A Mechanical Device for Lifting Water from Wells

Rampada Misra

Ex-Reader in Physics, P. K. College, Contai, Purba Medinipur, West Bengal, India

ABSTRACT

A self-rotating device has been designed which works due to the effect of gravitational force. This rotatory motion could be used for lifting of water from wells which may, ultimately, be necessary for irrigation of small cultivated lands.

Keywords : Mechanical device, ball-bearing arrangement, conical masses, concentric circular frames, automatic rotary system.

I. INTRODUCTION

History of the technologies for watering cultivated lands in different countries are known to the management personnel connected to irrigation system [1-5]. It is known that the major source of irrigation in India were wells and tube wells after which comes the use of canals. So, in agricultural sector often water is required to be lifted from wells for cultivation. There are different processes for lifting water from wells. Amongst them Moat, Chain Pump, Dhekli and Rahat are the main. The manual processes use buckets or watering cans for carrying water. This process is important for the fact that it has low requirements for its infra-structure and technical equipments but needs high labour. As manual process could not be used for cultivation at large scale hence, electric pumps are the only solution. Unluckily, power failure is a regular phenomenon in our country especially in the rural areas. As a result proper cultivation hampers.

Under this circumstances if we can provide a device for lifting water from a well only by mechanical arrangement totally leaving aside the use of electric power and, at the same time, with minimum physical labour, as far as possible, then it would be like "a blessing of God" to the cultivators.

In this work trial has been made to present the description and working with the diagram of a newly designed system which can satisfy the above criteria.

II. METHODS AND MATERIAL

Description and Action

The specifications, description and the method of working of the newly designed device are mentioned below.

The central thick metallic post consists of three parts 1-2, 2-3 and 3-4. The lowest part 3-4 is fixed to the ground (or placed on a base) at the centre of the mutually coupled concentric circular metallic frames 5,6 whereas the upper most part 1-2 is fixed by the bars 7 fitted to posts. The middle part 2-3 is attached to the upper and lower parts through ball-bearing arrangements at 2 and 3 respectively. Thus, the part 2-3 is enabled to rotate as and when required. A saw-toothed arrangement 8 is fitted (or welded) to the rotating portion 2-3. A rod (9) has saw-tooth

arrangement also which is fixed to the inner end (10) of it which could fit to 8 and, consequently, rotate when the portion 2-3 rotates. The rod 9 passes loosely through holes at the top of the posts 11 on which 9 also rests. It may be mentioned that by using more than one rotating rod like 9 work may be done by all of them simultaneously. Of course, in that case the r.p.m. will come down. A frame 12 is fixed to the part 2-3 of the post below 8. To this frame the conical heavy iron masses (13) (generally four in number which are equally separated) are attached through ball-bearings (14) so that the masses can spin about the fixed axis passing through 12 and can rotate about the central post. It may be mentioned that once the rotation of the masses starts it will continue for a long time according to our need. The rotation of the masses could be stopped or started by some brakes 15 attached to the system (usually two rods on two sides of the central post) which could be operated by lifting or lowering 16 by foot. The length of the conical masses is slightly larger than the difference between the radii of the circular frames 5 and 6 such that a small portion of them extends out of the lines of 5 and 6.

The masses (13) could rest or roll on several frames (normally eight in number) consisting of two posts (17, 18) with a slanting bar over them. The posts (18) attached to the outer circular frame (6) are smaller than those (17) attached to the inner circular frame (5) and the difference in height between 17 and 18 always equals the radius of the conical masses at the wider end. The narrow side of 13 rests on the higher side of 19 while the lower side would be occupied by the broader side after rotation so that the height of the centre of gravity does not change. The positions of 17 and 18 should be such that the end of the bar 19 on 17 and the beginning of the next one on 18 are on the common radius of the circular frames. The length of 19 should be such that a whole number of it covers the entire circumference of the circular frames. This arrangement enables the narrow side of the masses to

climb the next frame just at the moment the broader side reaches the lower end of the frame and the rotation will continue due to gravitational effect. It is to mention that if the difference between the radii of the circles is smaller then, the length of the masses would be reduced. All the posts 17 and 18 described above could be fixed to the ground or to the concentric circular frames (5, 6) coupled by rods (20). One end of a rope (21) could be attached to the rotating rod (9) which can coil and uncoil surrounding it as it rotates due to rotation of 13 and 8. The other end of the rope is tied to a bucket for carrying water. The length of the rope should be slightly greater than the depth of the water level in the well from the rotating rod (9).

The r.p.m. of the rotating rod depends upon the size and the number of teeth in the two wheels – one attached to it (10) and the other (8) attached to the central post.

The outline of the device is shown in figure 1. Some of the parts are, also, shown separately in figure 2 for clarity. The top view is shown in figure 3.
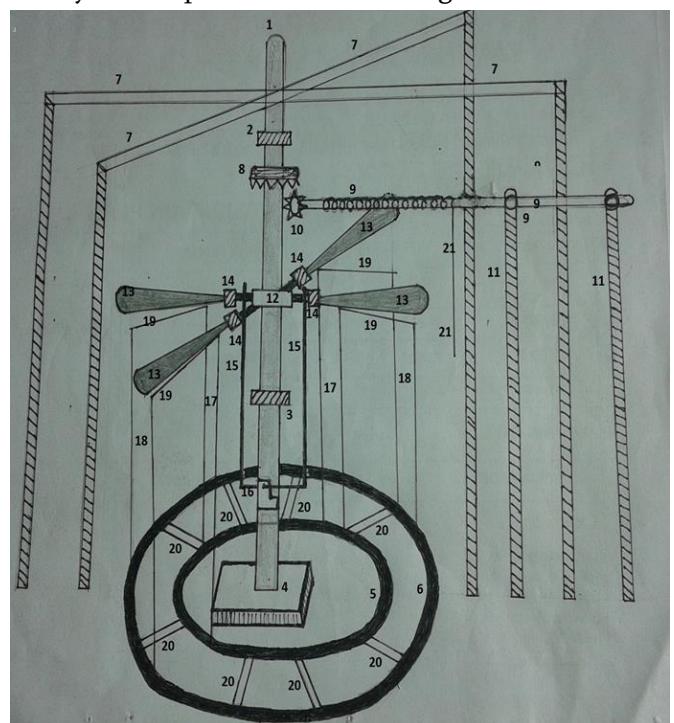
Figure 1. The arrangements of the Device
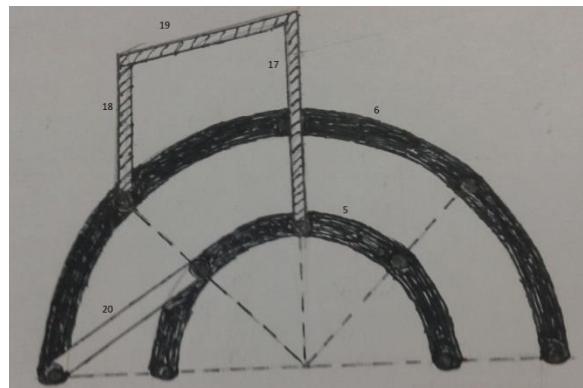
(a)
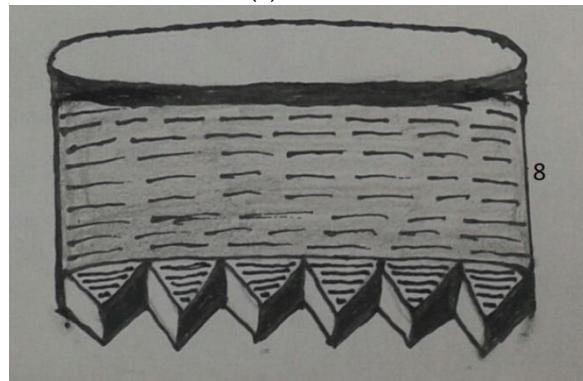
(b)
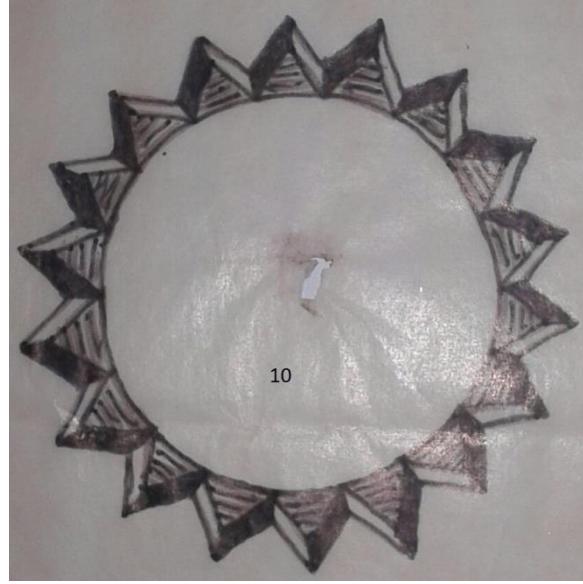
(c)
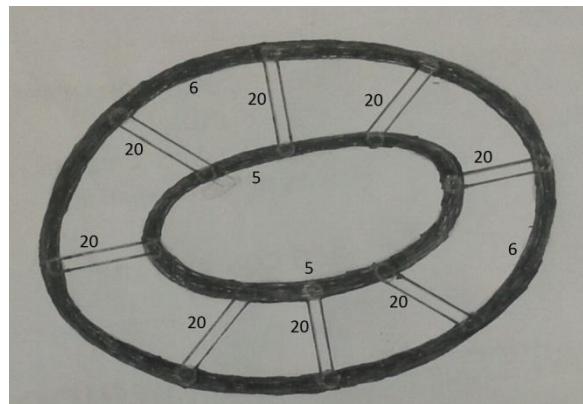
(d)
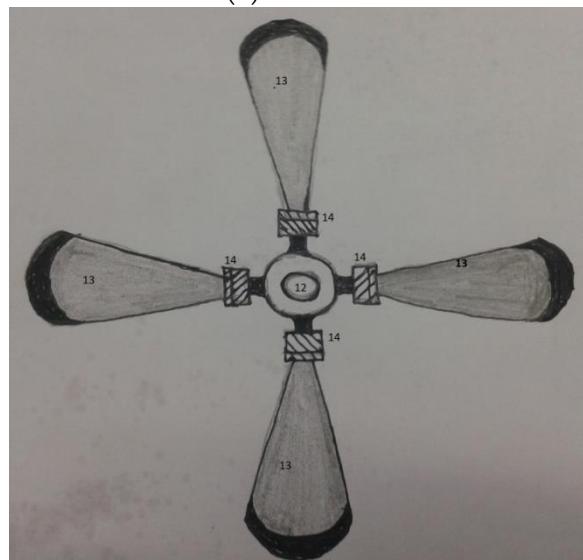
(e)

Figure 2. a) The frames for resting of conical masses, b) and c) Toothed wheels, d) Coupled circular frames, e) Conical masses.
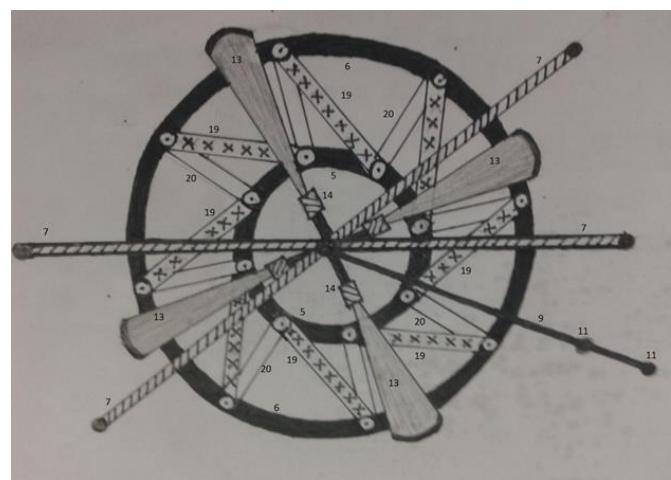
Figure 3. The Top View of the device.

Principle of Working of the Device

According to this design an automatic rotary system can supply energy, of course, at a constant rate due to the rotation of some conical masses attached to a post through brushes, resting on a frame consisting of two posts of different heights. The joints of the rotating parts are, conveniently, through ball-bearings and brushes.

The rotation of the masses as well as the working of the system is maintained by the gravitational force exerted on the conical masses so that the masses roll on the bars 19 which forces the portion 2-3 of the central post to rotate. The arrangement of the frames 17-19-18 are such that one side of the masses climbs the next frame just after a frame ends. Thus the rotation would continue. This rotation is, then, transferred to 9 when the rope attached to it may uncoil the rod.

Importance of the Device

Although, the initial cost of establishing the device is high yet the importance of the newly designed system lies in the fact that the cost of its operation is minimized and once installed it will work for years. Again, for its operation it requires no fuel, the availability of which is not easy in these hard days of fuel-crisis.

Use of the device

The designed system is useful in the following cases.

i. In lifting water from well for daily use and for agricultural or similar purposes.
ii. The system could be used for the purposes using rotatory motion at nominal cost e.g. for starting a generator for electrical power or any other type of rotary system.

Drawbacks of the Device

It has been found that the drawbacks of the device are –

i. It is heavy and could not be moved, with ease, to different places.
ii. The r.p.m. is small which, of course, could be increased by increasing the number of conical masses and the mass of each of the cones attached to the central post. It should be mentioned here that on increasing the number of conical masses the system becomes heavier.
iii. The conical masses can rotate in one sense only but not in the opposite sense. So, the system can be used to lift a bucket full of water but the device could not cause the bucket to go down inside the well. This operation is to be done manually from out side.

III. CONCLUSION

In spite of some drawbacks of the designed device it may be pointed out, in conclusion, that it is useful to all of us for the following reasons.

i. It is an automatically rotating device which could be operated by gravitational force only.
ii. It prevents loss of height and, thereby, loss of potential energy due to the masses which could be used to operate any rotating device.
iii. It has a brake to stop or start the rotation of the conical masses (which is its operational brake).
iv. It minimizes cost of operation and could be used for purposes of starting a rotatory system like electric power generator.
v. It does not use any fuel in these hard days of fuel crisis.
vi. In particular, item (v) is the main important characteristic of the design.
vii. Hence, due to the above advantages the device can be easily used for irrigating cultivated lands without the use of any sort of fuel.

IV. ACKNOWLEDGEMENTS

V. REFERENCES

[1]. The History of Technology—Irrigation, Encyclopaedia Britanica, 1994 edition.

[2]. K. Frenken (2005), Irrigation in Africa in figures—2005 (PDF), Food and Agriculture Organization of the United Nations, Rome (Italy), ISBN 92-5-105414-2, Retrieved 2007-03-14.

[3]. T. Peter (2015), Managing Wheel-Lines and Hand-Lines for High Profitability, Retrieved 29th May, 2015.

[4]. R. Hill (2015), "Wheel move Sprinkler Irrigation Operation and Management", Retrieved 29th May, 2015.

[5]. H. Torry (2000), "Drops of Life in the History of Irrigation", Irrigation Journal 3 (2000): 26-33, The History of Sprinkler System.

[6]. D. L. Bjorneberg (2013), USDA, Agricultural Research Service, Kimberly, ID, USA, 2013, Elsevier Inc.

[7]. Irrigation, Wikipedia.