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Design and Fabrication of River Cleaning Machine

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Abstract-*Water pollution has been a major cause of environmental concern. Most of the water bodies like rivers, lakes, streams, etc. are highly polluted. Floating wastes are a major source of pollution. Machines have been designed to remove the floating waste. Any such machine can involve the usage of some source of power which is again uneconomical. Hence it was thought by us to build a machine that would be simple and cheap and also not requiring any external power source. Taking into consideration that a flowing river or stream generally develops water heads at different locations in its course of flow, it was decided to make use of the heads available to produce hydropower that could be used to run a suitably designed machine. The river cleaning machine that we have built up makes use of hydropower developed by a turbine similar to a Pelton wheel. The rotation of the turbine runner causes the conveyor belts to move through suitable linkages like gears and chains. These linkages are designed taking into consideration the turbine speed and the power required to drive the conveyor belts which carry the floating waste away from the water body.*

Key words: *Water Pollution, Hydropower, Turbine, gears, sprockets, conveyors*

1. INTRODUCTION

Water is the source of life. Though 70% of the earth is covered with water, about 97% of it is in the form of oceans and hence not fit for human consumption. The remaining 3% is stored in various sources like glaciers, rivers, lakes and under-ground aquifers. Rivers and lakes which are found on the earth's surface are very much essential for the mankind. River water is used for irrigation which in return gives food to the people. Rivers also maintain the ecology of the region and bring in prosperity. Unfortunately, most of the rivers and lakes are getting polluted. This is due to human actions like letting domestic and industrial wastes into such water bodies. Thus rivers like Ganges, Yamuna and Narmada have become highly polluted. Even the South Indian river Kaveri is affected by pollution. Solid waste which floats on the river surface is a cause of serious concern. Disposal of solid waste is the first step towards minimising surface water pollution. Some machines have been developed to clear the solid waste found on the surface of the water bodies.

2. LITERATURE REVIEW

Some of the journal papers working towards building machines to remove floating waste are reviewed here.

Prof. N.G. Jogi et al [1] mentioned that the Ganges in India is one of the most polluted rivers. About 29 crore litres of sewage is dumped in the Ganges along with toxins. They have suggested the usage of pedal operated boat with the conveyor attached to it for collecting garbage from the lake. With the help of this conveyor it is possible to collect the garbage like plastic bags, plastic bottles, beverage cans, food wrappers, paper bags, straws, (marine debris) etc. With this methodology no fuel is involved.

Mr. P. M. Sirsat et al [2] mentioned that in accordance with the river cleaning projects like "Namami Gange", ''Narmada Bachao" and many major and medium projects in various cities like Ahmadabad, Varanasi etc. a machine is designed to clean river water surface. This machine consists of DC motors, RF transmitter and receiver, propeller, PVC pipes and chain drive with the conveyor attached to it for collecting wastage from water bodies. It also consists of a collecting plate which is coupled with conveyor belt and chain drives which rotate by the PMDC motor. The collected waste is thrown on the collecting tray. Propeller is used to drive the machine on the river & run with help of PMDC motor. The total electrical devices are controlled by RF transmitter and receiver which are used to control the machine remotely. This machine has been designed from an economical point of view and is easy to operate and helpful for water cleaning.

Sheikh Md Shahid Md Rafique and Dr. Akash Langde [3] have fabricated the remote operated river cleaning machine. The collecting plate and chain drives are rotating continuously by the motor. The collecting plate is coupled between the two chain drives for collect the waste materials from river. The collected waste is thrown on to the collecting tray with the help of conveyer. The machine has a propeller which is used to drive the machine on the river. The propeller is run with the help of two PMDC motor. The total electrical device is controlled by RF transmitter and receiver which are used to control the machine remotely.

M. Mohamed Idris et al [4] explained that the motive of the project is to automate the sewage cleaning process in drainage. A machine consisting of a chain and sprocket and driven by a motor is made use of in the cleaning process. When the motor runs, the chain starts to circulate and it makes the lifter to move upwards. The waste material is lifted by lifter teeth and stored in a collector bin. Once the collecting bin is full, the waste material is removed from the bin manually.

Pankaj Singh Sirohi et al [5] have fabricated a river cleaning machine which makes of a turbine driven alternator to produce electricity. When water flowing in the river falls on turbine the turbine begins to rotate. The alternator generates electricity. This drives the vertical conveyor belt and horizontal conveyor belt through timing chains and sprockets. With the help of spur gears both the conveyor belts are connected with each other.

3. PROBLEM STATEMENT

Solid waste has to be removed from the surface of flowing river or stream. This can be done by developing a suitable machine which makes use of a power source for doing this work. However, this can prove to be uneconomical and may need human intervention. The use of conventional fuels to operate such machines can cause environmental problems.

4. OBJECTIVES

1. To design and fabricate a cheap and simple machine to remove the floating waste from flowing rivers or streams.
2. To make this happen without external power source and also with no human intervention

5. WORKING METHODOLOGY

A flowing river or stream generally develops water heads at different locations in its course of flow. If this water is made to fall on the blades of a turbine similar to a Pelton wheel, the turbine begins to rotate. The turbine shaft can be made to drive conveyors through suitable gear drives and chain drives in order to get the desirable slow speed and more torque. The conveyors can carry the floating wastes away from the water body.

6. CONSTRUCTION AND WORKING OF THE MACHINE

A bicycle wheel with eight numbers of aluminium buckets attached to its periphery is mounted on a shaft (driver shaft) to make a turbine resembling a Pelton wheel. When flowing water falls on buckets, the wheel starts rotating. A spur gear called the driver, also mounted on the turbine shaft begins to rotate. Due to the meshing of the driver with another spur gear (driven gear) mounted on a parallel shaft (driven gear shaft), power gets transmitted to the driven gear. The driven gear shaft also carries sprocket 1 which drives sprocket 2 mounted on an intermediate shaft 3 through a chain.

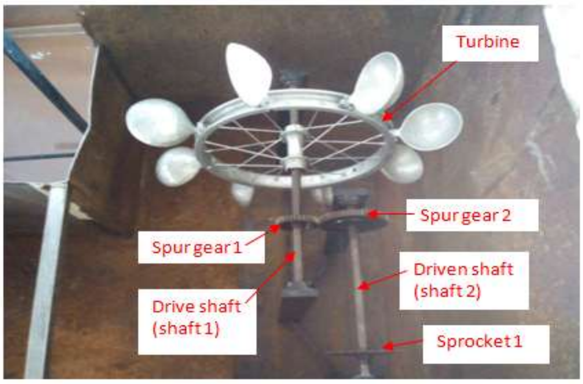


Fig-1: Turbine coupled with spur gear drive

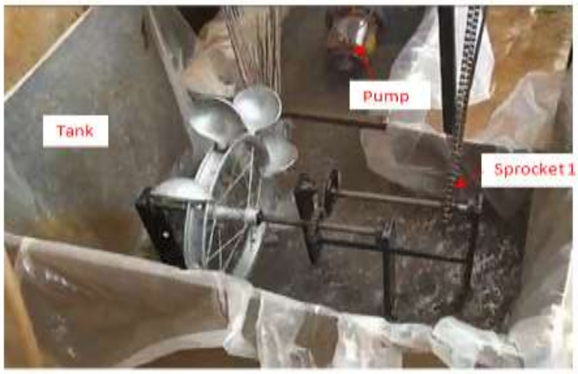


Fig-2: Turbine and gear drive in motion

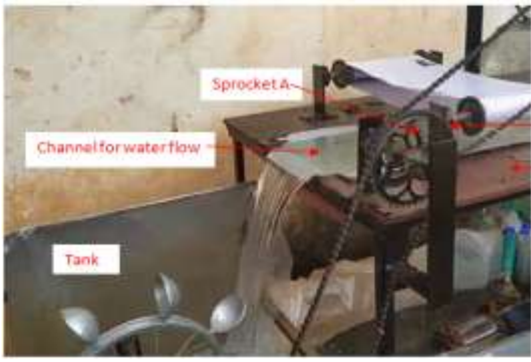


Fig-3: Drive from driven gear shaft to shaft 3

Sprocket A mounted on shaft 3 carries the drive to sprocket B mounted on the main sprocket shaft 4 through a chain. On shaft 4 two more sprockets C and D are mounted. Sprocket D drives another sprocket E through a chain. This chain carries meshed buckets meant for picking up the floating waste. This constitutes the inclined conveyor system. Sprocket C drives another sprocket F through a chain. The shaft of sprocket F also carries one bevel pinion meshing with another bevel pinion. This enables the direction change through 90 degrees. A roller is mounted on the shaft of the second bevel pinion. This roller drives another roller through an endless conveyor belt. This constitutes the horizontal conveyor system. The waste falling from the inclined conveyor is carried away by the horizontal conveyor.

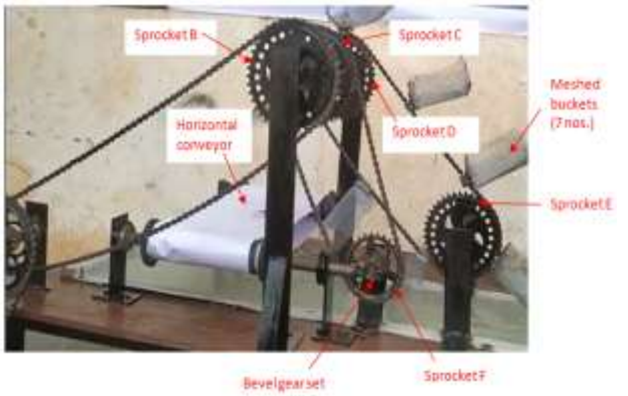


Fig-4: Drive from sprocket A to the conveyors through chain drives and bevel gear drive.

Fig-5: Isometric view of the machine

In order to simulate the river or stream flow, the entire setup is table-mounted, except for the drive shaft (carrying the turbine and driver gear) and the driven shaft (carrying the driven gear and sprocket 1). The drive shaft and driven shaft with their mountings are placed in a large metal tank placed in such a way that water flowing through a sheet metal channel held in the centre of the table falls on the turbine blades. Water flow is simulated by using a 1hp pump which re-circulates the water collected in the tank.

7. DESIGN ASPECTS OF THE MACHINE

The different components needed for the machine (turbine, gears, sprockets, chains, shafts, bearings, etc.) were listed. A conceptual model of the machine was made using Catia V12.

Since manufacturing critical components like turbine, gears and sprockets was not feasible in view of paucity of time, it was decided to use the existing ones available in the local market. A bicycle wheel hub of 290 mm outside diameter and 15 mm bore is selected to make the turbine. Eight numbers of hemispherical buckets are attached on its periphery equally spaced, to resemble a Pelton turbine having a mean pitch circle diameter of 405 mm.

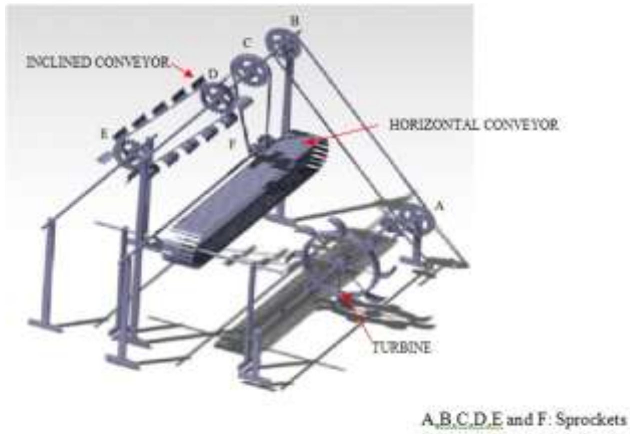


Fig-6: Conceptual image of the machine.

Two types of spur gears of 2 module (one with 32 teeth and the other with 53 teeth) and bore diameter 15 mm are selected. The smaller spur gear is mounted on the turbine shaft and acts as the driver for the bigger spur gear which is mounted on a parallel shaft. A series of sprockets are mounted on different shafts and the power transmitted by the gears is further transmitted through these sprockets to the conveyors by chain drives.

Two types of sprockets were selected:

- The smaller ones (2 nos.) termed Sprocket 1 and sprocket A having 26 teeth and 97 mm root diameter.
- The larger ones (6 nos.) termed Sprocket 2, sprocket B, sprocket C, sprocket D, sprocket E and sprocket F having 40 teeth and 153.92 root diameter.

The chains are of 08 (ANSI-40) with roller diameter of 7.95 mm and pitch 12.7 mm. A mitre gear set consisting of two bevel gears each of 4 module, 9 teeth and 20 mm bore diameter is selected for changing the direction of power transmission by 90 degrees. The two sprockets C and E are connected by chain drive carrying an inclined conveyor made up of curved meshes to scoop the floating impurities and to dump them on to a horizontal conveyor. The horizontal conveyor is made up of an endless belt made of plastic carried over the rollers. The design of shaft 1(drive gear shaft or turbine shaft) and shaft 2 (driven gear shaft) assumes more importance in view of restriction in diameter to 15 mm and slenderness owing to longer lengths (in order to accommodate more number of components). The other shafts are made of higher diameter (20 mm), have shorter lengths and are hence safe from design view point.

7.1 Design of Shaft 1 (Turbine Shaft or Drive Gear Shaft)

In view of the dimensions of the turbine and small spur gear used, the following factors are considered while designing the turbine shaft and bearings.

1. Since the bore diameters of the turbine and the drive gear are 15 mm, the drive shaft carrying

these two components has to be 15 mm in diameter which can make it very slender.

2. For this, the weight of the turbine, the torque developed by the turbine and the bending moment due to the reaction forces between the mating gears gives an equivalent bending moment which should be withstood by the shaft in terms of its the strength and slenderness.
3. The torque can be calculated by considering the flow rate of the water hitting the turbine buckets. This is done by simulating the flow rate of a major river like Kaveri which is 677m3/sec. A prototype is made by scaling down this flow rate by 1/5,00,000 which comes to 81.24 LPM and which is equivalent to the discharge of 84 LPM given by 1 hp pump. That is Q = 84 LPM

7.1.1 Calculation of Rotational speed, Power and Torque

$Q = \frac{\pi}{4} d^2 v$

Where d = diameter of outlet of 1 hp pump = 25mm and v = outflow velocity of 1 hp pump

Therefore $v = \frac{4Q}{\pi d^2}$ = 2.85 m/sec and water at this velocity impinges on the buckets of the turbine causing it to rotate in the clockwise direction.

Head on the turbine $H = \frac{v^2}{2g} = 0.414 \text{ m} \approx 0.4 \text{ m}$

Peripheral velocity of turbine is u = v x ϕ where

ϕ = speed ratio varying from 0.43 to 0.48 = 0.45 (say)

Therefore u = 0.45 x 2.85 = 1.28 m/sec

$u = \frac{\pi D N}{60}$ where

D = pitch circle diameter of turbine = 410 mm and

N= rotational speed of turbine.

$N = \frac{60\,u}{\pi D} = 59.62 \approx 60$ rpm

Theoretical power developed by the turbine

$= \frac{\rho g Q H}{1000} = 0.3296$ kW

Actual power output of turbine

$= \eta_o$ x Theoretical power

= 0.75 x 0.3296 = 0.2472 kW

Torque developed by turbine shaft

$T = \frac{60 \times 10^6}{2\pi N}$ x power output = 39343 N mm

The turbine shaft (shaft 1) carries spur gear 1 (driver gear) of module m =2 and number of teeth z = 32

Spur gear 1 drives spur gear 2 (driven gear) of module m =2 and number of teeth z = 53 which is mounted on the parallel shaft 2(driven shaft).

7.1.2 Strength consideration of driver gear

The driver gear being the smaller of the two meshing gears is checked for strength using Lewis equation:

Form factor Y= π x y where $y = 0.154 - \frac{0.912}{32} = 0.1255$

Therefore Y= 0.394

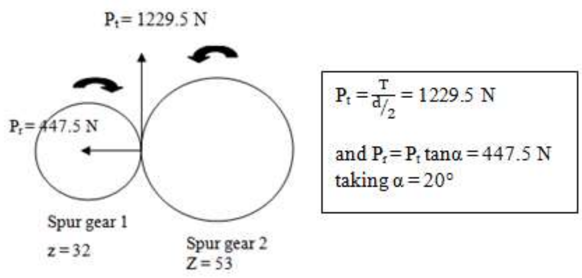


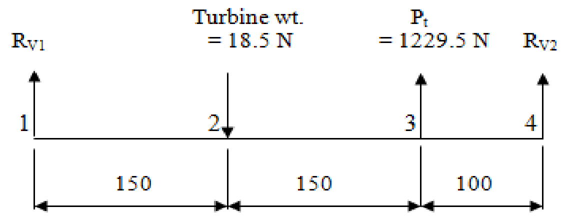
Fig- 7: Force analysis of Spur gears

Bending stress $\sigma_b = \frac{P_t}{mbY} = \frac{1229.5}{2x\ 10x\ 0.394} = 162.5$ MPa

The material of the gear is assumed to be a case hardened alloy steel whose strength is 345.2 MPa. Taking a factor of safety of 2, the allowable static stress is the gear is 172.6 MPa which is higher than the bending stress induced. Hence the gear design is safe from strength point of view.

7.1.3 Shaft Design

A shaft of length 400 mm was selected to ascertain if it fulfilled the design considerations. The turbine and drive gear are positioned as shown in fig-8 and calculations are done. Considering vertical loading we have



2: Turbine mounting point,

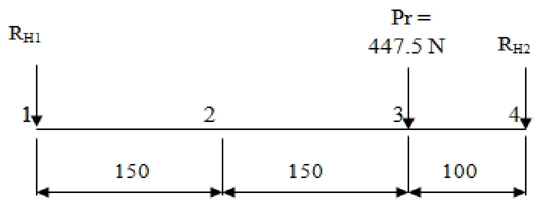
3: Drive gear mounting point

Fig-8: Vertical Loads and reactions on shaft 1

R_{V2} = 915.2 N and R_{V1} = 295.8 N so that

BM at 3 = -91520 N mm

Considering horizontal loading we have



2: Turbine mounting point

3: Drive gear mounting point

Fig-9: Horizontal loads and reactions on shaft 1

R_{H2} = 335.6 N and

R_{H1} = 111.9 N so that BM at point 3 = -33560 N mm

Resultant BM at point 3 is

$M = \sqrt{(-91520)^2 + (-33560)^2} = 97479$ N mm

Applying the maximum shear stress theory (because the shaft material is steel which is a ductile material) we have, the maximum shear stress induced in the shaft is given by $\tau_{max} = \frac{16}{\pi d^3}\sqrt{M^2 + T^2}$

Or $\tau_{max} = \frac{16}{\pi d^3}\sqrt{97479^2 + 39343^2}$ = 159 MPa

Using SAE 4340 material with yield strength of 470 MPa and taking a factor of safety of 2.5, we get the maximum permissible shear stress = $\frac{470}{2.5}$ = 188 MPa which is greater than 159 MPa developed in the turbine shaft. Hence the design is safe from the strength consideration.

Permissible angle of twist is given by $\theta = \frac{584\,TL}{Gd^4}$ where,
L= length of the shaft = 400 mm and
G = modulus of rigidity= 80 x 10^3 N/mm^2
Therefore, θ = 2.3° which is less than the permissible value of 3°.
Hence the design is safe from the slenderness point of view.

7.1.4 Bearing Design

Reaction at bearing 1
$= \sqrt{R_{V1}^2 + R_{H1}^2} = \sqrt{295.8^2 + 111.9^2}$ = 316.3 N
Reaction at bearing 2
$= \sqrt{R_{V2}^2 + R_{H2}^2} = \sqrt{915.2^2 + 335.6^2}$ = 974.8 N
Considering expected life of bearing L_{10h} to be 10,000 hours and N= 60 rpm, from
$L_{10} = \frac{60N\,L_{10h}}{10^6}$ we get L_{10} = 36 million revolutions
Load rating of the bearing is
C= P$(L_{10})^{1/3}$ = 974.8 x $36^{1/3}$ = 3219 N
Taking into account the shaft diameter of 15 mm the ball bearing with rating C= 7800 N is selected having D= 35 mm and = 11 mm

7.2 Design of Shaft 2 (Driven Gear Shaft)

The torque carried by the driven gear is given by
$T_1 = T \times \frac{Z_2}{Z_1}$ where T= 39343 N mm, Z_2 = 53 and Z_1 =32 so that T_1 = 65162 N mm
The speed of rotation of driven gear is
$N_2 = N_1 \times \frac{Z_1}{Z_2}$ = 36 rpm

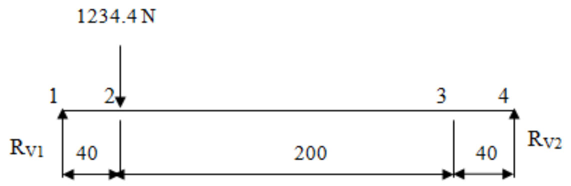
7.2.1 Shaft Design

Taking into consideration the higher value of torque of 65162 N mm compared to 39343 N mm of the driver shaft, the slenderness of the shaft is checked and found to satisfactory for a shaft length of 280 mm as calculated below:

Permissible angle of twist is given by

$\theta = \frac{584\,TL}{Gd^4} = \frac{584 \times 65162 \times 280}{80 \times 10^3 \times 15^4}$ = 2.63 ° which is less than the permissible value of 3°

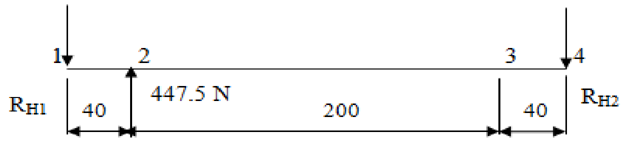
For vertical loading taking into consideration, the weight of the big spur gear (4.9 N) we have:



2: Driven gear mounting point
3: Sprocket 1 mounting point

Fig-10: Vertical loads and reactions on shaft 2

R_{V2} = 176.3 N and R_{V1}= 1058.1 N so that
BM at point 2 = -42312 N mm
Considering horizontal loading we have



2: Driven gear mounting point
3: Sprocket 1 mounting point

Fig-11: Horizontal loads and reactions on shaft 2

R_{H2} = 127.9 N and R_{H1} = 319.6 N so that
BM at point 2 = -30696 N mm
Resultant BM at point 2 is
$M = \sqrt{(-42312)^2 + (-30696)^2}$ = 52273.8 N mm
Again applying the maximum shear stress theory the maximum shear stress induced in the shaft is given by
$\tau_{max} = \frac{16}{\pi d^3}\sqrt{M^2 + T^2}$
$= \frac{16}{\pi \times 15^3}\sqrt{52273.8^2 + 65162^2}$ = 126 MPa

Using SAE 1040 material with yield strength of 415 MPa and taking a factor of safety of 2.5, we get the maximum permissible shear stress = $\frac{415}{2.5}$ = 166 MPa which is greater than 126 MPa developed in the driven gear shaft. Hence the design is safe from the strength consideration.

7.2.2 Bearing Design

Reaction at bearing 1
$= \sqrt{R_{V1}^2 + R_{H1}^2} = \sqrt{1058.1^2 + 319.6^2}$ = 1105.3 N
Reaction at bearing 2
$= \sqrt{R_{V2}^2 + R_{H2}^2} = \sqrt{176.3^2 + 127.9^2}$ = 217.8 N
Considering expected life of bearing L_{10h} be 10,000 hours and N= 36 rpm, from
$L_{10} = \frac{60N\,L_{10\,h}}{10^6}$ we get $L_{10\,h}$ = 21.6 million revolutions
Load rating of the bearing is
C= P $(L_{10})^{1/3}$ = 1105.3 x $21.6^{1/3}$ = 3078 N

Taking into account the shaft diameter of 15 mm the ball bearing with rating C= 7800 N is selected having D= 35 mm and B = 11 mm

7.3 Design of Chain connecting Shaft 2 and Shaft 3

Shaft 3 is 20 mm in diameter and 200 mm in length. It carries sprocket 2 (which receives the drive from sprocket 1). Taking into consideration the ground clearance for the turbine, water head of 400 m, an appropriate distance for water to splash on the turbine buckets and additional height of 100 mm for fixing and rotating sprocket, the chain drive is designed with an inclination of 55° to get a centre distance of a = 609.6 mm (48p which lies between the design range of 30p to 50p).

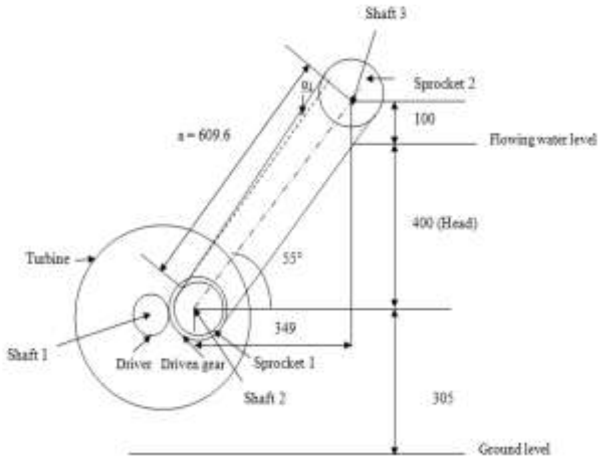


Fig-12: Drive from shaft 1 to shaft 2 to shaft 3

The number of links in the chain is calculated using the formula:

$$L= 2\left(\frac{a}{p}\right)+\left(\frac{Z_1+Z_2}{2}\right)+\left(\frac{Z_2-Z_1}{2\,\pi}\right) x \left(\frac{p}{a}\right)$$

$$=2\left(\frac{609.6}{12.7}\right)+\left(\frac{40+26}{2}\right)+\left(\frac{40-26}{2\,\pi}\right) x \left(\frac{12.7}{609.6}\right)$$

= 129.05 or 130

Taking pitch diameters of sprocket 1 and sprocket 2 as D_1 = 105.36 mm and D_2 = 161.87 mm respectively, $\sin\alpha_1 = \frac{D_2-D_1}{2a} = \frac{161.87-105.36}{2x616}$ = 0.04587 or α = 2.63°

Sprocket 2 runs at reduced speed

$N_2 = \frac{N_1 Z_1}{Z_2} = \frac{36 \times 26}{40}$ = 23.4 rpm

Sprocket A which is mounted on shaft 3 also runs at N_A = 23.4 rpm

Torque developed $T_A = \frac{T_1 Z_2}{Z_1} = \frac{65162 \times 40}{26}$

= 100249 N mm

7.4 Design of Chain connecting Shaft 3 and Shaft 4

Shaft 4 (also called the main sprocket shaft) is 20 mm in diameter and 500 mm in length. It carries sprocket B (which receives the drive from sprocket A).The main sprocket shaft is situated at horizontal and vertical distances of 550 mm and 315 mm from the centre of sprocket A as shown in fig. 10. These dimensions are arrived at by selecting a centre distance of 635 mm (which is 50 p and hence permissible) and the angle of inclination of 30° by taking into consideration, the space to be provided for the installation of the horizontal conveyor.

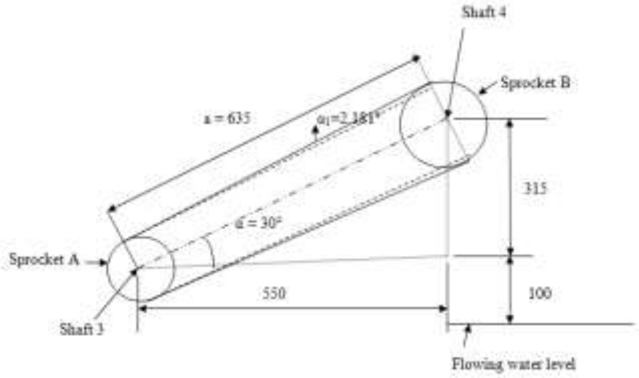


Fig-13: Drive from shaft 3 to shaft 4

$\sin\alpha_1 = \frac{D_2-D_1}{2a} = \frac{161.87-113.53}{2x635}$ = 0.03806 or α = 2.181°

The number of links in the chain is calculated using the formula:

$$L = 2\left(\frac{a}{p}\right)+\left(\frac{Z_1+Z_2}{2}\right)+\left(\frac{Z_2-Z_1}{2\,\pi}\right) x \left(\frac{p}{a}\right)$$

$$= 2\left(\frac{635}{12.7}\right)+\left(\frac{40+28}{2}\right)+\left(\frac{40-28}{2\,\pi}\right) x \left(\frac{12.7}{635}\right)$$

= 134

Sprocket B runs at reduced speed

$N_B = \frac{N_A Z_A}{Z_B} = \frac{23.4 \times 26}{40}$ = 15 rpm

Sprockets C and D which are mounted on shaft 4 also run at 15 rpm.

Torque increases to $T_B = \frac{T_A Z_B}{Z_A} = \frac{100249 \times 40}{26}$

= 154230 N mm

7.5 Design of Chain connecting Shaft 4 and Shaft 5

Shaft 5 gets the drive from shaft 4 through the chain drive between sprocket D (mounted on shaft 4) and sprocket E (mounted on shaft 5).

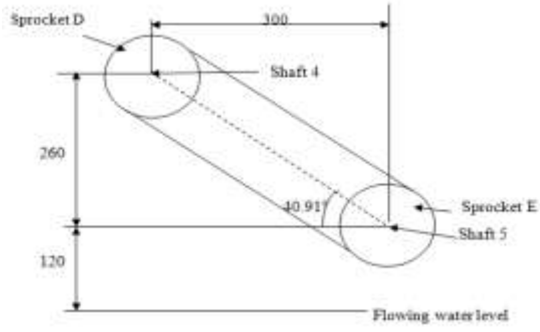


Fig-14: Drive from shaft 4 to shaft 5

Sprocket E has the same specifications as sprocket D and hence there is no speed reduction so that the speed remains at 15 rpm. Shaft 5 is situated at a vertical distance of 260 mm from shaft 4 and a horizontal distance of 300 mm from shaft 4.

The number of links in the chain is calculated using the formula:

$$L = 2\left(\frac{a}{p}\right) + \left(\frac{Z_1+Z_2}{2}\right) + \left(\frac{Z_2-Z_1}{2\,\pi}\right) \times \left(\frac{p}{a}\right)$$

$$= 2\left(\frac{393.7}{12.7}\right) + \left(\frac{40+40}{2}\right) + \left(\frac{40-40}{2\,\pi}\right) \times \left(\frac{12.7}{393.7}\right) = 102$$

7.6 Design of Chain connecting Shaft 4 and Shaft 6

Shaft 6 gets the drive from shaft 4 through the chain drive between sprocket C (mounted on shaft 4) and sprocket F (mounted on shaft 6). Sprocket F has the same specifications as sprocket C and hence there is no speed reduction so that the speed remains at 15 rpm. Shaft 6 is situated at a vertical distance of 305 mm from shaft 4 and a horizontal distance of 130 mm from shaft 4.

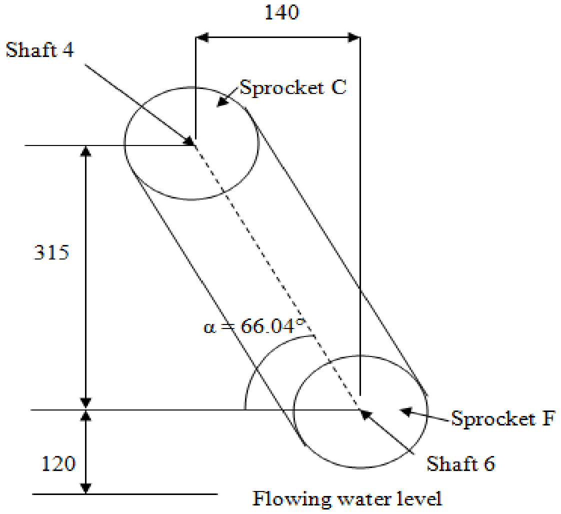


Fig-15: Drive from shaft 4 to shaft 6

The number of links in the chain is calculated using the formula:

$$L = 2\left(\frac{a}{p}\right) + \left(\frac{Z_1+Z_2}{2}\right) + \left(\frac{Z_2-Z_1}{2\,\pi}\right) \times \left(\frac{p}{a}\right)$$

$$= 2\left(\frac{343}{12.7}\right) + \left(\frac{40+40}{2}\right) + \left(\frac{40-40}{2\,\pi}\right) \times \left(\frac{12.7}{343}\right) = 94$$

The length of shaft 6 is kept minimum to 50 mm in view of mounting constraints.

7.7 Arrangement of Bevel Gear Drive

Shaft 7 which is 500 mm in length gets the drive from shaft 6. There is a change in the direction of power transmission by 90° due to the bevel gear motion. Shaft 7 carries an endless belt which extends over shaft 8 located at a distance of 400 mm across the direction of water flow.

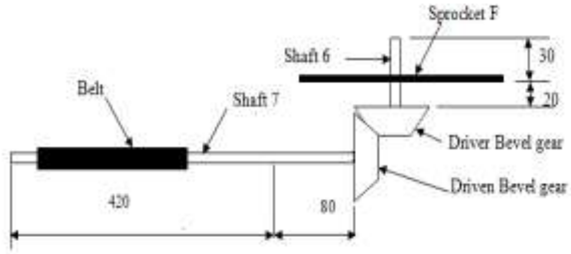


Fig-16: Bevel gear drive

8. ADVANTAGES AND LIMITATIONS

8.1 Advantages:

1. Useful for removing floating waste in flowing rivers and streams.
2. Easy installation and replacement of parts.
3. Makes use of hydropower and hence environmental friendly.
4. Easy to operate and maintain.

8.2 Limitations:

1. Only the waste floating on the water surface can be removed.
2. The machine works only if the required head for turbine operation exists.

9. CONCLUSION

The machine has a few parts which can be manufactured or bought out easily. Most of the parts like shafts, bearings and chains can be designed easily. The flowing water which contains the floating waste (that will be taken away by the conveyor) itself is the source of power for the machine and hence the machine is environment friendly. The machine can be installed at any location where a suitable water head is available and can be effective in the waste disposal process. Overall, the entire cleaning process is quite effective and without making use of any power source. Hence the commitment towards building a clean environment is achieved in this building this machine.

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