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DESIGN AND FABRICATION OF FLEXIBLE LAY FLAT PIPE REELING MACHINE

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ABSTRACT

Pipes are used to convey water. Lay flat hose is flexible type of pipe which gets flat when it is not in use. Polyethylene tubes are the most widely known as lay flat hoses. These pipes are mostly used for agricultural irrigation. Depending on their diameter they weigh between 8.5kg (65mm dia.) to 16kg (100mm dia.) per 100m and require little storage space. Using this pipes farmers can irrigate higher level lands which is not possible in clay canals and flood irrigation. Serve use of the polyethylene lay flat hoses is their short life. Sometime these pipes survive one irrigation season only, because exposure sunlight and storing of water when they are not in use make them brittle. They are easily puncture on rough surface due to pulling and rubbing while manual hand reeling. To overcome this difficulties and challenges the new and improved design is proposed in this research paper. The design of model allows user to reel various flexible pipe/hoses into coiled shape. The fabricated working model can work as per specifications and result into reduce work and time required for reeling of hose, promote their use, increase their life span and reduce their maintenance.

Keywords: - *Pipe, Lay Flat Hose, Reeling method, Reeling device design, Fabrication, Result et.*

I. INTRODUCTION

The pipes are the basic component of agricultural irrigation system. There is various type of pipe available in many pressure ratings and sizes (diameters). Rigid PVC Pipes, Polyethylene Pipes (Semi Flexible) and Lay Flat Hose (Fully Flexible) these are the types of pipes in used in agricultural irrigation system.

Fig.1 Lay Flat pipe

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Fig.2 Lay flat of various sizes

Fig.3 Agricultural irrigation

Lay flat hoses are mostly used for conveying water over long distance. Lay flat hoses are flexible, lightweight, and available in various sizes (mm or inch) from 1-6 inches and for working pressures of 4.0–5.5 bars. They are manufactured with plain ends and supplied in 25, 50 and 100 m length coil shape. Soft Polyethylene hose are the most widely sold as lay flat hoses. Depending on their diameter they weigh between 8.5kg (65mm diameter) to 16kg (100mm diameter) per 100m. For irrigation application lay flat pipes are made of soft polyethylene and LDPE plastics based on required pressure rating and environmental conditions. In recent years, hoses can also be manufactured from various special grades of polyethylene. To avoid buckling of lay flat hose at high pressure over long distance soft PVC reinforcement with interwoven polyester yarn is provided.

II. LITRATURE REVIEW

The review from this literature was used for developing the new design. The different innovations are invented by the inventors for reeling of various flexible hoses except agricultural lay flat hose. Overall in this chapter all the research issued about the various reeling devices is presented as follows.

Gary L. Ghio [1] In this patent author invented a device which only use for reeling of fire hose. A hose reel cart includes a reeling disk mounted at certain height from ground on one side of tubular wheeled cart. Tapered guide pins extending perpendicularly outwardly from one face of the reeling disk to hold end portion coupling of a fire hose. A hand crank provides selective rotary drive to the reeling disk via a chain and sprocket mechanism to flatten, drain, and coil a fire hose in overlying condition on reeling disk. The tubular frame includes a forwardly extending hose support guide bar which serves to align, drain, and flatten the hose and also functions as to support the cart. The ergonomic design of the cart allows a user to coil and remove a hose from the reel without stopping, and without the use of tools.

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Robert Stein [2]The author invent and patent a device which is suitable for reeling of smaller diameter flexible hoses such as garden hose and air hose. The device is designed to increase durability and stability while maintain weight for increased hose capacity. To avoid tipping of hose reel cart while removing hose from hose reel cart readily irrespective the location of user the hose reel is pivoted about an axis perpendicular to the horizontal hose reel rotary axis. This pivoting ability of the hose reel also permits the hose to be wound onto the hose reel evenly irrespective of the location of the hose without repositioning of the hose reel cart and also enables the use of a wider hose reel which increases the capacity of the length of hose carried on the reel. Crank is provided for winding of hose reel.

Terry N. Nelson [3] In this patent inventor patented improved garden hose reel caddy which includes a light weight, synthetic resin frame, a pair of front mounted transport wheels that are placed in no contacting relationship with the ground when the caddy is at rest, a woundable hose reel, an elevated hand crank for manually rotating the hose reel, and a gear drive mechanism coupling the hand crank to the hose reel. The hose reel rotate mounted on the support frame only a few inches above the ground so as to provide the hose reel caddy with a low centre of gravity, while the gear drive mechanism enables placement of the hand crank at an elevated position to allow a user to rotate the hose reel without stooping to the ground level.

Pierce A. Ryiott [4] In this patent author invented an apparatus for winding fire hose. Objective of author to make an satisfactory apparatus for winding fire hose having interlocking coupling on opposite ends. One object of the invention is to provide novel apparatus for winding fire hose and to provide less expensive, simpler and more satisfactory apparatus for accomplishing the ends of automatically winding fire hose. An important feature of this invention is the provision of Spaced tines, adapted to receive one of the interlocking coupling members of a length of hose, being eccentrically positioned with respect to a rotational axis extending through the center of gravity of a plate carrying the tines, thereby to position the center of gravity of the coupling member on the rotational axis of the plate.

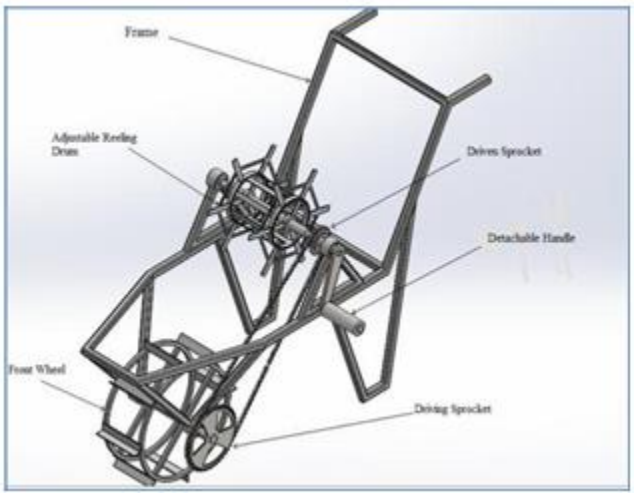

Fig.4 Solid Works CAD Model

III. DESIGNS CALCULATIONS

3.1 Design of Chain Drive

Major assumption made while designing chain drive mechanism is the distance covered by operator is equal to reeled pipe on reeling drum.

To make this possible forward moving velocity and pipe reeling velocity is equal i.e. V=0.5m/sec

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Fabricated front wheel diameter (D1) = 330mm
Front wheel speed or Input speed
(N_1) = 28.93rpm
Number of teeth on driving sprocket
(Z_1) = 44 teeth
Number of teeth on driven sprocket
(Z_2) = 18 teeth
Center distance between two sprocket
(a) = 500mm
Reeling drum speed to maintain same pipe reeling velocity of pipe on it,

From eqn. $V = \frac{1}{600}$ 00

$$i = Z_2/Z_1 = N_1/N_2$$

Reeling drum speed or driven sprocket speed (N_2) = 70.71 rpm
Selected chain specifications

ISO chain number	Pitch 'p' mm	Roller diameter 'Dr' mm	Width 'b' mm	Breaking load N
081	12.7	7.75	3.30	8000

The number of chain links,

$$L_n = 2\left(\frac{a}{p}\right) + \left(\frac{Z1 + Z2}{2}\right) + \left(\frac{Z2 - Z1}{2\pi}\right)^2 \times \left(\frac{p}{a}\right)$$

L_n = 111.175 links

The corrected centre distance,

$$X = [L_n - (\frac{Z1+Z2}{2})] = [111 - (\frac{44+18}{2})] = 80$$

$$a = \frac{p}{4}[X + \sqrt{X^2 - 8\left(\frac{Z2 - Z1}{2\pi}\right)^2}] = 505.2669\text{mm}$$

Length of chain,
L = Ln × p = 111× 12.7 = 1409.7 mm

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IV. RESULT & DISCUSSION

Fig.5 Fabricated Working Model

Fig.5 Actual model with reeled pipe

The design of model allows user to reel various type of pipes like agricultural lay flat pipe, Garden hose pipes. There is special arrangement has provided on reeling drum to reel various sizes of agricultural lay flat pipe. It is done by shifting movable reeling drum ring side ring to one side by unscrewing bolts. There is two modes has provided for reeling of pipe,

- Follow the pipeline with model and pipe get reeled on reeling drum by getting rotary motion from front wheel through chain and sprocket mechanism.
- Stand in one position and reel the pipe by providing rotary motion to reeling drum though handle.

V. CONCLUSION

From above we can conclude that the working model is suitable for small farmers. It makes the reeling of lay flat pipe, drip irrigation tubes and flexible garden hose easy. Use of this device avoids the rubbing of lay flat hose with ground or sharp surfaces while reeling results into increase in life span of lay flat hose. Use of this machine or device promotes use of lay flat hose instead of PVC pipes and small open water clay canals to transporting water over long distance to irrigate the crops on agricultural farm. This device removes the water pockets in pipe if the

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pipe is filled with water during reeling, which is not possible in hand reeling. The device can reel up to 30m of pipe in single run. Use of this device result into reduction in time and work saving.

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