INDIAN RAILWAYS

Centre for Advanced Maintenance TECHnology

MAINTENANCE HANDBOOK SERIES

MAINTENANCE HANDBOOK FOR SUBMERSIBLE PUMPS

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CAMTECH/EL/PUMP/4

TROUBLE SHOOTING CHARTS FOR SUBMERSSIBLE PUMPS

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TROUBLE : 1 Pump fails to start

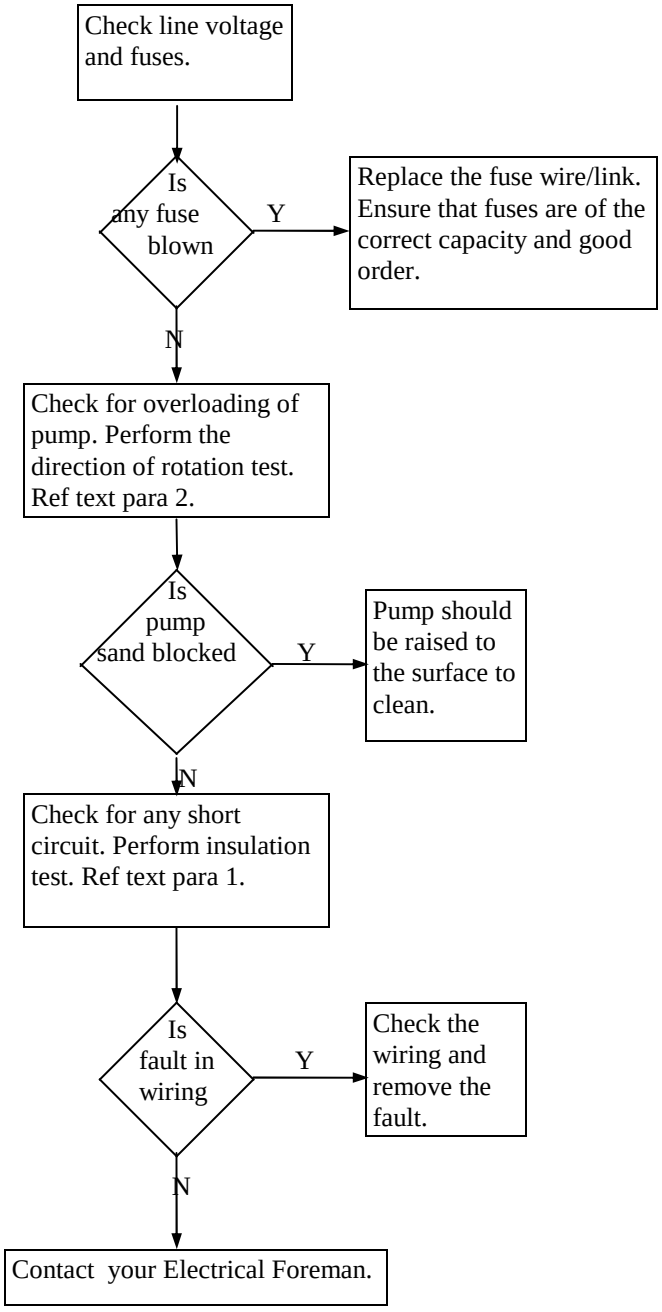

Chart No. 1

TROUBLE : 2 Pump starts but No/ Low discharge.

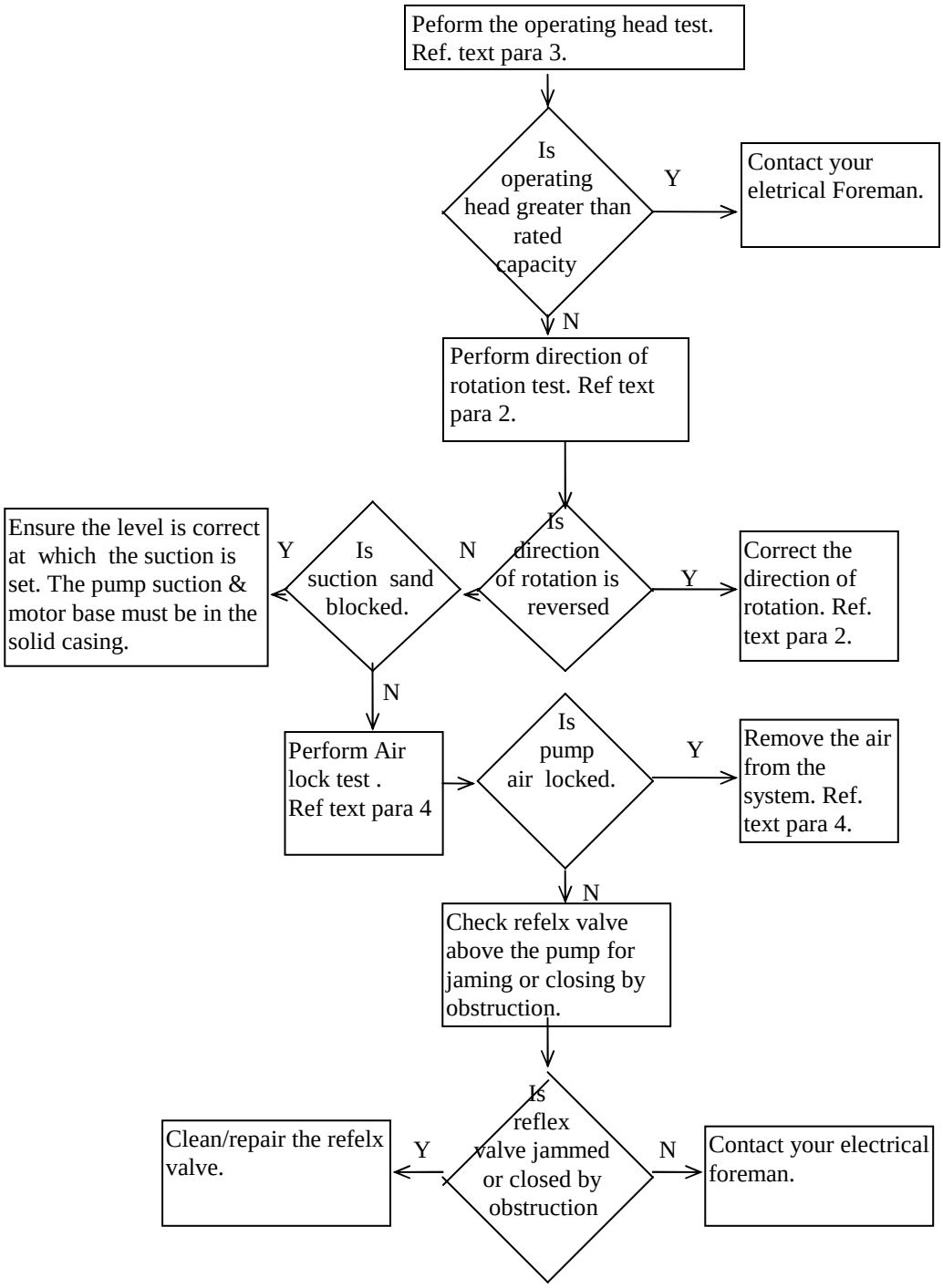

Chart No. 2

TROUBLE : 3 Pump runs and discharge steady but low.

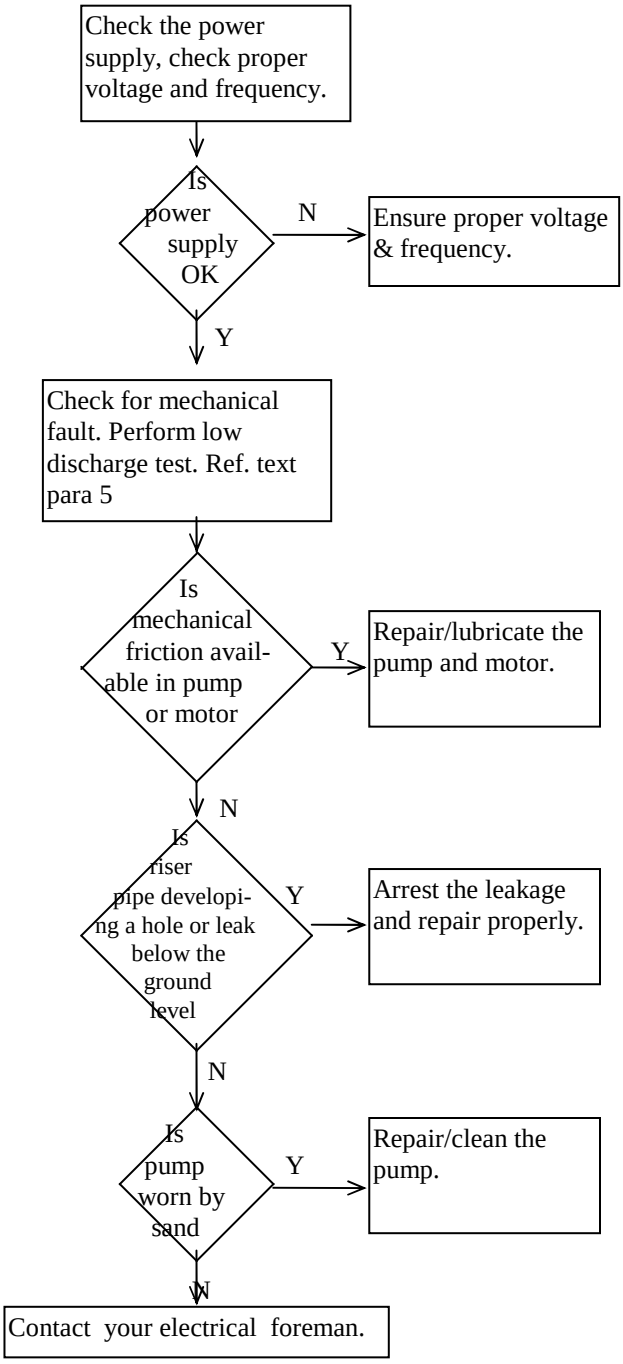

Chart No. 3

TROUBLE : 4 Pump runs and discharge intermittently.

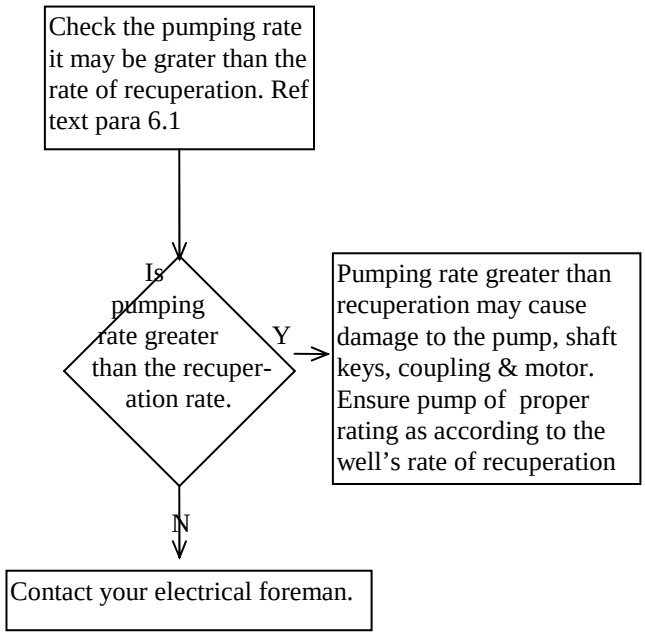

Chart No. 4

TEXT - PARAS

1. INSULATION TEST :

Connect one lead of a Megger tester to the rising main and the other lead to the read core of the motor cable. A reading of 2 Mega ohms or more indicates that the motor winding, cable and cable joints are sound. If the reading is less than 2 Mega ohms, the fault is either in the wiring or the pump is locked by sand or other foreign substances.

2. DIRECTION OF ROTATION TEST :

Check the above-ground wiring against the wiring diagram. Test the operation of all the above ground electrical equipments, with the motor cable disconnected. If the operation of the equipment is normal, reconnect the motor cable, close the gate valve and reopen it three quarters of a turn only. Switch on the motor. If the oveload release device trips or other fault occures, it is an indication that cable connections are wrong or the pump is sand blokced. Try to reverse the direction of rotation for about three seconds only. If the pump still does not start, it must be raised to the surface to be cleared of obstruction.

If the pump is sand locked, recheck the level at which the pump suction is set. The pump suction and motor base must be in the solid casing (pump housing) and not opposite the well screen.

3. OPERATING HEAD TEST :

Close the gate valve at the surface completely. Check the pressure gauge reading, ammeter reading and the distance gauge from the centre of the pressure gauge dial to the water level in the well.

Compute th etotal head by adding the pressure gauge reading and the distance dial to the water level in the well.

The total head obained should be approximately the same as expected.

4. AIR LOCKED TEST :

Close the gate valve at the surface completely. Check the pressure gauge and ammeter reading. Check the line voltage in all the phases while the pump is in operation. If the discharge from the pump is into an elevated reservoir or tank separate the pipe system at the ground level immediately after the gate valve at the ground surface, and check the meter current and discharge rate obtained at this point.

A lower than normal reading of line current without any discharge at all will show the air locked pump.

An increase in discharge and motor current will prove that the trouble is in the system beyond the gate valve and not in the pump or system below ground level.

5. LOW DISCHARGE TEST :

Close the gate valve at ground surface for a sufficient long time, to check the ammeter and pressure gauge reading. Check the water level in the well. Calculate the closed valve head developed by the pump. If this value is considerably less than the design total head, while the ammter reading is higher than that specified by the manufacturer on the test sheet, the existance of following faults confirm.

1. Mechanical friction in pump or motor
2. Riser pipe developing a hole or leak developing in the system below the ground level.
3. The pump being worn by sand , there is an increase in mechanical friction.

6. PUMPING RATE TEST :

a. The test procedure to test weather the pumping rate greater than the rate of recurperation of well will include closing of the gate valve at the surface completely and then opening on turn only. If the trouble is corrected this proves that the pump discharge is too high for the yield of the well.

b. If the trouble persists, close the gate valve further, a small part of a turn at a time, until the trouble ceases. Leave the gate valve stem. Remove the gate valve handle to prevent authorised interference.

OPERATION OF SUBMERSIBLE PUMPS

Before operating the pump, the direction of rotation is checked. To ascertain the correct direction of rotation, let the motor run in both directions with the stop valve closed. The direction of rotation is changed by interchanging two of the phases. The pressure gauge will show different readings for the two directions. The direction which gives the higher pressure is correct one. When running freely, the correct direction of rotation can also be judged from the amount of water pumped.

1. STARTING AND INITIAL RUN :

The pump is started with sluice valve closed or slightly open. During the initial run, it is checked as to whether the pumped water is clear or muddy and whether any impurities is being pumped. If the water contains sandy or gritty particles or the impurities, care is taken not to stop pumping, otherwise the particles will settle inside the pump and on top of the non-return valve (if fitted), and may choke or seize the pump. The pump must be rum with valve fully open (at not more than 40% discharge), until the sand content falls. The valve is then opened slowly to its full extent. Pumping is continued in this manner until it is possible to pump with a fully-open valve, without pumping excess sand. Generally, the permissible limit is up to 25 grains of sand per cubic meter of water (0.001 per cent, on volume basis, or 0.0025 per cent by weight). When the pumped water is clear, the pump may be stopped and restarted as required.

2. SHUT-DOWN PERIODS

The pump should not be allowed to remain stationary for more than 14 days at a stretch as, otherwise, lime, iron and other substances tend to settle in the bearings and impeller gaps, and block the pump rotor. If operating conditions require the pump to remain stopped for a longer period, it should be started and allowed to run for at least 5 minutes once every 14 days and preferably once every 8 days. Only then the pump will be ready for instant resumption of service at any time.

COMMON CAUSES OF BREAKDOWN OF SUBMERSIBLE PUMPS

The most common cause of breakdown of submersible pumps is the burning of motors. The following are the common causes of burning of the motor.

1. UNIFORM BURNING OF MOTOR WINDING DUE TO FORMATION OF INSULATING LAYER :

If the temperature of the winding exceeds the maximum allowable limit, it may result in the burning of the motor. This is generally caused by formation of an insulating layer around the motor surface, due to silt or grit gathered on the motor frame. The burning in this case is uniform. Whenever the motor is taken out, the surface should be cleaned and repainted before lowering.

2. BURNING OF MOTOR DUE TO OVERLOADING

A power overload occurs when the pump requires more power from the motor than the rated motor. Such a situation could lead to the overloading of winding, thus burning the motor. Power overloads can occur if the pump is run far away from the duty point specified on the pomp and motor . In the field, such conditions normally happen if the assessment of total head to be developed by the pump is not made properly. To avoid this, the motor selected should have adequate output.

3. BURNING OF MOTOR DUE TO VOLTAGE FLUCTUATION :

Submersible motors are designed to function without any problem, in the voltage range of ± 10% of the rated voltage. When the voltage exceeds the limit, the output of the motor increases, leading of overheating and burning of the winding.

It is always advisable to have a voltmeter and an ammeter fixed on the switchboard as near the motor as possible. Necessary action could then be taken, in case the variation in voltage is more then the permissible limit.

It is safer to have a motor of horse power about 10 to 15 per cent more than the rated power for the pump, so that some overload can be sustained. In case of fluctuating voltage conditions, a 3 phase voltage stabiliser should be provided.

4. BURNING OF MOTOR DUE TO SINGLE PHASING

Single phasing of the motor is frequent in the field. In most cases, the missing of phase can also be due to malfunctioning of the switch gear. Inadequate capacity of fuses can also lead to this hazard.

Further, single phasing can occur due to damage of the power cable. This can happen at the time of pump installation. Great care must be taken to avoid any damage or bending of the cable at the time of installation of the pump set.

It is recommended that economy should not be considered in the choice of switch gear for quality and capacity. It is always advisable to have a single-phasing presenter installed with the pump set.

5. BURNING OF MOTOR DUE TO EXCESSIVE NUMBER OF STARTS

The starting current of all motors is much higher than the current required for normal running. Consequently, if the number of times the pump is started is high and in quick succession, the winding will not have time to dissipate the heat developed in starting and will overheat. This will weaken the insulation and result in the winding burning. The permissible switching frequency depends on the motor horse power. The maximum switching allowed is 20 times and 15 times an hour for motors upto 5 hp, and 7.5 to 100 hp, respectively. If the motor does not start to run and build up to full speed as soon as it is switched on, it must be switched off immediately and should not be started again until about 5 minutes have elapsed.

6. BURNING OF MOTORS DUE TO ELECTRICAL DISCHARGE

Electrical discharge can occur between winding and earth or between turns. The cause can be direct sparking or accidental jumping of current from one conductor to another. The contact between winding and earth, due to defect in insulation of the wire or puncture of the wire at the time of winding, could also cause the damage.

7. WRONG REPAIR AND REPLACEMENT :

The spare parts used in the repair of motor, starter and pump may be improper quality and capacity, which may cause burning of motor due to non-matching of characteristics. The parts replaced should be genuine, purchased form authorised dealers of reputed manufacturers.

In addition to burning of submersible motor, the following are the other causes responsible for breakdown of submersible pumps :

a) Damage to motor and pump :

The submersible pump and motor until is aligned by manufacturer or in repair workshop. Rough handling in transportation and carriage to the site of installation may cause misalignment which will be noticed only after lowering of the unit. Misalignment may cause vibrations leading to damage to motor and pump parts, and overloading of motor resulting in the burning of the windings.

The motor and pumps should be assembled and checked for free movement in the shop, and packed in wooden containers of six matching the equipment. The box should be carried carefully to the site and should be opened only at the time of lowering.

b) Heavy fine-Sand Pumping :

Submersible pump will provide long service life if the sand content of the water is limited to 28-40 ppm. With sand pumping, the service life of the pump is reduced drastically. Sand in water damaged the rubbing surface of the neck ring and impeller and cause more clearance. Too high a clearance result in high vibrations which reduce the discharge and overload the motor. Vibrations disturb the motor alignment and ultimately burn the motor.

c) Loose and Electrical Column pipe :

A loosely bolted and non-rigid column pipe to which a submersible pump is attached can cause vibrations in the whole system. These vibrations will ultimately damage the pump due to misalignment and lead to the breaking of motor or its burning.

Flanges and other types of joints must be properly matched and tightened with an ordinary nut and a check nut. The pipe should be kept at the centre of the housing and on one side.

d) Fallen Pumps and Motors :

The falling down of pumps and motors is due to vibrations, and faulty repair, i.e. non-replacement of worn studs and water hammer. Fishing is easier with a fallen pump than a detached motor. For fishing the fallen motor, the manufacturer should be asked to provide a mechanical clamp from the bottom of the motor to the discharge nipple over the non-return valve, which can be attached to a wire rope. This wire rope should be brought up to the top of the well so that in case of an accidental fall, the motor can be easily pulled out. this will not only save the motor but well itself because, many a time, the well is abandoned because of the failure to fish out the motor.

e) Seizure of Pump or Motor Bearing ;

Seizure of the pump bearing can result when the pump runs dry. This can happen due to a fall in water level during summer or over pumping of the tube well. The pump can be safeguarded from dry running by installing a pneumatic water level indicator, observing it. periodically and extending the column pipes to cater to situation of falling water, if required.

LIST OF PARTS

Part No.	Part Name
1	Water level indicator
2	Sluice Valve
3	Stopping clamps
4	Non-return Valve
5	Discharge casing
6	Bearing sleeve
7	Bearing Bush
8	Pump bowl
9	Impeller
10	Shaft
11	Suction casing
12	Sand guard
13	Radial Shaft
14	Cable gland
15	Motor Bearing bush
16	Motor bearing housing (upper)
17	Rotor
18	Stator
19	Motor bearing bush
20	Thrust bearing plate
21	Thrust bearing housing
23	Thrust bearing ring
24	Breather diaphram
25	Water filling-cum-Drain plug.

DESCRIPTION OF MAIN PARTS

SN.	Part name	Description
1.	Discharge Case	To provide water passage from bowl assembly to drop pipe. Also connects bowls to drop pipe.
2.	Top intermediate bowl	To provide smooth water passage equipped with difusion vanes to convert water valocity to pressure.
3.	Impeller wear Ring	Furnished on closed impellers. Made of Aluminium bronze to resist wear and provide long impeller life.
4.	Intermediate bowl	Cast iron housing for impeller. Equipped with several diffusion vanes to provide passage for the water.
5.	Impeller tapered lock	Split tapered bushing forced between impeller and shaft to hold impeller firmly in place.
6.	Shaft	Made of corrosion resistant stainless steel and adequately sized to carry the torque requirement.
7.	Bearings	Sleeve type to provide radial support for pump shaft. Combination for bronze and rubber bearings are furnished in most of the models. The bronze bearing gives alignment to the pump shaft and thefluled rubber bearings acts as a vibration domper. Both berings are lubricated by water being pumped.
8.	Suction Case	Ruggedly made of cast iron to connect the motor and pump and is scientifically designed to give smooth entrance of water to pump.
9.	Cable guard	Stainless steel protector to prevent damge to the cable as pump is installed in the well.
10.	Shaft coupling	Connects pump and motor shafts and is preadjusted at factory for proper impeller clearnace.

DO'S AND DONT'S FOR SUBMERSIBLE PUMP

1. DO'S :

1. Do ensure that motor is filled with adequate quantity of clear, cold water before coupling to the pump.
2. Do ensure that no air is trapped while filling wate in the motor.
3. Do avoid sharp bend to cable.
4. Do rnsure that pumpset never touches the borewell bottom.
5. Do ensure that the pumpset is atleast 3m above the mud accumulated in well.
6. Do ensure that in case of extreme urgencies, dissassembly should be carried out only by trained machanic with proper tools.

DONT'S :

1. Do not fill distilled water in the pump.
2. Do not connect wate filling plug to tap.
3. Do not run motor without water even for short time.
4. Do not pull power cable.
5. Do not use any gasket between pump and motor.
6. Do not tamper with important assembly setting like axial play of pump and motor.
7. Do not use vice to hold the motor, use 'V' shaped wooden hooks.

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