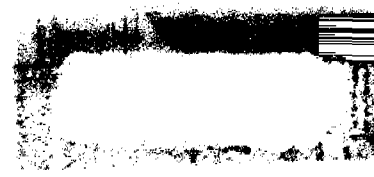
DO IT YOURSELF

KEEPING CENTRIFUGAL PUMP TROUBLE FREE AND ENERGY SAVING TIPS



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KEEPING CENTRIFUGAL PUMP TROUBLE FREE & ENERGY SAVING TIPS

Syed Anis Ahmad*

1.0 Introduction :

In the past few years, there has been significant achievement in the development of ground water resource involving increase in the number of irrigation pumping sets. The increase in pumping sets has like-wise been affected throughout the country. However, comparable facilities for proper repair and maintenance have so far been lacking. It may not be possible for the users to take up major repairs by themselves but usual maintenance, proper handling and minor repairs can be performed by them knowing schedule of maintenance, possible trouble and their remedies. A properly maintained pumping set gives trouble free operation and low operating cost.

The pumping sets commonly used are centrifugal pumps driven by diesel engine or electric motor. A break down of

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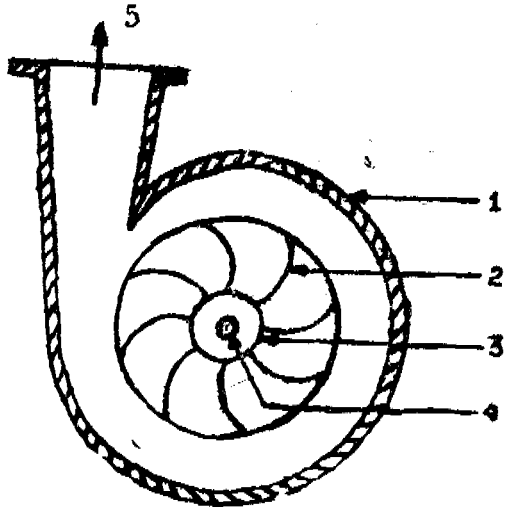
the pump during the irrigation season could mean a great reduction in yield and farm income. Therefore, it is necessary to ensure proper care and maintenance of centrifugal pumps for their efficient and prolonged service.

2.0. About the Centrifugal Pump :



1. Casing 2. Vane 3. Eye of Impeller 4. Impeller Shaft 5. Discharge

Fig. 1

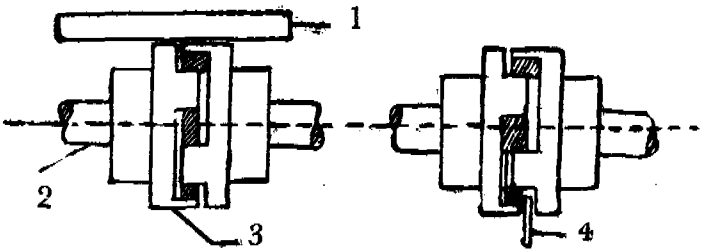
A centrifugal pump is a rotary machine consisting of two basic parts, the rotary element or impeller and the stationary element or casing (Fig. 1). The impeller is a wheel or disc mounted on a shaft and provided with a number of vanes or blades usually curved. The vanes are arranged in a circular

array around an inlet opening at the centre. The impeller is secured on a shaft mounted on suitable bearing. The shaft usually has a stuffing box or seal where it passes through the casing wall. Stuffing box packings are generally made of basic materials such as asbestos or organic fibre.

3.0. Care Prior to Starting Pump :

Prior to starting the pump for the first time special attention should be paid to the following points :—

1. Check the alignment of the pump. (See fig. 2).



1. Steel straight edge 2. Pump shaft 3. Couplings
4. Thickness gauge.

Fig. 2 (a)—Incorrect Alignment

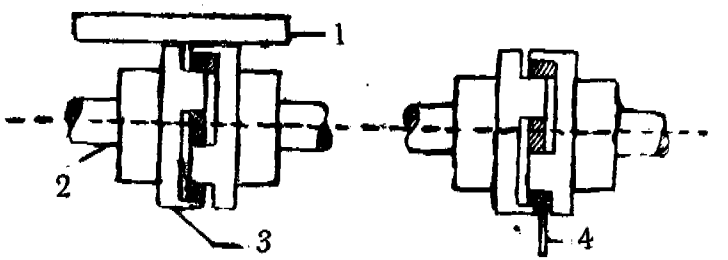
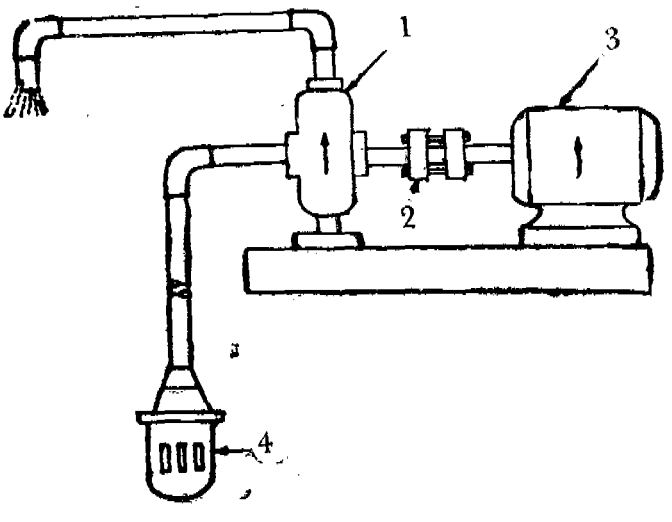


Fig. 2 (b)—Correct Alignment

Fig. 2 (a & b) checking of pump alignment

The pump and primemover (driver) must be carefully aligned. The correct method of aligning couplings is shown in above fig. 2. Parallel alignment can be checked by placing a straight edge across the coupling halves. They must raise evenly on both halves at four positions placed at approximately 90° intervals around the coupling. Angular alignment can be checked with a feeler gauge placed between the coupling halves at 4 points around the coupling.

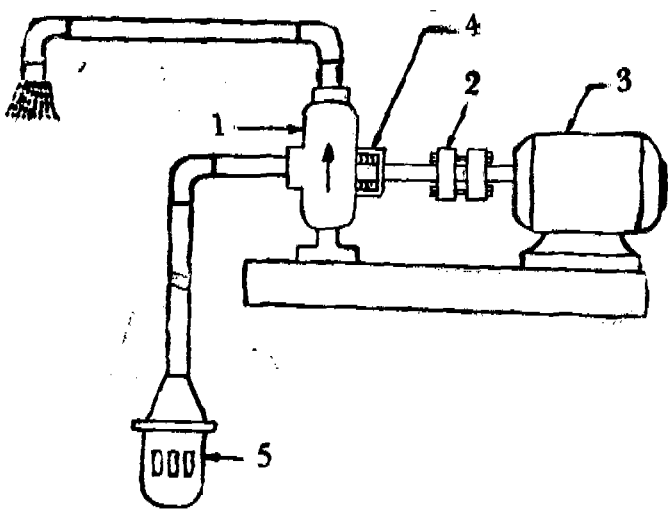
2. Make sure that the engine/motor will drive the pump in the direction indicated on the pump body (Follow Fig. 3).



1. Pump 2. Coupling 3. Primemover 4. Foot Valve.

Fig. 3—Correct direction of Rotation

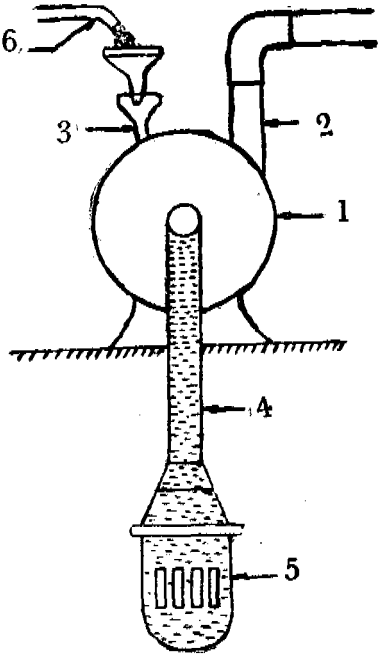
3. Make sure that the gland is lightly and evenly adjusted and the pump shaft revolves freely when turned by hand. (Follow Fig. 4).



1. Pump 2. Coupling 3. Primemover 4. Gland packing lightly and evenly adjusted/tighten 5. Foot Valve

Fig. 4

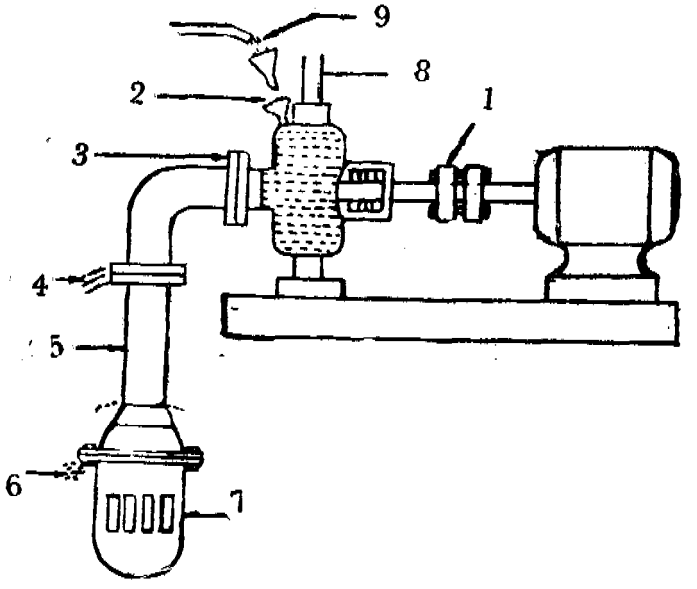
4. Fill the suction line and pump with water and remove the air from casing. (Fig. 5).



1. Pump casing
2. Delivery pipe
3. Air Bleeder or Vent
4. Suction pipe
5. Foot Valve
6. Priming of pump by filling water.

Fig. 5—Removing of Air from Pump casing and suction line by Priming.

5. Check the air tightness of the suction pipe and any leakage in the foot valve. (Fig. 6).



1. Coupling
2. Vent
3. Airtight flanges
4. Water leakage
5. Suction pipe
6. Water leakage
7. Foot valve
8. Delivery pipe
9. Water.

Fig. 6

After fitting the airtight flanges and foot valve in the suction line as shown in Fig. 6, fill the pump body and its suction pipe completely with water and leave the system for few minutes If there is any air leakage in flanges and foot valve joints the filled water will flow in drops. Dismantle all the joints, clean the surfaces, place the rubber packing in between flanges joint, coat the white lead over the threaded portion and then tighten all the joints carefully. For foot valve check seat and packing and repair it. Insert the foot valve properly in the suction line and tighten the pipe and make a coat of while lead over the joint.

6. Attend to lubrication requirements wherever necessary.

4.0 Pump Operation :

On account of its simple construction, the centrifugal pump requires practically no attention while running. Proper lubrication of the bearing and adjustment of the glands are usually the only things which need attention from the operator. The centrifugal pump must be stopped promptly if no liquid is being pumped.

5.0. Pump Maintenance :

Operating conditions of pumps vary widely and so do the maintenance requirements. There are some tips, that should be kept in mind for the successful operation and maintenance of a centrifugal pump. The following maintenance schedules apply to most pumps under average operating conditions :—

5.1. General :

(i) The pump and engine/motor flanges should be in alignment.

(ii) The entire suction and discharge line should be self-supporting. No weight from the piping should be put on the pumps otherwise the casing is likely to be cracked or damaged.

(iii) Use a suitable foot valve at the entrance of the suction pipe when it is planned to pump from an open pit.

(iv) Gland packing should be replaced periodically. Never put a new packing on the old one.

(v) Never tighten a gland more than necessary. After the required number of rings have been inserted, they should first be tightened until there is no leakage. (Fig—4).

(vi) Replace the worn out rubber flap of the foot valve.

(vii) Never run pump dry. If pump runs dry, the rotating parts will wear out quickly. In case the prime-mover is to be started, it should be disconnected from the pump.

(viii) Coat all the piping joints with white lead.

(ix) Lubricate the bearings with grease of proper grade. Clean the nipple and the connector before lubrication. It should be done while the pump is running.

5.2. Every Month :

Check bearing temperature. Bearings may run hot due to lack of lubrication or excess lubricants.

5.3. Every Three Month :

Drain lubricants in ring oil bearings and wash out oil wells and bearings with kerosene. In case of sleeve bearings, check to see that oil rings are free to turn with the shaft. Refill with the lubricant recommended by the manufacturer. Check the wear in the bearings and replace, if excessive.

5.4. Every Six Month :

Replace gland packing. Check alignment of pump and driver and add shims if required.

5.5. Every Year :

Thoroughly inspect the unit once a year. Remove bearings, clean and examine for flaws. Clean bearing housings. Remove packing and examine the wear in the shaft sleeve or shaft. Disconnect coupling and check alignment. Inspect foot valve and check valves.

6.0. Spare Parts :

It is advisable that following spares be maintained by the owner for quick replacement and smooth operation of the pump.

(i) Set of ball bearings.

(ii) Coupling bolts with washer.

(iii) Rubber packing.

(iv) Gland packings.

7.0. Pump Troubles, Causes and Their Remedies :

When the centrifugal pump fails to operate or there is reduction in discharge or pressure drops, the cause of trouble should be investigated and steps taken to eliminate it. A list of the most common troubles, causes and their remedies are given below :—

S. No.	Troubles & Causes	Remedies
1	2	3
A.	**Pump not Delivered water at First Start**	
	(i) Lack of Priming	(i) Fill the pump and its suction pipe completely with water. Leave the vents open until clear bubble free liquid flows from them. Close the vents and start the pump.
	(ii) Speed of pump driver too low.	(ii) Adjust the driver speed to its proper speed.

1	2	3
	(iii) Discharge head too high	(iii) Check vertical head (particularly friction loss).
	(iv) Suction lift too high	(iv) (a) Total lift including friction loss in suction pipe should not exceed 7.5 meters.
		(b) Check the foot valve strainer choking.
	(v) Wrong direction of rotation	(v) Check up the pump turns in the direction of arrow.
	(vi) Air leaks in gland	(vi) Tighten the gland.
	(vii) Air leaks in suction pipe	(vii) Tighten the suction pipe.
	(viii) Water leaks through foot valve.	(viii) Check up the foot valve.
	B. Not Enough Water Delivered	
	(i) Speed too low	(i) Adjust to its proper speed.
	(ii) Impeller eye too small	(ii) Install the pump having a suitable capacity for the job.

1	2	3
	(iii) Discharge head higher than anticipated.	(iii) Check particularly friction loss.
	(iv) Air pocket in suction line.	(iv) Remove air pocket by filling the pump and suction pipe completely by water.
	(v) Impeller or suction pipe plugged up.	(v) Remove the foreign matter causing plugging.
	(vi) Air leakage.	(vi) Check the pump stuffing boxes and adjust the gland.
	(vii) Foot valve too small	(vii) Replace with the suitable foot valve.
	(viii) Mechanical defects :	(viii) Remove mechanical defects.
	(a) Wearing rings worn out	(a) Replace all worn out parts during the pump overhaul.
	(b) Impeller damaged	(b) Repair or replace the damaged impeller.
	(c) Casing packing defective	(c) Make the casing packing properly effective.

1	2	3
	C. Low Discharge Pressure Developed :	
	(i) Speed too low	(i) Adjust suitable speed.
	(ii) Worn wearing rings, packing, gasket etc.	(ii) Replace the wornout parts.
	(iii) Damaged Impeller	(iii) Repair or replace the damaged impeller.
	(iv) Pump water passage obstructed.	(iv) Remove any obstructions in the passage.
	(v) Excessive amount of air or gas in liquid.	(v) Remove if possible or wait till the air or gas exhausted.
	(vi) Impeller diameter too small.	(vi) Check with the pump manufacturer.
	D. Pump Stops Delivering Water While Working :	
	(i) Air leaks through the gland.	(i) Tighten the gland.
	(ii) Air leaks through the flange or some joint in the suction line.	(ii) Locate the leak and remove the cause of leak.
	(iii) Impeller is choked up with foreign matter.	(iii) Remove the foreign matter.
	(iv) Foot valve strainer choked up with rubbish.	(iv) Clean the foot valve.

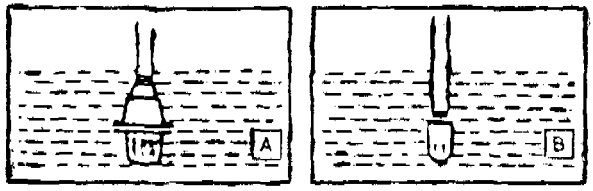
1	2	3
	(v) Water level gone down below practical suction lift.	(v) Wait till the water rises or lower the pump within the practical suction lift.
	(vi) Engine is running slow	(vi) Adjust the engine to its proper speed.
	(vii) Belt is slipping, if driven by belt.	(vii) Tighten the belt.
	E. Pump is Noisy :	
	(i) Bearing worn out	(i) Check and replace.
	(ii) Pump and driving units misaligned.	(ii) Make the proper alignment of pumps and driving unit.
	(iii) Rotating parts out of balance, loose or broken.	(iii) Check and repair.
	(vi) Foundation is not rigid	(iv) Use correct foundation for rigidity.
	(v) Lack of lubrication	(v) Lubricate the moving parts.
	F. Pump Takes too Much Power	
	(i) The bearings are running hot.	(i) (a) Check the lubrication is properly given.
		(b) Check that the belt is not over tight.

1	2	3
	(ii) Speed too high	(ii) Adjust the speed suitably.
	(iii) Vibration in pump	(iii) (a) Use correct foundation for rigidity. (b) Check for pump misalignment. (c) Check for bent shaft.
	(iv) Stuffing box too tight	(iv) Adjust the tightness.
	(v) Rotating element rubbing	(v) Check and repair the rubbing parts.
	G. Pump does not Start	
	(i) Impeller locked	(i) Remove the sand or any other cause of locking.
	(ii) Trash in casing	(ii) Remove the obstruction and fit the suction with strainer to keep trash out of the pump.
	(iii) Corrosion in case of pumps out of service for long period.	(iii) Remove the corroded matter from the pump by using acid or other recommended chemicals.
	(iv) Too much bearing friction	(iv) Use the right lubricating oil and check the shaft bent, replace if necessary.
	(v) Wiring faulty, if driven by electric motor.	(v) Check the circuit breaker of fuses for an open line.

ENERGY SAVING TIPS FOR FARMERS

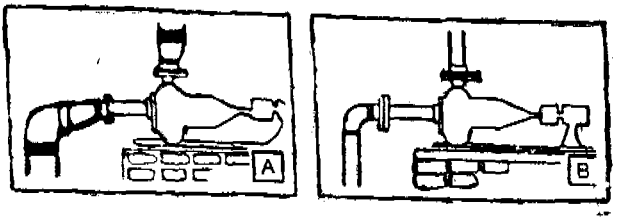
Which foot-valve saves more energy ?

The foot-valve in the diagram A has a wider mouth and larger area of openings. This helps save about 10 percent energy (diesel/electricity) because less fuel or less power is needed to draw water from the well (A good foot-valve, though slightly costlier, pays back fast for the extra cost by saving a lot of energy). The recommended foot valve should have K valve which is less than 0.8 mm.



Which pipeline requires lesser quantity of diesel ?

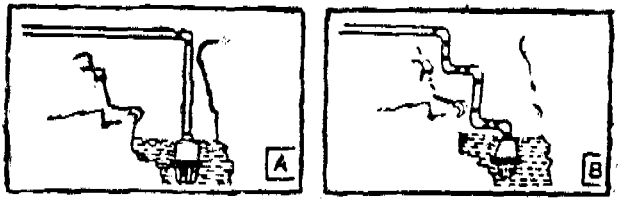
The pipeline, with bigger diameter figure B requires less energy. More energy is required to pump water through small diameter pipes because they offer higher friction. If the pipe is bigger than the pump flange size, a reducer (see the figure) must be used. A 20 mm decrease in diameter increases the friction 3 times. If, in place of a 100 mm (4") pipe, you use 80 mm (3") pipe, the loss due to friction for drawing the same quantity of water will be three times more, and your energy consumption greater.



Which pipeline arrangement needs less energy ?

The pipeline arrangement Figure B With many bends and unnecessary fitting, increase energy consumption. Do you know that each bend in a 80 mm (3″) diameter pipeline leads to as much friction loss as with 3 metres of additional pipe length ?

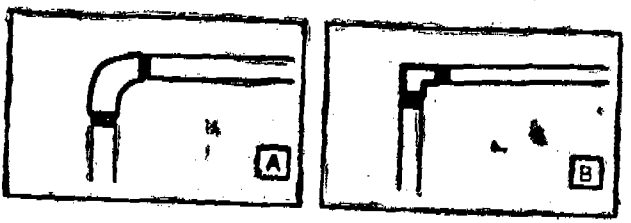
Just remember, the lesser the number of bends and fittings in a pipe, the more energy it saves.



Which bend would you use in the pipeline ?

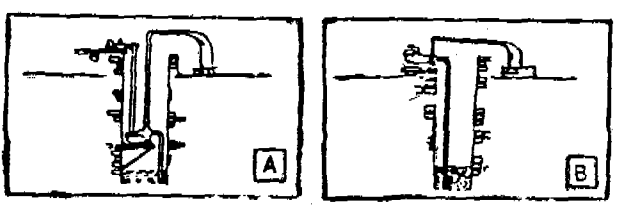
The right bend is Curved. Sharp bends and L-joints in the pipe lead to 70 percent more frictional losses than standard

bends. And this results in a greater energy consumption. Recommended RPVC pipes/HDPE material with minimum 5 kg f/cm² strength (grade 6 of I. S.) should be used.



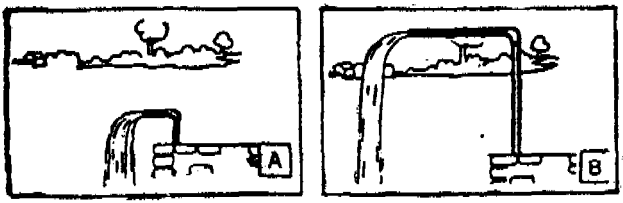
Which installation is better ?

Your pump works most efficiently when it is not more than 10 feet above the water level, Figure A. Some farmers install their pumps even upto 25 feet above the water level. This results in a wastage of energy. If the well is deep, the pump should be installed on a platform at the right height.



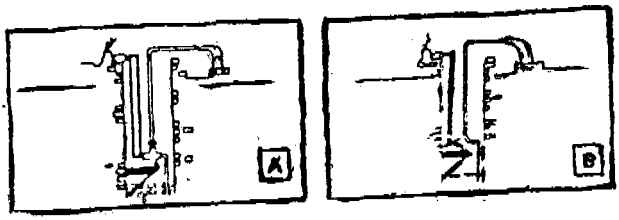
Which pipe will you choose for pumping water ?

The short-length pipe Figure A. The pipe that is unnecessarily high and this would require more energy for pumping water.



Which transmission is better ?

The transmission shown in the Figure A. The belt in the second picture is old and worn out. It can slip or snap anytime, causing a loss in the transmission of power and hence an increased energy consumption.



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