An Overview of Bore Well Motor Pump Installation and Lifting Machine

Mayur N. Adhude[1] Dr. Sharad S. Chaudhari[2]
[1]M.Tech Student [2]HOD
[1,2]Department of Mechanical Engineering
[1,2]Yeshwantrao Chavan College of Engineering. Nagpur, MH, India

Abstract— This paper discuss the innovations that took place in the Bore well motor pump installation and lifting process from the earliest time and also includes the future scope. The paper also shows the various machines and mechanisms available for Bore well motor pump installation and lifting with its advantages and limitation. Paper also provides the detail information and steps to be followed while installation and lifting process.

Key words: Installation, Lifting, Chain Pulley Mechanism, Bore Well

I. INTRODUCTION

Now a day's Bore well is the very popular and major water source in India for domestic as well as agriculture fields. The bore well drilling is carried out with the available highly cost machine. The average size of bore well drilling in India varies from 2 to 5 inches.

But after the bore well drilling we required no of components to lift the water. The components required may be bore well casing pipe, submergible water pump, water lifting pipes, electric cables, starter and many more. One of these component i.e. Bore well motor pump has a great importance and its installation in the bore well after drilling is a major task. There are some major steps that to be followed while installing the bore well motor pump. For this installation procedure we required specially designed mechanisms and machines. It also required labor in the major number to carry out this whole process. Now a day's no of labor required is reduced by automation of some of the activities involved. But the operating cost of these big machines is high with great initial investment. After some successive working days of bore well water pump, its maintenance should be done for its proper working.

For that we have to again lift that motor, necessary action is to be carried out and again we have to install that successfully. These both procedure installation as well as lifting of bore well motor pump is very time consuming and required large no of labor to carry out process. There are several machines and mechanisms are available to carry out these process. But the major problem is that there operating cost is high and also due to its large size they cannot installed or unable to work in the restricted space.

So that the total integrated information and steps to be followed during Bore well installation and lifting is to be focused. In the ancient days these process carry out with the help of chain pulley mechanism. This method is traditional method and very time consuming. This chain pulley mechanism also required no of labor to carry out the process. After this there is a innovation took place of hydraulic and other machines which access in installation and lifting process. The major drawback of these machines is higher of operating cost, its huge structure and required skilled labor to operate. So that its today's need to design and develop a suitable small mechanism to carry out installation and lifting process at low operating cost.

II. INSTALLATION AND LIFTING PROCESS

As we know after bore well drilling completed we have to install a submergible motor pump to lift the water. One by one bore well water lifting pipes also have to be lower in the bore drill. There are some steps to be followed while installation of water pumps for its smooth and safety operation.

The installation procedure is one of the major tasks in the bore well water lifting mechanism. There are several machines and mechanism are available for installation. But here we are describing the detailed steps carried out in the chain pulley mechanism used in ancient days. This mechanism is very less costly but required more time to carry out the whole process.

Also the pulling of chain continuously is monotonous task creates fatigue and also the workers heath problem. Labor faces the pain in the backbone after a long duration of service. One of the major tasks in the installation process is to match the center of bore well. All this problem can be solve by using the latest installation machines but its limitation is its high operating cost.

There are following major steps involved in the installation procedure. The all steps here are shown by the block diagram. These all steps are carried out in the installation procedure with the help of chain pulley mechanism. One or more steps may be added in this while the installation process is carried out with the help of other machines and mechanisms.

These all activities should be taken into consideration for safe and effective installation. These are the basic activities or steps take into consideration. One or more activities may be added or eliminated.

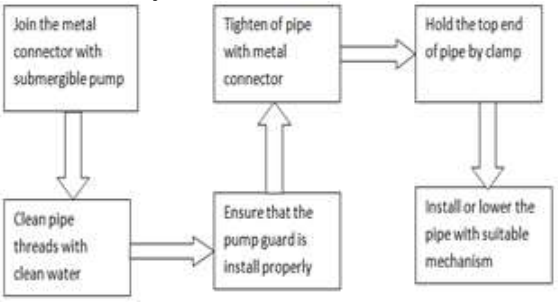

Fig. 1: Steps in installation procedure

Block diagram is shown above giving the details activities to be carried out in installation procedure of bore well motor pump for lifting of water. The very first in the installation process is to join the metal connector with the submergible motor pump. This is very important activity in the installation task as it motor is connected to the water lifting pipe. In this the metal connector acts as a gripper to hold the submergible water pump. It holds pack motor pump with the pipe assembly access in lowering the motor in bore well drill with the help of pipes.

Fig. 2: Installation Guide

The metal connector is joining with the submergible pump by engaging the threads. The next step in the installation is cleaning of pipe threads with clean water so that the last pipes bottom end has good attachment with metal connect to hold the motor by engaging its thread. This cleaning should be done for all pipes so that reliable operation and long life of water lifting pipes. The next step is that to ensure that pump guard is installing properly or not. Now we tighten the pipe with metal connector. This pipe is the last pipe in the bore well which is nearer to the pump and attach with metal connector by engaging threads. This engage and disengagement of threads can be carried out manually. If threads engage with the metal connector then it get attached and when disengaged then the pipe is removed away from submergible pump.

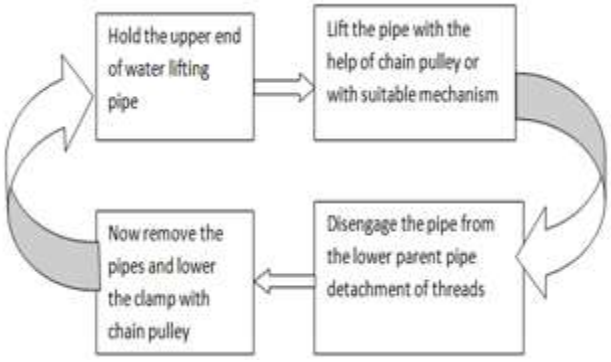

Fig. 3: Steps in lifting Process

Now in the next step the upper end of the same pipe which already engaged with submergible pump through metal connector is hold in the clamp. After this one or two man leave that motor in bore well drill and then with the help of chain pulley we lowering the pipes one by one. The pipes are attached with each other by engaging the threads. The installation process not creates too much fatigue to labor as motor lower down easily due to gravitational force. Worker need mot to apply any force in this operation, he only wants to manage all the things.

After some successive working days of bore well water pump, its maintenance should be done for its proper working. The maintenance also is done to achieve greater efficiency and long submergible pump life. Also we have to lift the motor pump when it's working stop as we are unable to provide service in the bore well. For that we have the remove the motor out of bore well drill.

Lifting process of bore well motor for its maintenance consists of four major steps as shown in block diagram. In the first step the clamp is lower and holds the top portion of water lifting pipe. Then by chain pulley or other suitable mechanism the pipe is lifted upward. As that pipe is attached with the lower pipe that's why whole pipe assembly with submergible pump is lifted upward. As the 10feet pipe comes ground then we have to disengage it from the lower pipe by rotating anticlockwise. After detachment from lower pipe the free pipe is now removes from assembly and clamp.

Now again the chain pulley lowers to the ground to hold the new one pipe and after clamping it lift upwards and this cycle again repeated for each pipe of 10 feet standard length. In this lifting process man has to pull the chain continuously in chain pulley mechanism. Here it creates fatigue and also health problem to labor. The one more drawback is that continuous pulling of chain is monotonous task which is boring affect the working capacity and performance of worker.

III. AVAILABLE MECHANISM AND MACHINES

As we know the lifting and installation we required special mechanism and machines. As it is not possible to lift the bore well motor pump manually with mankind due to its heavy weight. In the traditional manner it carries out with chain pulley mechanism hanging exactly above the center of bore well drill with help of three pipes. These three pipes or support is of woods in the ancient days. Now due to innovation it is replaced by metallic pipes or support. But this mechanism is very less effective and time consuming. So that the further development is made in this by automation. Now hydraulic submergible motor lifting machine, mechanically actuated vehicle mounted machine etc. are available for installation as well as lifting process. The available recent technology, machines and mechanisms are discussed here in detail.

A. Chain Pulley Block Mechanism

This is very ancient and traditional method of installation and lifting bore well motor pump. This chain pulley mechanism operating cost is too low as it totally manually operated.

All the activities during the installation and lifting process of bore well motor pump with chain pulley block mechanism carried out manually with mankind. There is no such a small automation in the whole process. The major drawback of this chain pulley mechanism is it requires large time to install and lifting. Center adjustment with bore drill is also the major task in this process. The table shows the chain to be pulled to lift a specific length of pipe. From the reading we come to know that number of times we have to pull the chain continuously to lift the pipe above. The ratio of pipes to lifted to the chain to be pulled so less. It means for smaller lifting we have to pull the chain in a huge manner. In this process the large amount of rotation of chain pulley block is completed.

Fig. 4: Chain pulley block mechanism.

This is widely used bore well motor pump installation and lifting method. This mechanism contain a tripod i.e. three metal pipes are kept inclined in angle and their top ends are bolted commonly. The chain block pulley is hanged with tripod and other end is used to lift the pipe line in bore well. But in this system the chain of pulley block is pulled manually and this works creates fatigue to worker. In this mechanism the continuous pulling of chain is monotonous task and boring. This method is widely used in the rural areas due to its initial cost and operating cost. Most of the bore well motor installation and lifting is carried out with chain pulley block mechanism. The major drawback in this process is time consuming, requires more no of labor and it also required the large area for installation set up.

Sr.no	Length of pipe(feet)	Length of chain pulled(feet)
1.	10	182
2.	100	1825
3.	300	5475
4.	500	9125
5.	750	13687
6.	1000	18250

Table 1: Chain pulled to lift the specific length of pipe

In this the three pipes are placed on the periphery of circle. The three pipes are placed at 120^0 with respect to each other. This mechanism cannot be installed in a restricted space for example when the bore well drilling is nearer to the wall compound.

B. Hydraulic Submergible Motor Lifting Machine

This is the modern technique available for installation and lifting with the help of hydraulic power. In this machine the whole hydraulic mechanism is mounted on a vehicle. Now day in an urban areas bore well submersible pump-motors are lifted by using Hydraulic lifter mechanism. This system is also fastest method of installing and uninstalling the bore well submersible pump-motor. But this machine is very costly in terms of initial cost and running cost.

At congested areas this machine cannot be installed because of their bigger size. This machine has large primary cost about 12 to 15 lacks, which is difficult to invest as compare to their output.

Fig. 5: Hydraulic operated submergible motor lifting machine.

Now day in an urban areas bore well submersible pump-motors are lifted by using Hydraulic lifter mechanism. This system is also fastest method of installing and uninstalling the bore well submersible pump-motor. But this machine is very costly in terms of initial cost and running cost. At congested areas this machine cannot be installed because of their bigger size. This machine has large primary cost about 12 to 15 lacks, which is difficult to invest as compare to their output. This machine consists of hydraulic actuators mounted on lorry, and powered by engine of the vehicle.

The hydraulic pump is rotated by engine and pressurized fluid (hydraulic oil) is accumulating in the pressure tank. This stored pressurized oil is directed by direction control valve, for the particular application. The actuators are provided of double acting type which enable to movement of piston in either direction. The pump may be of gear pump or reciprocating pump. Due to such pump and continuous high oil pressure allow to leakages and power loss occurs during working. In the urban areas there is a very high population due to this land is an important factor. During making the bore well it may be inside the building or inside compound walls at such times this hydraulic lifter mechanism cannot be installed at these places.

C. Mechanically Actuated Vehicle Mounted Motor Lifting Machine.

The installation and lifting process of bore well motor pump can be carried out with several machines available.

The mechanisms and the power source for the machine may be different but the process followed during installation and lifting remains same. The power source may be hydraulic operated, mechanically actually or pneumatically powered machines etc.

Fig. 6: Mechanically Actuated Motor Lifting Machine.

The above image shows the whole structure of mechanically actuated bore well motor lifting machine. In this the motor is lifted by gear mechanism as shown. Some of the activities are also automated with the help of electric motors. The whole mechanism is mounted on tempo or trucks. Its initial investment and operating cost is too high.

It also required somewhat skilled labor for carry out operation successfully. These machines are not useful in restricted space available like in the urban areas the bore well is in the compound. So due to its huge structure it cannot approach to that place. The machine cost is 1.5 to 2.75 lacks without vehicle. If we add the cost of vehicle then this type of machine is not affordable as compare to their output.

IV. DEVELOPED AND SUGGESTED MACHINE

As we discussed and observed the available mechanisms and machines for installation and lifting purpose are not suitable and affordable due to some reasons. In the chain pulley mechanism all activities are carried out manually hence it very time consuming and also requires the large no of labor for continuous pulling of chain block. In the other available machines like hydraulic or mechanically actuated works very precisely and at very faster rate.

But its initial investment and running cost is too high and also they cannot approach or work in a restricted space available. So there is needed to develop such a machine which can be having low initial investment and running cost. It can also have a capacity to dis assembled and assembled where ever needed.

The above line diagram shows the overall structure of developed machine. The mechanism on which this machine works is as same chain pulley block mechanism. The only difference is that the chain pulley block mechanism totally works manually and in this machine we tried to automate some of the activity. The bore well motor pump machine has main three parts i.e. top plate, bottom plate and supported pipes. On the top plate we mounting and fixed some mechanical component as shown in the diagram for power transmission purpose. The electric motor, gear box and bearings are fixed on the top plate for power transmission. The electric motor transmits the power to the gear box by using v belt and pulley. The gear box used here to reduce the rpm and to increase the torque.

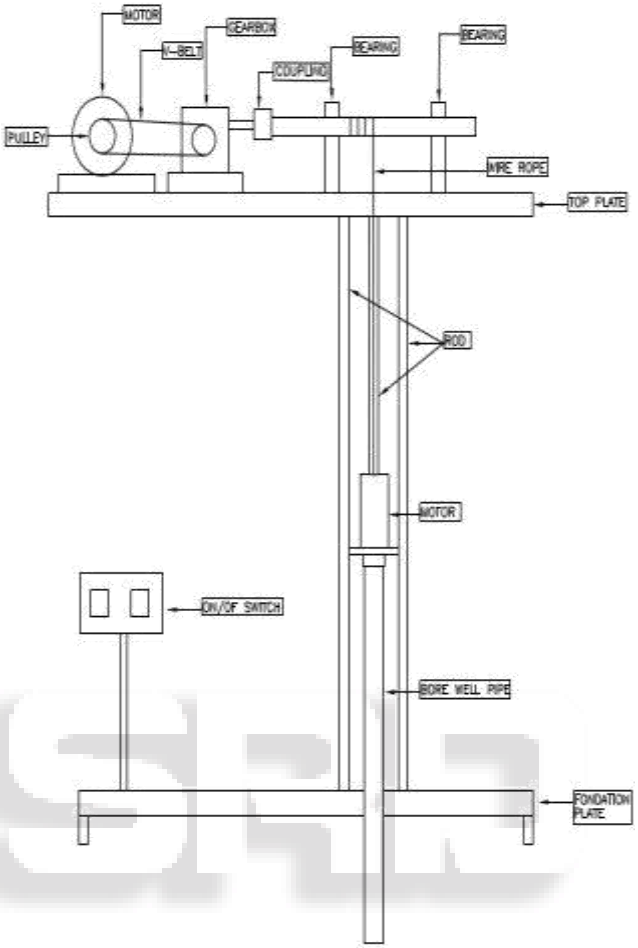

Fig. 7: Developed bore well motor lifting machine.

After the rpm reduction it provides rotation on the shaft supported by two bearings. The rpm reduction is from 1440 to 23 rpm as we required less rotation on the shaft for effective lifting and safer operation.

Another motor is suspended in between three supported pipes with the help of wire rope. The motor having a specially designed coupler to engage and dis engaged threads with pipe for holding purpose. In this this second motor is acts like a gripper to hold and un hold the pipe. When we actuated the motor fixed on top plate then shaft rotates and wire rope wounds on it results in lifting of pipe and in the opposite manner when wire rope un wound it result in lowering of pipe. The lowering of pipe means here installation process is carried out. We used three hollow metallic pipes to support the top plate. The three pipes are mounted at the periphery of circle. Each pipe is placed at the angle of 120^0 to each other. The electric on/off switch is provided to operate both electric motors. The whole structure is mounted on the base plate made up of L- shaped angles.

The benefit of this machine is that it can assemble and dis assembled. The top plate, supporting and bottom plate can be dis assembled as they are joined with the help of nut bolts. Hence this machine easy to carry and

implement or installed where ever needed. It's one more benefit is that it can works in restricted space available as dimension of bottom plate is small. Its covers less floor space when installed. Only two men can operate this machine easily, one is to operate motor and second one is to carry and remove the pipes. This machine lifting capacity ranges from 100 to 1000 kg as per the design.

A. Advantages of This Machine:

- Automation in the installation and lifting procedure of bore well motor pump.
- Improvement in time economics, i.e. Reduction in the time required for installation and lifting procedure.
- Reduction in the labour required for the installation as well as lifting of bore well motor pump.
- Easy access in the installation of bore well motor pump when bore well drilling is very nearer to any wall compound
- It avoids the labour health problem like pain in back bone.
- It also avoids the monotonous working task like continuous pulling of chain to pull the bore well pipe.
- Improves the performance of worker.

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REFERENCES

[1] 1S.Prithiviraj, 2S.Ravikumar1Post Graduate Student, 2Assistant Professor Department of Mechanical & Production Engineering, Sathyabama University, Chennai-600119," Modeling, Analyzing and Fabrication of Lifting SPRhook for Bore well Pipe" , 2014 IJEDR | Volume 2, Issue 1 | ISSN: 2321-9939 .
[2] Guidelines of Construction & Maintenance of Bore wells and Tube wells, 2014 Research Designs and Standards Organization, Lucknow – 226011.
[3] 1Dr. C.N. Sakhale, 2D.M. Mate 3Subhasis Saha, Tomar Dharmpal, Pranjit Kar, Arindam Sarkar, Rupam Choudhury, Shahil Kumar, "An Approach to Design of Child Saver Machine for Child Trapped in Borehole" , Volume 1, Issue 2, October-December, 2013, pp. 26-38, © IASTER 2013
[4] Big Bore Well Drilling in New Zealand – A Case Study, John Bush and Christine Siega, Proceedings World Geothermal Congress 2010 Bali, Indonesia, 25-29 April 2010.
[5] Selection, installation, operation and maintenance of submersible pump set – code of practice, DRAFT INDIAN STANDARD IS 14536.
[6] http://en.wikipedia.org/wiki/borewell motor lifting machine in India.

