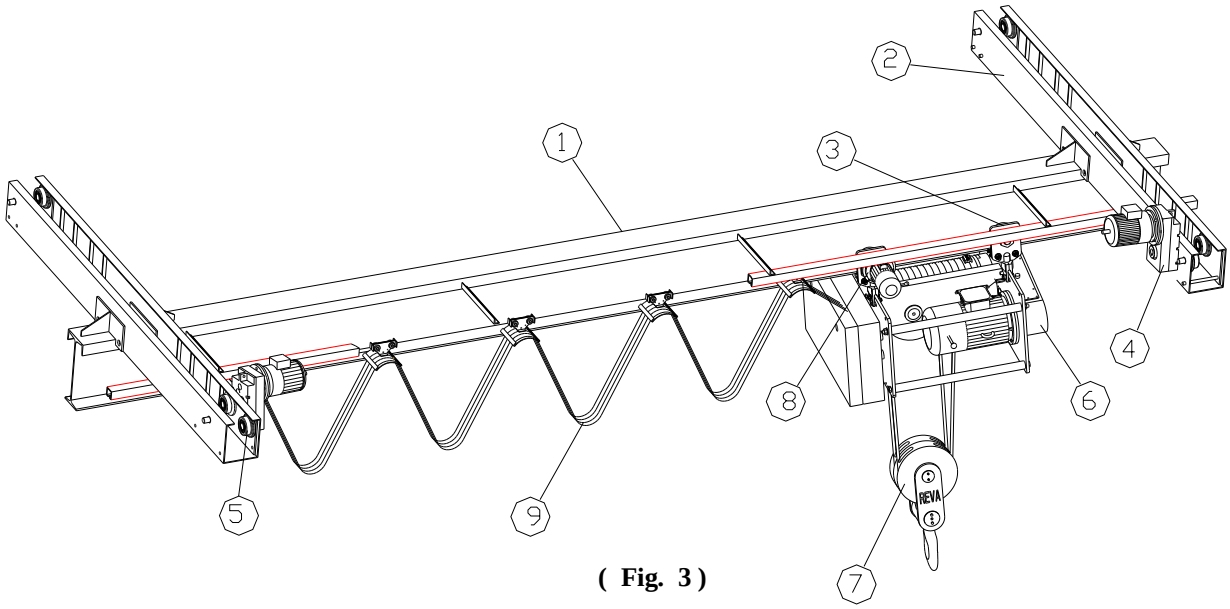
(Fig. 2)

Single Girder Crane

1	Bridge Girder
2	LT End Carriage
3	CT Wheel
4	LT Gear Box
5	LT Wheel

6	Main Hoisting Gear Box
7	Bottom Block Assembly
8	CT Gear Box
9	CT DSL Arrangement

UNDERSLUNG EOT CRANE



(Fig. 3)

The items shown here may not necessarily be the part of the crane offered. Please refer detailed General arrangement drawing for the same.

1. OPERATION OF CRANES

1.1 Operators Qualification & Training

Although adequate care has been taken while designing the crane and various safety features provided, the overall safety and maintenance of cranes depends to a large extent on the skill of the operator.

A trained and efficient operator could contribute to a large extent in reducing maintenance cost and prolong the life of the crane by skilful manipulation of the controls, allowing the motors to accelerate gradually to avoid heavy impacts and prevent high current drawl. The operator shall avoid swinging the loads and shall coase the crane to stop rather than causing sudden stopping of the motor and hard braking which result in skidding of brakes.

Therefore, it is absolutely essential that operator is given proper training in handling the crane and is duly certified by a qualified person before he is permitted to handle the crane independently. It may be ensured that no one should be in the cab with the crane operator except when under training or on maintenance duties. Likewise, no person shall be on the bridge walkway or on the trolley during normal operation.

1.2 Operating Procedure

Before operating the crane, the special instructions as given by the crane manufacturer alongwith the instructions of the supervisors should be noted. Having done so, proceed as under:

- Make sure all controllers are in 'OFF' position. Close the mainline switch and press the 'ON' power button of the crane.
- Before a load is lifted, ensure that the bridge and the hoist is brought in position so that these are directly over the load. Dragging of load on floor by the hoist must be avoided.
- Ensure that the load is securely slung on the hook and it is free from any obstruction.
- Lift the load just above the floor to ensure that it is well balanced. If it is not so, lower the load and adjust the sling.
- Lift the load just above the ground and check the perfect working of hoist brakes.
- Traverse the trolley with load both ways and check the functioning of cross travel brakes.
- Similarly, check the brakes for long travel.
- Avoid impact loading by sudden lifting or lowering of the load. Sudden hoisting or lowering may cause breakage of the wire rope.

1.3 Operating Rules

Some recommendations regarding safe operations of the crane are given below:-

- Whenever there is any doubt as to SAFETY, the crane should be stopped and supervisor's clearance obtained before operation of cranes proceeds.

- The operator shall respond only to signals from the person who is directing the lift. When the rigger or signalman is not required as part of the crane operation, the operator is then responsible for carrying out all lifting operations. However, the operator is responsible for obeying all stop signals, notwithstanding as to who gives the signal.

- If there is any warning board/sign on the switchboard the operator shall not close the main switch if energize the crane unless the sign is removed by the authorized person. Furthermore, the operator shall not close the main switch until he has ascertained that no person is in or adjacent to the crane. Again, to prevent any inadvertent starting, the operator shall see that all controllers are in 'OFF' position before the main switch is closed.

- The warning bell/hooters or pulsating lights shall be checked immediately after energizing the crane.

- The check on brake operations is absolutely necessary.

- The working of all controls including operation of limit switches shall be checked before starting operation.

- The controllers should be moved gently to avoid any jerk on the load.

- The crane should be carefully centered on the load to avoid swinging the load at the start of the lift. Loads must not be swung to reach the area beyond the reach of the crane.

- The operator must not lower the rope beyond a point when only two turns of rope are left on the wire rope drum.

- All slings must be removed from the crane hook when not in use.

- The operator must not use a limit switch to stop motion under normal operations. Limit switches are protective devices and must not be used as an operating control.

- The load carried by magnet must not be used over anyone's head or over important equipment. Electric power failure will drop the load and cause mishap.

- Be careful while moving molten metal. Even slight swing can cause spurting of the molten metal.

- Approach to the runway stop or to any other crane in the vicinity should be with extreme caution.

- Operators should familiarize themselves with working of fire extinguisher on the crane.

- Operators should park and anchor the outdoor cranes at the time of leaving to guard against any sudden wind or storm.

- In case of crane with magnet, never disconnect the magnet from its cable unless magnet power is 'OFF'. The operator after switching off the magnet switch, shall advise the concerned person by hand signal (arms extended) and if required, by shouting.

1.4 Hand Signals for Overhead Cranes & Hoists

There are certain guidelines regarding hand signals to be used so that there is no misunderstanding between the crane operator and the rigger or the signalman. There could be some variations regarding signals used in different establishments,

It is recommended that the signal chart/diagram should be framed and displayed at suitable locations at the place of work so that the operators and the signalmen are fully familiar with the signals to be used during crane operation.

2 MAINTENANCE OF WIRE ROPES

For safe operation of the crane, it is essential that wire ropes are properly maintained, timely checked and replaced, if necessary.

2.1 Examination of Wire Ropes

The following points relating to wire ropes may be kept in mind while carrying out examination of the ropes:-

- The part of the rope which passes over the stationary sheaves may be thoroughly examined.
- Any part of the rope which may be subject to external abrasion.
- The rope may be given internal examination for corrosion & fatigue.
- Examine the part of the rope that is exposed to heat.
- Examine the rope thoroughly at termination. Broken wires at or adjacent to the termination may be the result of incorrect fitting of termination. Where possible, the termination in such case may be remade even at the cost of shortening the length of the rope. Brazing may be resorted to prevent unwinding of termination.

2.2 Salient Maintenance Practices:- Wire Rope

a) Before installation, be sure that the rope has been stored in proper condition and is free from any damage in transit or delivery. A rope already deteriorated during service is bound to give unsatisfactory service.

b) The rope should be regularly lubricated at fixed intervals with suitable lubricant Rope Lubricant we use AP3 Grease to protect against atmospheric corrosive conditions.

c) Ensure that the new rope is correct for the pulleys and anchorages. All pulleys should be checked to ensure that they are not worn out with the old rope and become unsuitable for the new rope.

d) It is a common practice to leave a crane idle on the week ends with the rope hanging at different positions so as to avoid the same part of the rope constantly remaining on the bend. The bending at one place would open the seal between the strands and permit entry of rain/moisture to the inner strands or core. The suspect portion of the rope should be cleaned thoroughly with a stiff wire brush to remove the grease and dirt between the strands. To obtain maximum penetration, make a liberal application of light fortified mineral oil, while the rope is passing around the pulley or over the drum. When the rope has been treated in this manner, it should finally be dressed up with a high viscosity mineral oil containing anti-corrosive additives.

2.3 Discard of the Wire Ropes

The wire rope is discarded from service on various account like heavy corrosion, fatigue, heavy wear, wire breakage, heavy flat on the surface, heavy pitting on the surface, deformation of the strand etc. The decision for discard will depend on the usage & wire manufacturer's recommendations, if any, and local rejection criteria based on the experience gained. It is not possible to prescribe or lay down an exact code for decision-making. There are, however, certain generally accepted criteria for discarding wire ropes:-

- Discard when the outer wire has become definitely loose or have lost about 35% depth for single layer construction, i.e., 6x7(6 strands each containing 7 wires) or 40% depth for multi-layer construction like 6x19, 6x36 etc. One method to determine this stage could be to compare reduction in diameter of the portion of the rope, which is subjected to abrasion & stresses with that portion of the rope which is subjected to stresses only. This reduction in diameter should not exceed about 8% in single layer construction and about 6% in case of multi-layer construction.
- Discard when the total number of visible broken wires exceeds 10% of the total number of wires in the rope, at any place, in a length equivalent to eight times diameter of the rope. It is important to take note that this condition applies only to the cases where breakage of wires are more or less evenly distributed to all strands and not when the breakages are concentrated only in a few strands.
- Discard when there is evidence of plastic wear or surface embitterment.
- Discard when there is evidence of severe corrosion like chain pitting. The condition may be alarming if in addition to corrosion, fatigue is present. Fatigue, in conjunction with corrosion, may affect the safety of the wire rope even at relatively early stages of corrosion. Thus, a less used rope would be less affected as compared to rope, which has been in use longer for the same extent of corrosion.
- Discard when the rope has been subjected to localized distortion, damage or kink, which disturbs the balance between various strands of rope & various wires in any strand.
- Discard when the diameter of the rope has suddenly decreased or the length of lay has suddenly increased or decreased. A decrease in lay length is usually associated with waviness in the rope.
- Discard when the core has collapsed. It is important to distinguish between waviness and collapsing of core. In case of waviness in the rope, there will remain similarity between the measurements of diameters at perpendicular section and the deformity will be over a length of rope whereas in the case of core collapse, the strands will tend to flatten out and deformation may be localized. A wavy rope need not be withdrawn from service immediately but a rope with collapsed core will not be safe.
- Discard when it is found that one or more strands have broken.
- Discard when a birdcage is formed.

The above-mentioned instructions serve as guideline but the final say will be of experienced Inspecting officer. However, when there is doubt in the mind of Inspecting Officer, it is safe to change the rope.

2.4 Replacement of Wire Rope

While replacing it may be ensured that the make and the construction of the rope is the same as originally fitted by the manufacturer

When the length of rope required for the crane is to be taken from a longer length, necessary clamping be done to prevent the rope from untwisting when the cut is made. Prior to rope cutting, it should be tied with annealed soft wire for a length not less than 14 times rope diameter at minimum five places from cutting end at approximately one meter distance from each seizing.

At least 2 nos. of clamps should be put in crosswise position at the intermediate position of each serving. Two more clamps should be fixed adjacent to cutting marks. The distance between these two clamps at the cutting point should be kept minimum. These measures ensure that the outer layers containing shapes wires do not become slack on

core, which if allowed to occur, will disturb the balanced condition of the rope resulting in permanent distortion of the outer cover.

Rope should not be cut under any circumstances with chisel & hammer. It should be cut using hacksaw, high-speed abrasive cutter or oxy-acetylene flame depending on means available at site.

The replacement rope should properly fit in the grooves of drum and sheaves. It has also to be ensured that the loops, kinks or bends are not formed on the rope. It is a good practice to stabilize the rope by carrying out a number of operations at approximately 10% of the normal load.

2.5 Wire Rope Disembly/Assembly

♦ Disembly:

1. Lower the block to the lowest position.
2. Slacken the wire rope guides by loosening the socket head screws.
3. Remove the rope guide support by removing the hexagonal bolts.
4. Remove the guide along with guide springs.
5. Loosen the rope clamp and slide the wire rope by using the push button control or cabin control.

♦ Assembly

1. Clean the drum with the help of wire brush.
2. Apply the coat of grease on drum slots.
3. Clean and grease the wire rope guide.
4. Unwind the new wire rope on a clean floor to ensure that there is no loop or pinches.
5. Fasten one end of wire rope to the drum using three clamps. Ensure that the wire rope end sticks approximately 30mm out of the clamps.
6. Rotate the drum with the help of push button control/cabin control.
7. Look for any torsion while winding.
8. Fix the wire rope guide around the coiled wire. Close the guide spring to prevent slackening.
9. Fix the guide position support by means of hexagonal bolts.
10. Operate the hoist motor for windings of the rope. Ensure that the rope guides are working properly.
11. Pass the wire rope through the sheaves.
12. pass the wire through wire rope anchorage.
13. Fix the rope clamp.
14. Tighten the anchorage bolts.

3 Maintenance Of Pulleys & Sheaves

- Check the pulleys and sheaves frequently for wear and alignment and take corrective action.
- The pulleys and sheaves are made of hard metal to minimize the wear during service.
- Check the pulley & sheave bearings for wear and see that these are lubricated.

- Flats develop on sheaves and pulleys through usage and set up vibration. Check that these are round. In extreme cases when the groove has flattened out, a fine cut on lathe would bring the pulleys / sheaves for further use.
- Ensure that the pulley and the rope are matching. The rope is supported by the groove for one third of its circumference. If the pulley is large, the rope has a single point contact with the groove and there would be no lateral support. In this case the rope would flatten under load.

If the pulley is too small, the rope is not sitting at the bottom of the groove and is nipped between the pulley flanges. For want of proper support, the rope gets deformed from the sides.

4 Maintenance of Reduction Gear Box

The oil bath in the gearbox is totally enclosed. The lubricating oil is filled up to one-third capacity. The oil used is Castrol Alpha SP-220 or equivalent.

An inspection cover is provided on the top of the gearbox to visualize the condition of gears & gearings. An oil level indicator is also provided to see the oil level in the gearbox. The drain plug has also been provided for changing the lubricant after prescribed interval that is once a year. A breather plug has also been provided on the gearbox for escape of entrapped gasses/air from the gearbox when the gears are in motion.

When a gearbox has been opened up for maintenance, the mating surfaces should be cleaned up and a suitable sealing compound used when remaking the joint. The sealing compound we use is Oil Seal / Oil Gasket Sheet.

It may be ensured that no sealing compound enters any oil passage groove in the flanges of the gearbox.

5 Maintenance of Couplings

At least once in a year, the coupling should be inspected for tightness of the connecting bolts and wear in the coupling. Wear can be recognized from outside by checking the position of the points in relation to the two notches in the boss. If the pointer is exactly between both notches, no wear has taken place.

6 MAINTENANCE SCHEDULE

6.1 Daily Inspection (by operator)

- Check that no overhead part is loose that could cause accidental fall.
- Check that the brakes are in good working order.
- Check that the limit/end switches are in proper working order.
- Check the overall condition of steel wire ropes. If there is any damage affecting safety, the operator should immediately report to supervisor for detailed check.
- Check that the wire ropes are properly lubricated - Greasing is done by hand.

6.2 Weekly Inspection (by maintenance mechanic).

- This inspection is basically the same as daily except that during daily check, very limited time is available whereas during weekly check, when the crane is idle, the above aspects could be thoroughly checked and attended to. Reports from operators during week days which could not be attended to due to exigency of work, are also given proper attention on week ends.
- During weekly inspection, oil level in Gear Box is checked and if need be, oil is filled up to indicator level.
- Spot checks may be carried out by supervisor.

6.3 Monthly (Quarterly Inspection- by Maintenance Supervisor)

If the utilization of the crane is less, the following items be checked on quarterly basis, otherwise on monthly basis.

- Check the entire unit for any structural damage, unusual wear and tear.
- Check for any loose bolts and nuts.
- Check pins and bearings.
- Check the hoisting gear, sheaves and drums.
- Check hook, wire ropes.
- Check control mechanism.
- Check proper functioning of brakes and change lining, if required.
- Check functioning of limit switches.
- Check oil level in Gear Box and arrange greasing in all bearing points. It is good practice to change the gear box oil in first quarterly schedule.
- Check and see that the contactor coils are clean. Measure current drawn by the coil. If exceeding the specified limit, replace the same.
- Check and see that the overload relays are free of dust. Check for the mechanical fitment of relays. Firmly tighten the mounting screws. Check the operation of overload relay. Under no condition, overload relay is to be bypassed. If faulty, replace; otherwise, set the relay to full load current consumed by motor.
- Check and ensure the single phase preventor is free of dust. Test the operation of the same.
- Check & clean timers. Adjust the timing of the timers.
- Check the fuses and replace blown ones
- Thoroughly check motors at six months intervals, i.e., second quarterly schedule.

6.4 Yearly Examination

In most of the workshops, there are continuous holidays once in a year. The yearly schedule should be planned. The history sheet of the crane should be checked and major items attended during this period so as to make the crane fully fit for the next year.

Special attention is paid to the crane structure, travel wheel wear, brake functioning, hoist mechanism, wire ropes and safety devices.

All greasing points should be thoroughly attended to and oil topped up in the gear boxes.

After check and repair, test may be carried out with 25% overload with load in the center of span. Different motions may be checked with the load lifted.

Similarly, checks may be carried out on the functioning of electrical equipment and safety devices.

Necessary record regarding check and attention duly certified by the supervisor or independent Inspection Authority be maintained.

Note:- It may be noted that the maintenance schedule hitherto given is only for guidance. The user may suitably modify the schedule based on the site and working conditions and keeping in mind the safety aspects.

7 MAINTENANCE CHART

Sl. No.	Assembly and Components	Details of service	Monthly/Quarterly	Yearly
1.0	**Hoisting**			
1.1	Gear Box	Check and top up oil		Y
1.2	Wire Rope Guide	Check and grease	M	
1.3	Sheaves & Pulleys	Check and grease bearings	Q	
1.4	Hooks	Check and grease bearings	Q	
1.5	Plummer Blocks	Check and grease	Q	
1.6	Bearing Housing	Check and grease	Q	
1.7	Motor Bearings	Routine check in monthly/quarterly. Thorough check six monthly		H/Y
1.8	Brake Functioning	Routine check in monthly/quarterly. Thorough check six monthly.	M	
1.9	Thrustor	Oil Change		Y
1.10	Limit Switch	Check functioning	M	
1.11	Overload Test	Check after thorough attention		Y
2.0	**Traversing**			
2.1	Gear Box	Check and top up oil		Y
2.2	Motor Bearings	Routine check in monthly/quarterly. Thorough check six monthly.		H/Y
2.3	Brake Functioning	Routine check in monthly/quarterly. Thorough check six monthly.	M	
2.4	Limit Switches	Check functioning	M	
2.5	Wheel condition	Check for wear		Y
3.0	**Travelling**			
3.1	Gear Box	Check and top oil		Y
3.2	Motor Bearings	Routine Check in monthly/quarterly. Thorough check six monthly		H/Y
3.3	Brake functioning	Routine Check in monthly/quarterly. Thorough check six monthly	M	
3.4	Limit Switch	Check functioning.	M	
3.5	Wheel Condition	Check for wear.		Y

4.0	**Control**			
4.1	Terminals & Connections	Check, Clean and Fix.	Q	
4.2	Switch Gears	- do-	M	
4.3	Push buttons, control switches	-do-	M	
5.0	**Miscellaneous**			
	Major damage of components	Replace as & when necessary	-	-

Note :- Considering the safety aspects involved the prevalent practice is to give maximum attention during the monthly schedule.

The yearly schedule is primarily for carraying out repairs where welding on structure is involved or replacement of a major part is required. During this schedule, more time is available and a thorough attention is possible as compared to monthly schedule when limited time is available for maintenance.

8 RECOMMENDED LUBRICANTS

The periodicity of lubrication of different components & recommended lubricants are given below. The user may use equivalent brand of lubricant. However, for better service from bearings and some key components, mixing of brand should be avoided.

Sl. No.	Components	Activity	Frequency of Lubrication	Recommended Lubricants
01.	Gear Box	Oil filling	Change in first quarter after that topping up.	Castrol Alpha BG-220
02.	Motor	Greasing	Once in quarter through nipple.	AP3 Grease
03.	Wire Ropes	Greasing	By hand once in fortnight	AP3 Grease
04.	Geared Coupling	Greasing	Once in quarter	Greasing
05.	Bearing Housing	Greasing	Once in quarter	- do -
06.	Equalising Pulley	Greasing	Once in quarter	- do -
07.	Hook bearing	Greasing	Once in quarter	- do -
08.	Thrustor	Oil change	Once a year	HYSPIN EP-100/ Transformer Oil
09.	Plummer Blocks	Greasing	Once a month.	Asatma AP 3 Grease
10.	Pulleys/Sheaves	Greasing	Once a month.	- do -

9 Maintenance of Electric Motors

9.1 Hoist Motors (Periodicity of maintenance 6 months)

9.1.1 Insulation Resistance

If the insulation resistance is low, there would always be danger of short-circuiting and motors getting damaged. It is, therefore, useful to measure the insulation resistance of motor at the time of installation.The recommended insulation resistance is minimum 5 mega ohms when the motor and brake are cold, 30^0C.

9.1.2 Loading Capacity

Measure the stator current of all three phases when hoisting the nominal load and compare the same with the ratings given on the motor frame.

9.1.3 Motor Disembly and Assembly (For flange mounted motors)

- Disembly:-

1. Remove the fuses from incoming power supply to isolate the crane.
2. Disconnect the power supply to motor.
3. Remove the brake lining disc
4. Unfasten the securing bolts and remove the brake backing plate with a lever avoiding any damage to the brake power feed cables and the stator winding.
5. Slacken the bolts fixing the motor to the Gear Box housing.
6. Remove the motor frame for check and repair.
7. Remove the circlip for extracting the ball bearings from the gearbox housing.
8. Recommend replacement of the two ball bearings and the oil seal at the time of repair of motor.

- Assembly

To re-assemble, fit the ball bearings into the gearbox. Fit the circlip for retaining the ball bearings. Place the oil seal between circlip and motor end cap.Thereafter, follow the Brake Assembly process.

9.2 Travelling Motors (Periodicity of Maintenance 6 months).

9.2.1 Insulation Resistance

Check with 1000 volts mega ohmeter. Take the reading when the test voltage has been connected for a minute. In cold winding (+10^0C to 40^0C), resistance should be more than 5 megaohms and in warm winding (greater than 40^0C), at least 1 megaohm. If resistance is lower, the winding needs to be dried. This could be accomplished by putting the motor into a warm and well-ventilated oven (temperature about 80^0C).

9.2.2 Commissioning the motor.

Certain checks are required prior to putting the motor in service. These are:-

a) Direction of rotation

Traveling motors are installed symmetrically and operate on opposite rails rotating in opposite directions. The direction can be changed by reversing two of the three line leads connected to the terminals of the motor.

b) Noise

If there is a loud growling noise from the motor, the connection is wrong and the motor must immediately be stopped. If there is a distinct clatter instead of buzzing sound in the bearing, there is damage and the bearing must be changed.

c) Vibration

In case of excessive vibration, check the mounting of motor and the gearbox. The straightness of motor shaft be also checked.

d) Running Temperature

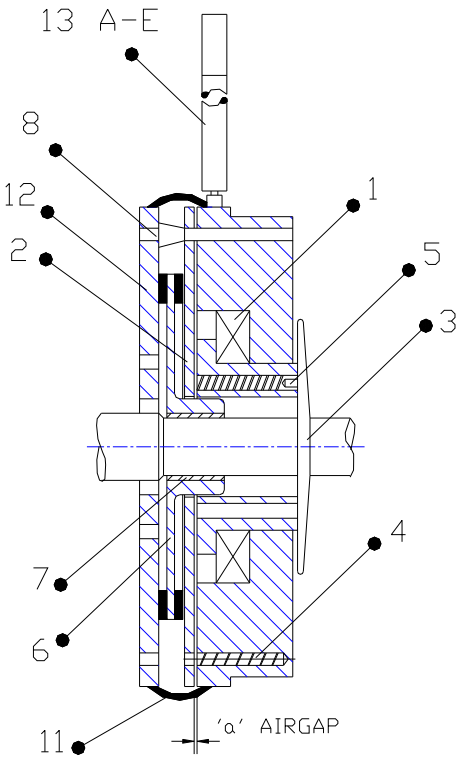
The maximum allowed winding temperature defined by measurement of winding resistance, is 120^0C for B class and 140^0C for F class insulations.

The temperature check is carried out during the first long term use. Check the running temperature three hours after start of the motor. Carefully touch the stator frame by hand. If the stator frame feels burning hot (temperature over 50^0C), measure the accurate temperature with the thermometer. The maximum allowed temperature of hottest spot on the widening is 130^0C for B class and 150^0C for F class insulation.

10 Maintenance of Brakes

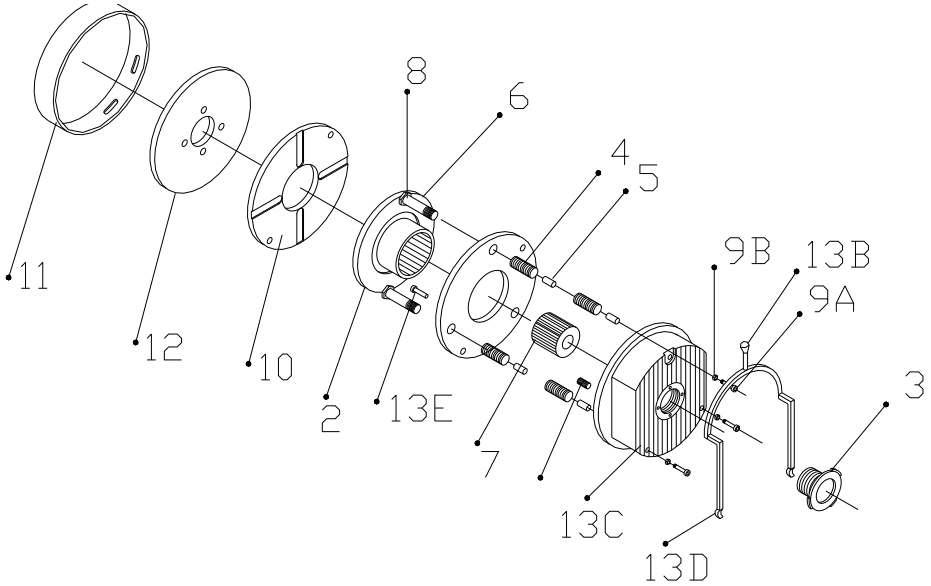
10.1 DC Disc Brakes

The brake torque is provided by several compression springs. In the event of power failure, axial spring force will press the armature plate against the rotor, which in turn is pushed against the mounting flange or a suitable counter surface. On applying a direct current power supply, the magnetic field produced, pulls the armature plate over the air-gap towards the stator against the spring force and the rotor is free to rotate.



In the event of continuous power failure, rotor can be freed by pulling the hand release, which is "deadman type". When the release is freed, the brake will immediately apply.

Like other type of brakes, the brake lining should be kept dry. Oil, grease & foreign materials affect the characteristic of braking system. The salient features of this type of braking system include dust protection seal; adjustable brake torque and simple wear adjustment.



1	Stator
2	Armature Plate
3	Torque Adjusting Ring
4	Compression Ring
5	Compression Parts
6	Rotor
7	Hub
8	Adjustment Tube

9	A/B Mounting Bolt and Washers
10	Friction Plate
11	Rubber Seal
12	Mounting Flange
13	A-E Hand Release Assembly

10.1.1 Brake Disassembly (D.C. Disc brakes)

Since the brakes remain 'ON' in normal position, it is necessary to release the load on the brake and lower the hook until it is resting on the floor. The sequence, thereafter, is:-

1. Disconnect power supply to the motor.
2. Remove the motor cover, the retainer ring and the fan.
3. Disconnect the two cables that feed the brake winding from the power connection.
4. Extract the block comprising of brake winding plate and the armature plate by removing the connecting bolts.
5. In case of failure of any part of the brake including brake winding, take action to change the complete block for satisfactory performance of the crane.

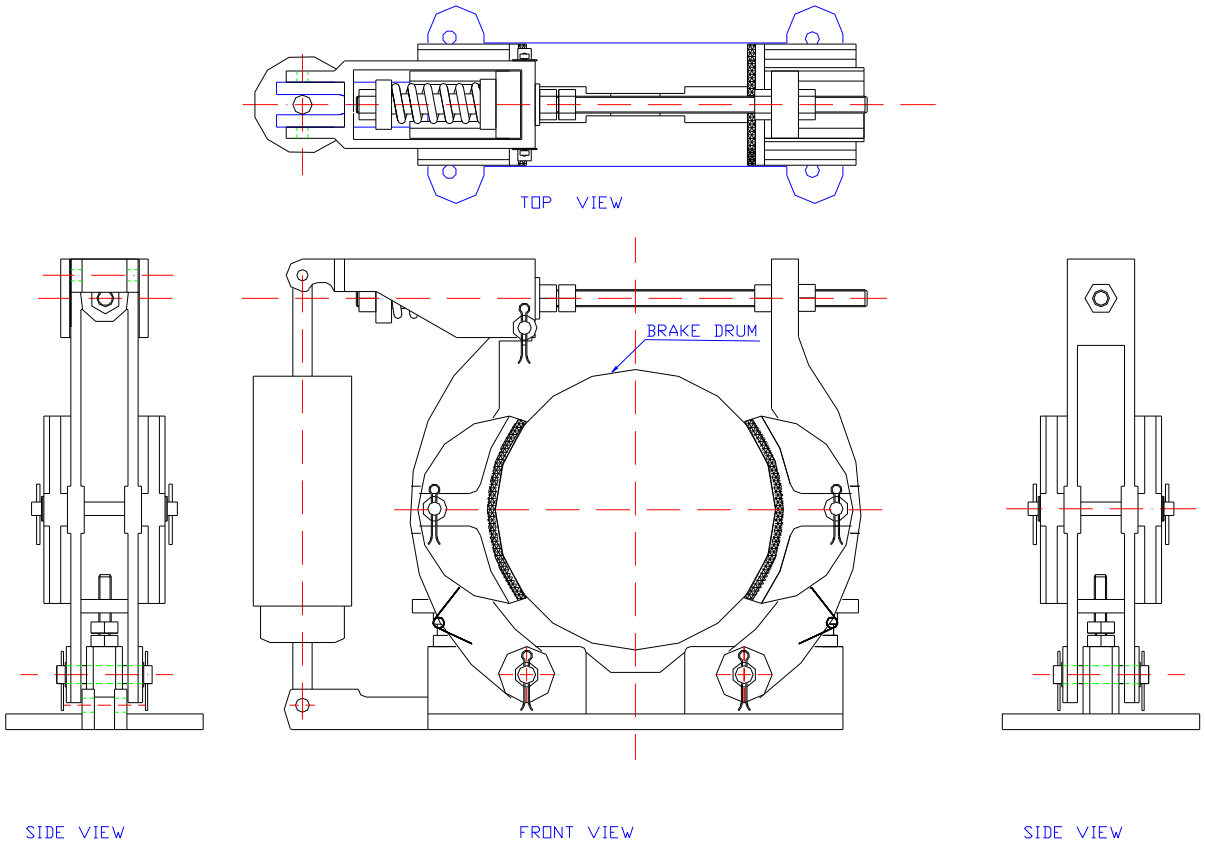
10.1.2 Brake Assembly (D.C. Disc brakes)

- Connect the brake backing plate to the motor frame and fix the head screws.
- Place the brake lining on the motor shaft.
- After installing the brake, fit the fan on the motor shaft and fix it with bolts and the retainer ring.
- Check to ensure that the brake nucleus plate is attracted by electromagnet with good sliding contact and the fan does not rub in the housing.
- If the brake working is in order, fit the fan cover with hexagonal bolts and lock washers.
- Carry out load test to check the operation of assembled units.

Note: - For detailed maintenance, it is advisable to go through the maintenance instructions of brake suppliers. Some extracts are given as Annexures at the end of this chapter.

10.2 Electro-Hydraulic Thrustor Brake

These brakes are suitable for heavy duty on EOT cranes & operate on AC supply. Thrustor brakes have been designed to suit drum sizes 100 mm to 500 mm.



The main components are of cast steel. The spring & all machined steel parts are plated. All pins are of stainless steel and are secured by split pins. The connection to the thrustor terminal box has been made through flexible cable. The brake shoes are self-aligning and are easily removed when worn linings are to be replaced. Asbestos free linings have been bonded to the shoes.

10.2.1 Adjustment of Hoist Brakes

The brakes are suitably adjusted before dispatch from Reva factory with a gap of 0.3 or 0.4 mm on the drum and no additional adjustment is normally required at the site. With wear in use, some adjustment may become necessary and there are provisions for adjustments with the help of two nuts on the tie rod above the brake shoes.

If the brake is not perfect due to excessive brake linings wear, necessary action be taken to change the worn out lining. The worn out asbestos lining is scraped out, the brake shoe surface cleaned and new brake lining (approximately 6mm thick) is glued with high quality brake lining adhesive. The brake lining is clamped on a simple fixture & heated in oven to a temperature of 170^0C approximately for half an hour for perfect setting of asbestos lining on steel backing.

The change is required if the brake lining material wears down to mm thickness.

Operation of the Brake

Emco Design - To check remove the motor from cover by easing the securing bolts. Check the condition of brake lining. A gauge should be used to measure the air gap between the brake lining and the outer rim of the brake wound cap. The air gap varies from normal 0.3 mm to maximum of 1 mm.

For adjusting the gap, the locking screws on the adjusting brake nuts are tightened. This will result in fan moving the brake lining towards motor winding cap.

Once the adjusting brake nut has been tightened, it should be released by half a turn. The air gap will automatically be regulated to its normal value.

Tighten the socket head screws and check the brake. The fan cover should then be fitted.

11 Maintenance of Control Panel

All functions of the crane are processed in the control panel. It comprises of a long panel box having all power & auxiliary contactors, relays, switch gears & other control equipment.

All equipment inside the panel has permanent identification labels in accordance with circuit diagram. Similarly, all power & control terminals shall have identification labels.

The power and control terminals should be inspected once in a month or every 3 months. Every terminal and connection at switchgears must be fully tight.

Panel must be cleaned with compressed air to avoid accumulation of dust & dirt.

Insulation resistance should be checked between terminals & earth on monthly basis so as to have minimum insulation resistance of 0.5 mega ohm.

12 Power Feeding Arrangement

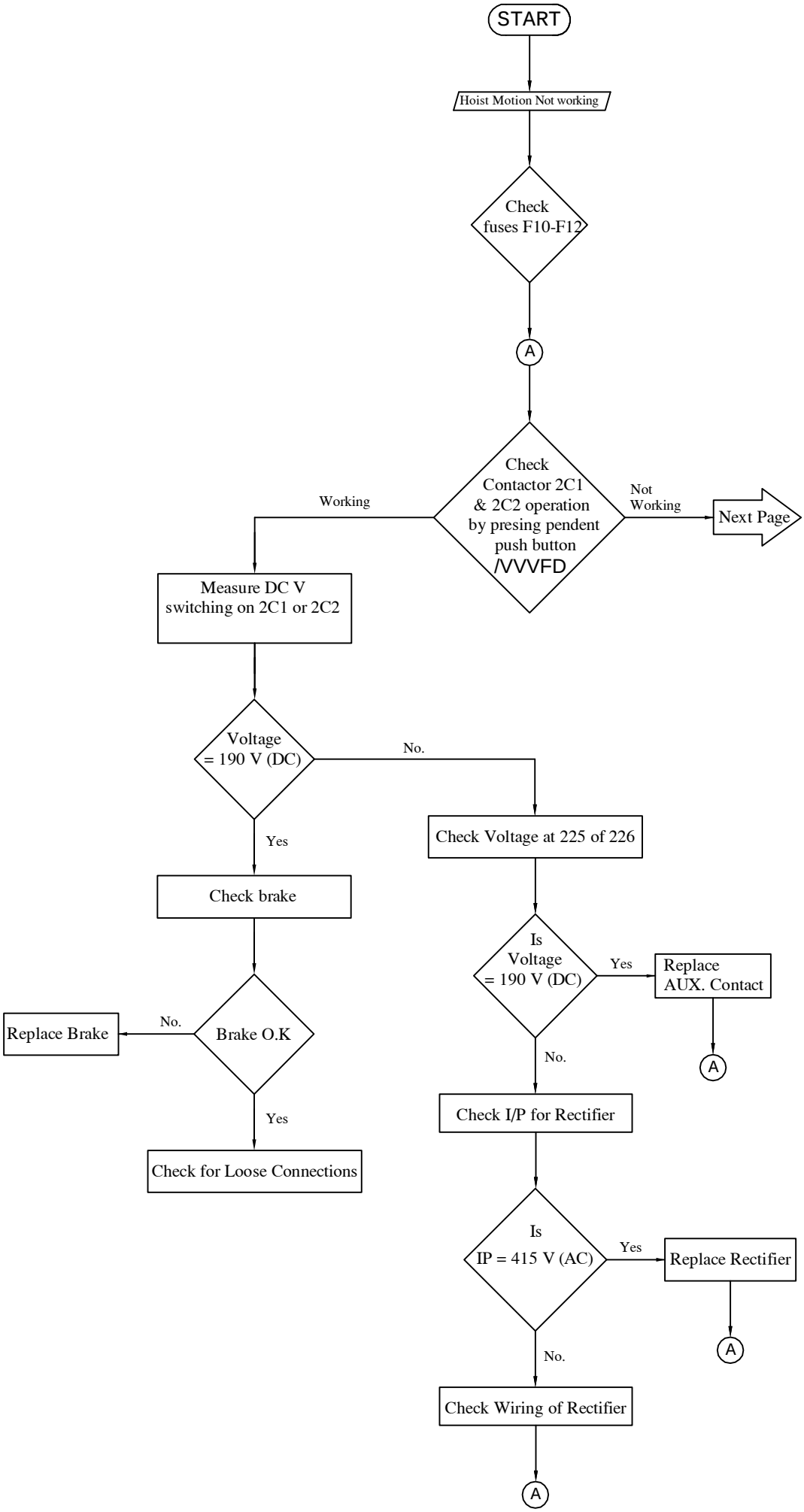
Reva has provided the following types depending on the customers requirements:-

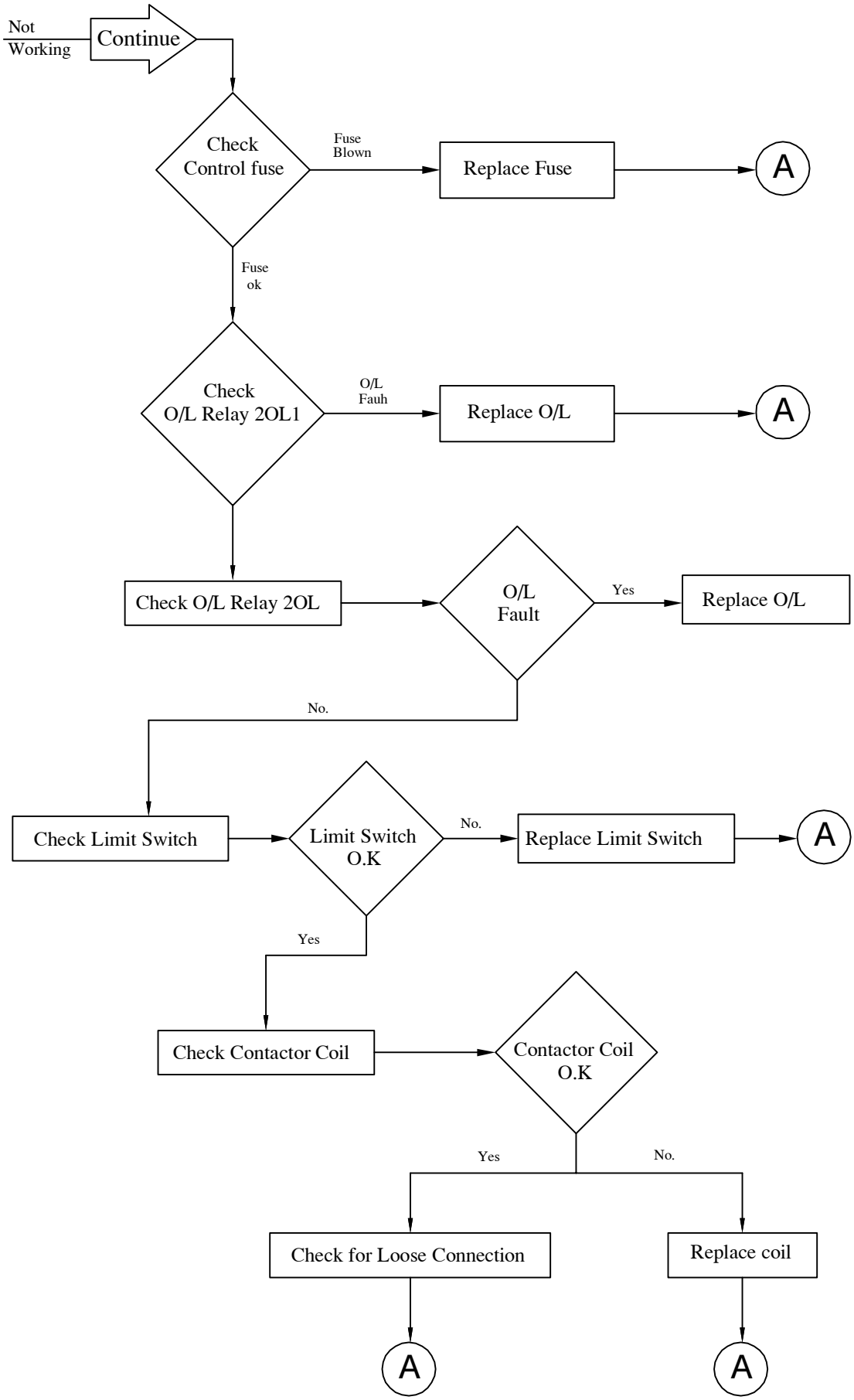
- Taut wire type has a wire held tight between two ends on which the power is to be transmitted. Power is tapped for the crane with the help of freely moving trolleys.
- Shrouded Bus Bar has been used as current collection system at some places as per purchaser's requirements.
- Angle iron type has the required length of angle irons fixed between two ends. Since the power supply is 3 phases, four nos. of angle iron are laid. The power is drawn with the help of current collector assembly.

In case of shrouded bus bars, contact shoes should be checked on monthly basis until a wear pattern could be established.Failure to replace worn out contact shoes would result in damage to the conductor and reduce subsequent control shoe life.

When checking for contact shoe wear, ensure that the collector pivot points are free. The alignment of the collector to the conductors should also be checked.

The maintenance requirement is to check that there is no physical damage to taut wires or angle irons or the insulators connected to those. Sometimes bird dropping creates problems of contact with current collectors. All that is required is cleaning of wires or angle irons.


START
Hoist Motion Not working
Check fuses F10-F12
A
Check Contactor 2C1 & 2C2 operation by presing pendent push button /VVVFD
Working
Not Working
Next Page
Measure DC V switching on 2C1 or 2C2
Voltage = 190 V (DC)
No.
Yes
Check brake
Brake O.K
No.
Replace Brake
Yes
Check for Loose Connections
Check Voltage at 225 of 226
Is Voltage = 190 V (DC)
Yes
Replace AUX. Contact
A
No.
Check I/P for Rectifier
Is IP = 415 V (AC)
Yes
Replace Rectifier
A
No.
Check Wiring of Rectifier
A


Not
Working
Continue
Check
Control fuse
Fuse
Blown
Replace Fuse
A
Fuse
ok
Check
O/L Relay 2OL1
O/L
Fauh
Replace O/L
A
Check O/L Relay 2OL
O/L
Fault
Yes
Replace O/L
No.
Check Limit Switch
Limit Switch
O.K
No.
Replace Limit Switch
A
Yes
Check Contactor Coil
Contactor Coil
O.K
Yes
No.
Check for Loose Connection
Replace coil
A
A

MH POWER WIRING

MHR / 2.2:E
MHY / 2.2:E
MHB / 2.2:E
100/100A F10 F11 F12
SPP1
2D1 HOIST 18.5 KW
2BR1
9 AMP 2CB0 /4.8:D
MH MOTOR 18.5 KW
AC EHT BRAKE 1
AC EHT BRAKE 2

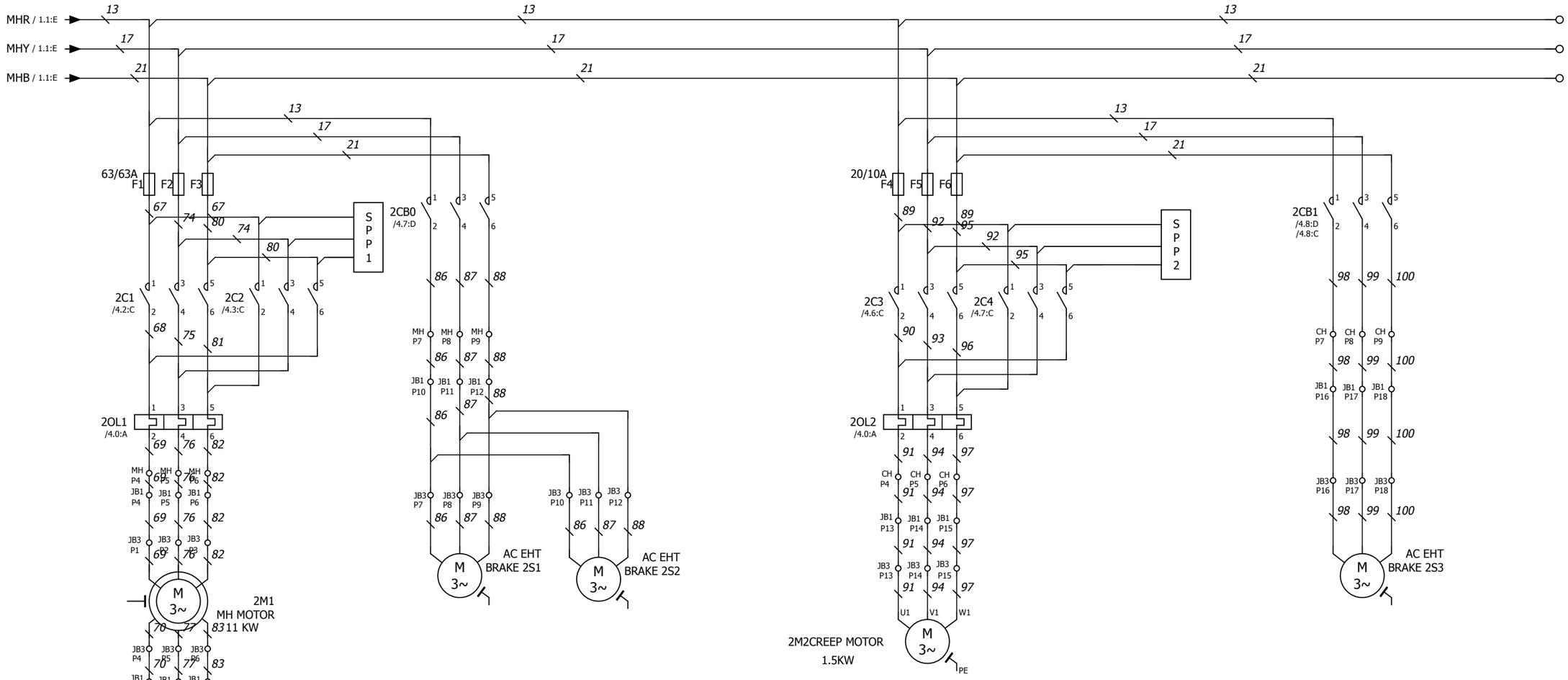
MH SPP1 3.4:D / L4
PEN
PP K25 JB1 k19
2PB1 E
2PB2 E
JB1 K21 JB1 K22 JB1 K23 JB1 K24
JB3 K3 JB3 K5
2RLS1 /4.5:C /4.5:C
JB3 K4 JB3 K6
JB1 K27 JB1 K28
MH K3 MH K4
2R2 /4.5:D 2R1 /4.5:D
2R1 2R2 2R3 2CB0
MH K2
3.4:D / N4
MH UP /4.1:D /4.5:C
MH DOWN /4.1:E /4.5:C
MH SPEED INCR. /4.1:E
CAB
PP K26 JB1 K20
J/S-1
2PB3 E
1PB1 E
JB1 k25 JB1 k26
2R4 /4.2:E
BRAKE RELEASE
1 2 /4.2:B
3 4 /4.2:B
5 6 /4.2:B
13 14

MH MOTOR
3 PHASE INPUT SUPPLY
AC VVVFD - 2D1 HOIST
RELAY IN BUILT IN DRIVE
4R4
2R1 /4.5:D
2R2 /4.5:D
2R3 /4.6:D
UNUSED
M1 M2 /4.8:B

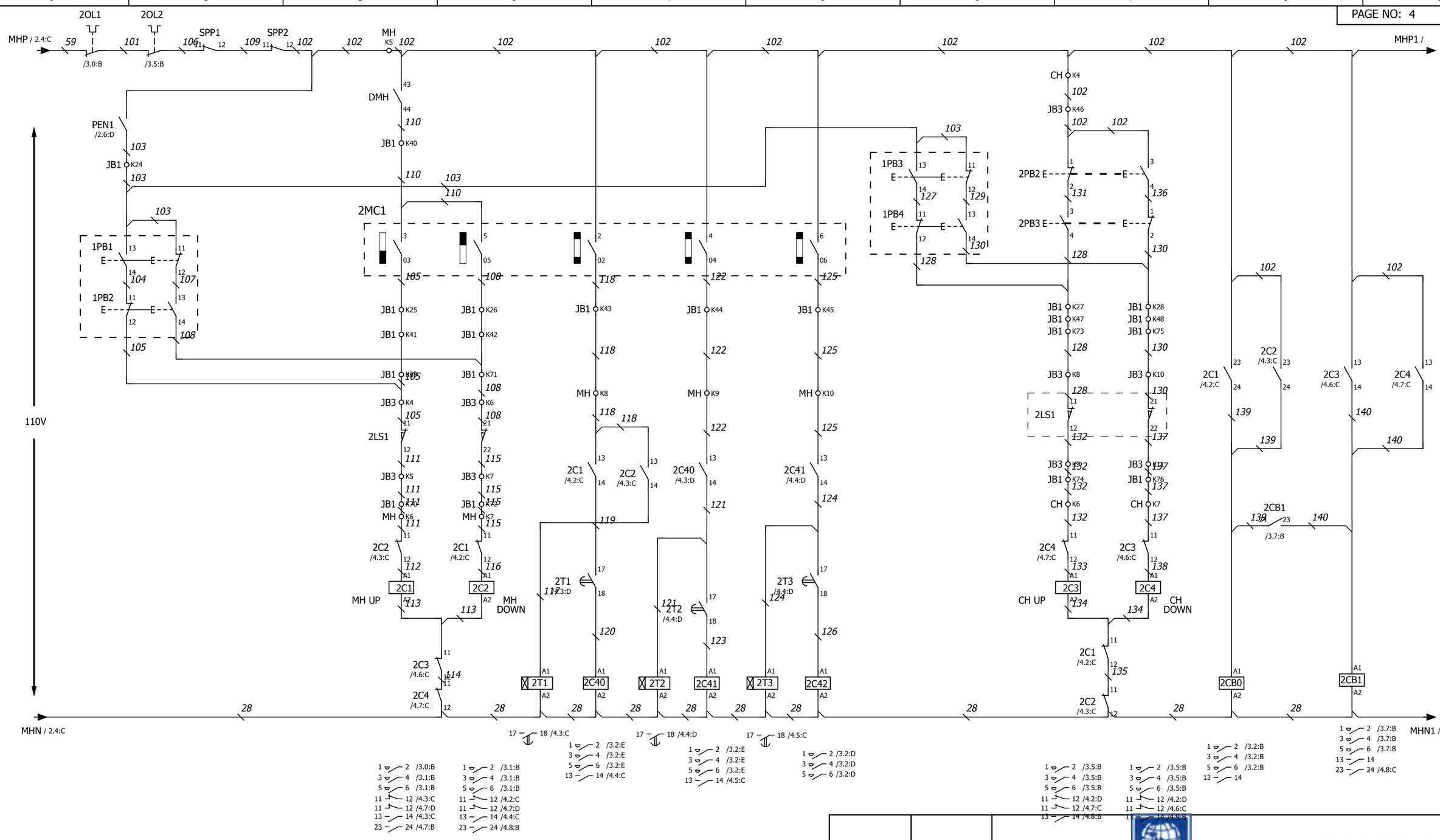
REVA INDUSTRIES LTD
FARIDABAD-121004

DATE	REVISION NO.	SIGN	SCALE:NTS		SIGN	DATE
TITLE:				DRAWN		
				CHKD		
PROJECT:				APPD		
				PROJECTION		
CLIENT:		M/S - COFMOW		DRG NO.		

MH POWER WIRING



			REVA INDUSTRIES LTD FARIDABAD-121004			
DATE	REVISION NO.	SIGN	SCALE:NTS		SIGN	DATE
TITLE:-				DRAWN		
				CHKD		
CONSIGNEE :-				APPD		
CLIENT:- M/s - COFMOW				PROJECTION		
				DRG NO.		



DATE	REVISION NO.	SIGN	SCALE:NTS		SIGN	DATE
TITLE:-				DRAWN		
				CHKD		
CONSIGNEE :-				APPD		
CLIENT:- M/s - COFMOW				PROJECTION		
				DRG NO.		

REVA INDUSTRIES LTD
FARIDABAD-121004

13 TESTING OF CRANES.

13.1 Precommissioning Check on Site Condition.

- Check correctness of power supply in respect to voltage, frequency and phase. Any deviation from specification could result in reduced efficiency of the equipment, overheating of motors and also damage to equipment.
- Check the span and alignment of overhead rails on which the crane has to move. Check the joints between rails.
- Check that the crane stops at the end of runway have been provided.

13.2 Precommissioning Check on Crane

- Check tightness of all nuts, bolts and screws.
- Check that the electrical wiring on the crane is complete and the cables/wires are properly fixed.
- Check the power feeding arrangement before the crane is connected to the power supply.
- After erection but prior to connecting the crane to the power supply, the insulation of electrical equipment shall be tested by a megameter and any defect revealed shall be rectified.
- The voltage required for the insulation resistance test shall be a D.C. voltage not less than twice the rated voltage.
- The insulation resistance of each wiring circuit exclusive of connected apparatus shall not be less than 2 megaohms.
- Check oil level in the gear box.
- Check condition of wire rope. Ensure that it is neither kinked nor twisted out of shape. Any damage of this kind may render the rope unserviceable.
- Check that hook block is undamaged and that all screws and nuts are secure. Check that hook fastenings rotate freely.
- Check that the rope sheaves are undamaged and rotate freely.
- Check that push button pendant has been properly supported independent of the cable by means of wire rope/chain.
- Check the insulation resistance of motors. A low resistance may indicate dampness or dirt. In low voltage Motors, the resistance should normally be at least 5 megaohm when cold and 1 megaohm when worm.

13.3 Final Commissioning & Testing.

13.3.1 Test before hoist block reeving.

Hoist Performance:-

- Close the runway switch; the main crane switch, motor and accessories switch in respective order.
- Connect power supply and place hoist switch in 1st position (slow motion) (with SR motors).
- Observe the contactor for proper sequence and direction of hoist drum rotation. If okay, move to next step. If hoist contactor and rotation is not correct, switch off power and reverse leads on the main supply collectors or on the hoist (whichever is incorrect) to obtain correct phasing. Restore power and recheck.

- After checking hoist at different speeds, return master switch to neutral position and observe braking action. Readjust, if necessary.
- Check and reset hoist timers to 2 secs. Interval.
- If auxiliary hoist is provided, follow the same sequence as per the hoist.

Trolley Motion

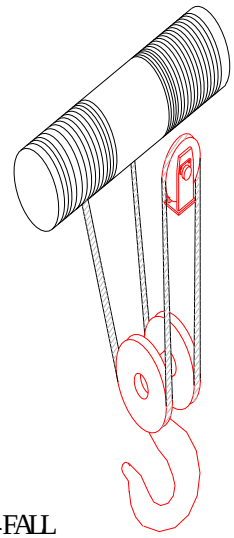
- Place Master Switch in 1st position trolley travel.
- Observe contactor sequence and direction of trolley travel. Reverse phasing, if necessary.
- Move trolley over entire length of bridge span and check for alignment of collector system and obstruction with building structure.
- Adjust end limit switches.
- Reset trolley timers, if needed.

Bridge Motion

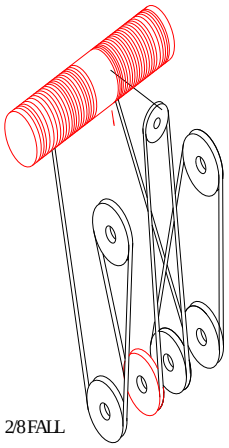
- Place master switch in 1st point bridge travel position.
- Observe contactor sequence and direction of travel and reverse phasing, if necessary.
- Move the bridge over the entire length of runway. Observe any obstruction with the fixed structure and check the alignment of main collector pole and runway conductors.
- Adjust end limit switches.
- Reset bridge timers, if needed.
- Check the functioning of accessories.

13.3.2 Hoist Block Reeving

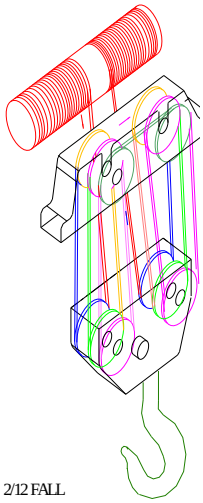
The hoist blocks and rope may now be installed. The various reeving arrangements are as below.



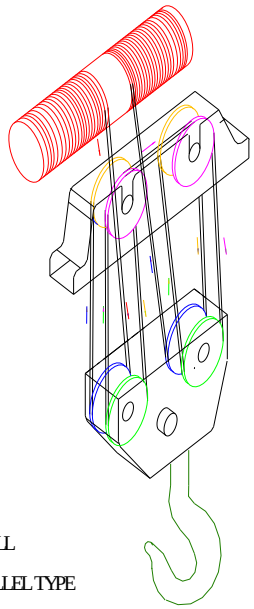
2/4 FALL



2/8 FALL



2/12 FALL
PARRALLEL TYPE



2/8 FALL

PARALLEL TYPE

13.4 No load test

- Raise the empty block slowly until the limit switch trips and stops the hoisting motion. Adjust alignment between load block and limit switch, if necessary. Also check that block stops at the correct height and adequate clearance maintained between block and trolley frame (or upper sheaves).
- If the lower limit switch is fitted, lower the empty block until one wrap of rope remains on each end of the drum.
- Set lower limit switch at this point.

13.5 Load Test

This is carried out after no load test is completed. Proceed as follows:-

- Hoist a load about 50% of safe working load and stop. The brakes should be firm. Adjust, if necessary.
- Lower load and stop. Check drift of load during stopping. If load drifts, brake adjustment is necessary.
- Repeat the test.
- Check the functioning of creep speed control, if necessary.

13.6 Overload Test

Finally, carry out overload test with 125% test load. Hoist the test load and hold. Brakes should be firm. Move trolley across entire span of the bridge. The next step is to move the bridge on runway along with 125% test load in hoisted position at one extreme end of the crane. Again, move the hoisted load to the other end of the crane and transport along runway.

The crane shall contain the load under full control. In this test, the specified speeds need not be attained but the crane shall prove itself capable of dealing with the overload without difficulty.

The safe working load is 80% of the overload tested and the relays shall be set in the control room to limit the lifting of load during normal working beyond the rated limit. The overload test takes care of any deviation in performance of relays and is more a design safety factor.

The satisfactory commissioning of the crane shall be demonstrated to the purchaser and commissioning certificate attained.

14 TROUBLE SHOOTING

Sl. No.	Defects	Possible Consequence	Remarks
1.0	**Hook**		
1.1	Excessive wear on working surface	Hook Failure	Keep under watch & replace at the earliest.
1.2	Crack on the hooks	- do-	Replace immediately.
2.0	**Pulleys**		
2.1	Uneven Wear	Rapid wear of rope & pulley.	True the pulley by machining, check matching alignment between rope & pulley
2.2	Uneven rotation	Damage to rope & axle	Check bearing.
3.0	**Drums**		
3.1	Excessive wear on the drum surface	failure of drum	Replace.
4.0	**Wire Ropes**		
4.1	Excessive wear	failure of wire rope	Check matching with pulley. Ensure greasing.
4.2	Breakage of wire strands	-do-	Follow wire rope maintenance & rejection instructions and replace, if necessary.
5.0	**Brakes**		
5.1	Brake lining worn	inefficient braking	Replace brake lining.
5.2	Inefficient braking	load slip	correct spring tension. Correct the gap between lining & the drum.
5.3	Burning of brake coil.	brake not releasing	Check the excessive spring tension & correct magnet gap.
6.0	**Gear Box**		
6.1	Vibration in Gear Box	damage to shaft/coupling	Check alignment with motor, tighten nuts & bolts.
6.2	Wear of teeth	jerking operation, noise	lack of oil. Replace if necessary.
6.3	Getting overheated.	deterioration	Replace oil.
7.0	**Couplings**		
7.1	Loosening of bolts	damage to coupling	Tighten bolts, using lock washers.
7.2	Holes elongated	jerk start & loosening of bolts	Ream the hole and use oversize bolts / Replace Coupling.
7.3	Keyway damage	damage to key & shaft	Repair keyway and replace key.
7.4	Surface crack	ultimate failure	Replace.
8.0	**Bearings**		
8.1	Heating of bearings	failure	Replace
8.2	Jerking running	failure	Replace.

9.0	**Wheels**		
9.1	Uneven wear on tread	jerky running	True wheel on lathe, check rail joints.
9.2	Excessive flange wear	damage of bearing.	Check rail alignment.
10.0	**Drive Motor**		
10.1	Fails to start	single phasing or no operation	Check fuses, check voltage in all phases, check limit switch operation.
10.2	Runs in wrong direction	-	reverse any two phases and recheck limit switch operation.
10.3	Getting heating up	a) Short circuit in winding. b) Overload Relay c) Low voltage d) Lubrication failure	Check phases Check overload relay operation, single phase preventor. Check voltage & do not operate below 360 volts. Clean bearing and lubricate.
11.	**Control Panel** No power for crane operation		Check and attend control circuit contactors, relays as per circuit diagram.
12.	Main Switch	a) Contact burnt/ defaced b) No power c) Line discontinuity	Replace Check & replace burnt fuses Check voltage in all three lines. Check whether main switch is ON.

Annexure A

1.5 DC DISC BRAKES

1. For satisfactory performance of the brakes, the air gap between stator and armature plate has to be maintained. When releasing the brake, a DC voltage is applied to the stator coil. The magnetic force generated attracts the armature towards the stator against the spring force. The rotor is then released and can rotate freely.

2. The spring force and thus the brake torque can be reduced by unscrewing the torque adjustment ring.

3. Ratting data for different types for DC voltage 190V are given hereunder:-

Type	Rated brake torque,N.M.	Power	Air gap mm		Coil resistance Ohms	
			Rated ±0.05mm	Max.	Min.	Max.
14.458.06	4	20	0.2	0.5	1661	1949
14. 45808	8	25	0.2	0.6	1336	1552
14.45810	16	30	0.2	0.6	1125	1282
14.48.12	32	40	0.3	1	848.4	956.7
14.458.14	60	50	0.3	1.1	682.3	761.7
14.458.16	80	55	0.3	1.4	568.6	634.8
14.458.18	150	85	0.4	1.4	403.5	445.9
14.458.20	260	100	0.4	1.6	342	379
14.458.25	400	110	0.5	2.2	313	343

For detailed instructions regarding assembly/disassembly maintenance and trouble shooting.

4. If the air gap deviates too much from rated air gap ‘a’ readjust as follows:

a) Loosen the screws on the stator
b) Turn the thread adjustment tubes by means of a spanner:
   - Screw the adjustment tubes into the stator if the air gap too large
   - Screw the adjustment tubes out of the stator if the gap is too small
   - The width of air gap changes by approx. 0.15 mm when turning the sleeve by 1/6 revolution.
c) Tighten the screws on stator
d) Check the air gap and repeat the adjustment, if necessary.