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Innovative Power Drive System

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ABSTRACT

By designing a system with configuration of various mechanical, electrical equipment the problem of flooding in areas, having history of flooding due to heavy rains, is solved. Water Reservoir is built in affected areas. When the affected area near the Reservoir starts flooding up to a pre-determined water level, creating inconvenience, the de-flooding operation starts. In this design, various unique features of equipment are exploited to solve the problem.

During phase 1, D.C. Motor and a pump will be in operation to de-flood affected areas. The water in the Reservoir will be held during high tide.

In phase 2, water in the Reservoir will drive Hydraulic Turbine. Its power is transmitted to an A.C. Generator through a set of equipment. Hydraulic Turbine operation ends when the Reservoir is empty.

In this unique design feature, in phase 3, the designed system will continue to produce electricity even after flooding emergency situation is over. D.C. Motor's enhanced full power - by using D.C. Controller - is transmitted to A.C. Generator. In this way more power than that produced by Batteries Pack, can continue to be produced till D.C. motor life is over. Please refer to the Conclusion.

1. INTRODUCTION:

The chaos created by the heavy monsoon rains is well-known to the citizens of metropolitan cities. Whenever there is heavy monsoon rain, flooding in the low-lying areas of Metropolitan Cities like Bangalore, Delhi and Mumbai and many other places takes place. There is much inconvenience to the general public. The undersigned Author and Originator of the said Research Paper has found a solution to this 'perennial' flooding problem. The same can be resolved by practically implementing the scheme envisaged by him as described in the following pages:

2.1 The Equipment / Structure List with relevant information is as enumerated below: (Refer TABLE "A")

1) Water Reservoir with a platform (1No.). A Water Reservoir with a platform a few meters near the flood water level will be constructed. As per the study carried out previously of the flooding area, the maximum capacity of the Water Reservoir in liters (or cubic meters) would be determined. The amount of flood - water to be carried away is, thus, known. Hence, when the Water Reservoir is filled to the maximum capacity, it implies that the area concerned is de-watered i.e. de-flooded. The size / capacity of the subject Reservoir will be as per the local requirement and can vary from 1, 00,000 to 10, 00,000 liters of water or more. The Water

Reservoir would be constructed /assembled using pre-fabricated / constructed components, which can be brought from the site of fabrication, to a place near or very much in the flooding area. The design of the Water Reservoir would be as shown in the schematic **DIAGRAM 1**.

2) D.C. Batteries Pack (1 No. Pack). A Lead Acid Batteries pack of suitable number as per the design - which will depend upon the size/capacity (HP/KW) of the D.C. Drive Motor - would be used. Lithium Metal Hydride or Lithium Ion Batteries Pack can also be used; but the same would be costlier than the Lead Acid Batteries Pack option.

3) D.C. Controller (1 No.). D.C. Controller would be of designed capacity suitable for controlling D.C. produced by the D.C. Batteries Pack which would be used to feed D.C. to the D.C. Drive Motor through a D.C. Controller and also to control the speed of the D.C. Motor.

4) D.C. Drive Motor (with a Starter / Control Panel) (1No.). The D.C. Motor would be driven by the D.C. current produced by the D.C. Batteries Pack. The HP / KW of the Electric Motor would be determined as per the capacity (quantity of water to be stored) of the Water Reservoir in liters and to suit the pumping operation and an array of D.C Batteries.

5) Pulley and Belt System No.1 (1No.). This is mounted on the output shaft of the D.C. Motor. This will be designed to transmit the power to the Pulley and Belt System No.2.

6) Pulley and Belt System No.2 (1No.). This is incorporated between the Hydraulic Turbine and A.C. Generator. Item Nos. 5 and 6 (Pulleys) are connected with a Belt.

7) Plummer Block (with Bearings) (2 Nos. + 2Nos.). Pulley and Belt System No.1 and No.2 are mounted on a shaft supported between Bearings of Blocks which are bolted to the base plate.

8) Multi Disc Friction Type & / or Electro - Mechanical Clutch Nos.1 & 2 (2Nos.). These would be used to connect the D.C. Drive Motor to the Centrifugal Pump and to drive the same in "Pump Operation Mode". It would be of suitable capacity to transmit the HP / KW of the Electric Motor.

9) Centrifugal Pump (1No.). The capacity of the same would be determined in terms of water head in meters and quantum (m3/sec) of water that needs to be pumped up to the Water Reservoir (and time needed to fill it up).The time needed to fill up the reservoir is works out to be = 4058.44 seconds (i.e. more than one hour). The height of lift = 6 meters.

10) Hydraulic Turbine (1No.). The capacity of the same would be determined by the amount of water being discharged from its outlet pipe in terms of m3/s. The time it should take to fully utilize the stored up water works to be 405 seconds (i.e. 6 to 7 minutes). The water head acting on the same is = 6 meters.

11) Multi Disc Friction Type Mechanical Clutch No.3 (1No.). This third clutch would be employed to transmit power generated by the Turbine in "Turbine Operation Mode" to the A.C. Generator through a Fluid Coupling. This would be similar to clutch No.2 mentioned earlier (that is a Mechanical Type).

12) Fluid Coupling. (1 No.). This is fitted between the Pulley No.2 and the A.C. Generator, which acts as torque converter to produce torque 2.7 times the input torque for 30 seconds and functions as per the timer incorporated in the electrical circuit.

13) A.C. Generator (1No.). HP / KW of this equipment would be as per the output power of the D.C. Motor in second mode operation.

14) A.C. - D.C. Convertor (1No.). This gadget converts A.C. to D.C. Its KW capacity would be as per the power that would be transmitted from A.C. Generator to D.C. Batteries Pack.

15) D.C. Controller (1No.). This gadget controls transmission of power produced by A.C. Generator to D.C. Battery Pack after the same is converted from A.C. to D.C. by the A.C. - D.C. Convertor.

16) Lighting System and Cables (1Lot). These would consist of products of suitable capacity and reputed brands for the purpose of lighting the Water Reservoir are / local area.

17) Butterfly Valves and Piping System (1 Lot). The butterfly valves (and piping system) of suitable size, capacity and reputed brand would be used and controlled manually.

18) Water Level Indicator (1No.). When the water level crosses the maximum limit of Storage Water Reservoir capacity, a signal would be sent by the Water Level Indicator would be used to stop the Electric Motor.

19) Strainer (1No.). Since rain water in the concerned area would be full of debris/garbage (such as leaves, paper, plastic items, rubbish, flotsam etc. etc.), the suction pipe end will be normally fitted with strainer. This would allow only water to enter the inlet pipe and debris/garbage would be arrested outside the strainer and would not be allowed to enter the pipe inlet. The same would need to be cleaned periodically.

20) Canopy (1No.). A canopy for all the equipment for protection from the rains or any other unforeseen causes is provided.

21) Base Frame for Machinery (1 No.) and relevant Hardware (1 Lot). A base frame to mount / fix all the machineries will be fabricated and anchored to the platform described earlier.

2.2 Principle of Operation (Methodology): This system would be employed in the areas where there is history of flooding due to heavy (monsoon) rains or any other reason. When the area near the Water Reservoir starts to get flooded up to a pre-determined water level, creating inconvenience / nuisance, the pumping operation would be started by pressing the switch ON button on the Starter Panel as per the signal received from the Water Level Indicator fitted under the Platform. The D.C. Drive Motor works as described below:

The D.C. produced by the D.C. Batteries Pack is fed to the D.C. Drive Motor. Initially (during the phase no.1) the D.C. Motor will be operated on a power of 12.5 kW = (16.756 H.P.) and at 1500 R.P.M.) as determined by the D.C. Controller. The rotational energy of the D.C. Drive Motor is used to drive the Pump in "Pumping Operation Mode" though Clutches Nos. 1 & 2.

The Pump will pump up the flood - water through suitably designed piping system (having strainer) to the Water Reservoir for time duration of about 1hour and 7 to 8 minutes as designed. (The pumping operation will continue till the Reservoir is filled to its maximum capacity). This will ensure de-flooding of the concerned area around / near the Reservoir. Once this stage is reached, the Water Level Indicator of the Reservoir will send out a signal to switch OFF the D.C. Drive Motor and thus the pumping operation will stop. This will also ensure that the D.C. current from the D.C. Batteries Pack, through the D.C. Controller, will be disconnected from the D.C. Motor. The water in the Reservoir will be held as long as there is high tide. Once the high tide is over and low tide sets in or alternatively, when there comes a dry spell of rains, (whichever occurs first), the Butterfly Valve No.1 (Delivery Valve) will be closed manually to stop pumping operation. Then by opening manually Butterfly Valve No.2 (Inlet

Valve) the stored up water in the Reservoir will be allowed to enter the Hydraulic Turbine inlet manifold through Inlet Pipe. The energy in the form of hydraulic pressure is converted into mechanical (rotational) energy. The mechanical (rotational) energy of the Turbine shaft is transmitted to the shaft of A.C. Generator through the Clutch, Pulley and the Fluid Coupling (which acts as the torque converter). As the rotor of A.C. Generator rotates, A.C. is produced. This A.C. is converted to D.C. by means of A.C. - D.C. Convertor and is fed to the D.C. Batteries Pack through the D.C. Controller. Part of electricity from the A.C. can be utilized for lighting up of machinery house situated on the platform, and / or the nearby area. The water coming out of Turbine's Outlet (Drain) Pipe is fed into the drainage holes at the time of low tide or when there is dry spell of rains, whichever is convenient. The Hydraulic Turbine operation will end when the water is completely discharged from the Reservoir to the Drain Holes. The Turbine operation will take place in 6 to 7 minutes as designed.

In this unique design feature, it is **significant** that after the flooding emergency situation is overcome the designed system will continue to produce electricity. The same is explained in the Protocol that is to be followed as given in the following pages:

2.3 Protocol for Operation Manual:

I) **Phase I: (A) Start:** (1) **Connect** the Batteries Pack and D.C. Controller to the D.C. Motor.
(2) **Open** Butterfly Valve No.1.
(3) **Engage** Clutches Nos.1 & 2.
(4) **Disengage** Clutch No.3.
(5) **Start** D.C. Motor to **drive** the centrifugal pump. The pump is **running** through Clutches Nos. 1 & 2 & Pulley No.1.
(6) Pulley No.1 is **running**. Pulley No.2 is **running idle**.
(7) Hydraulic Turbine is **not running**.
(8) Fluid Coupling (T.C.) is rotating, but **slipping (stalling)**.
(**Note:** F.C. is **stalling** when D.C. Motor - which is connected through the Pulleys Nos. 1 & 2 to F.C. - rotates).
(9) A.C. Generator is not **running**. Hence, it is **not producing** any power.
(10) Batteries Pack is **discharging**.

(B) Stop: (1) **Stop** the D.C. Motor when the reservoir is filled up.
(2) **Close** the Butterfly Valve No.1.
(3) **Disengage** Clutches Nos.1 & 2. Clutch No.3 is **engaged**.
(4) The pump is, thus, **disconnected** from the D.C. Motor.

II) Phase II: (A) Start:
(1) **Engage** Clutch No.3. The Fluid Coupling is put in **engaged** position through Pulley No.2.
(2) **Open** Butterfly Valve No.2 to let water from the reservoir enter the inlet manifold of the Hydraulic Turbine through Inlet Pipe.
(3) **Start** of Hydraulic Turbine (which happens with the opening of Butterfly Valve No.2 & water rushing through the Turbine, now **running** & **producing power**).
(4) Pulley No.2 is **running** & **transmitting power**. Pulley No.1 is **running idle** (while Clutches Nos. 1 & 2 are in **disengaged** position).
(5) Fluid Coupling (Torque Converter) is **running**, **transmitting power.**
(6) A.C. Generator - **connected** to the Hydraulic Turbine is **operational** through the Clutch No.3 - Pulley No.2 and the Fluid Coupling (T.C.), **produces** A.C. electricity.

(7) Batteries Pack is **re-charged** through the charging system.

(B) Stop: (1) **Stopping** of Hydraulic Turbine due the water from the reservoir being fully discharged to the drain holes through the Outlet (Drain) Pipe.

III) Phase III: (A): Status Quo:

(a) The Fluid Coupling is already in the **engaged** position.
(b) Pump is **not pumping**.
(c) Hydraulic Turbine is **not running**.
(d) Butterfly Valve No. 1 is **closed** & No.2 is **open**.

(B) Start: (1) **Close** Butterfly Valve No. 2.
(2) **Disengage** Clutch No.3.
(3) **Engage** Clutch No.1.
(4) Clutch No.2 is in **disengaged** position.
(5) **Re - start** D.C. Motor with increased voltage having been controlled through D.C. Controller to give higher power output of 15 kW and is **transmitted** to the A.C. Generator through the Pulleys Nos.1 & 2 and the Fluid Coupling.
(6) A.C. Generator is **running**, **producing more power**.
(7) The D.C. Batteries Pack is **re-charged** through the charging system.

2.4 Significance of the system:

(i) The **Innovative Power Drive System** runs and produces power for other usage also or can be connected to the grid through voltage and current control panel, even after the flooding situation is overcome.
(ii) This system would run till the Batteries life is over, which can be 15 - 20 years.

2.5 Calculation Sheet

(1) Pump: The stored up water from the flooding area is estimated - as an example - to be, 10, 00, 000 liters, that is, 1000 m3. The same can be even more or less as situation demands. This needs to be pumped up to the Water Storage Reservoir a.s.a.p., say in an hour plus a few minutes. Precisely this works out to be 4058.44 seconds. This is arrived at by using trial and error method. Therefore, the flow of water to be pumped up will be Q = 1,000 m3/4058.44 seconds = 0.2464 m3/s.

Now, if we could find out the H.P. (or KW) required to run the pump, we can calculate the D.C. power required to run a D.C. Motor. One of the **objectives** of this research paper is to run the system independently of the grid power. The D.C. power would be produced locally at the pumping site.

From the standard formula for Pump, we can calculate the H.P. The std. formula is:

H.P. = WQHn/75… where W = 1000 kg/m3 for water, Q = 0.2464 m3/s., H = 6 meters, n = efficiency of the pump, 85%. Substituting these values in the above formula, we have: H.P. = 1000 x 0.2464 x 6 x 0.85/75 = 16.755 (=12.5KW).

This entails us to produce more power than 12.5KW from the Batteries Pack. The motor in view is a 15 KW (20.10 H.P.) D.C. Motor running at a speed of 1500 R.P.M.

(2) Batteries Pack + D.C. Motor: The configuration of the Batteries Pack would consist of 4 Nos. of 12 Volts Batteries of reputed make and giving Amperage of 400 Amperes. Thus, we have: 4x12x400 = 19,200 volts-amperes. Dividing this by 1000, we get 19.20 KV. This in terms of KW will be = 15.36 KW (20.58 H.P.) (=19.20x0.8). Hence, we have 15KW D.C. Motor in view. It will be worthwhile to know the torque developed by the D.C. Motor in design consideration.

The standard formula for calculating the torque is as given below:

(i) Torque (in Nm.) = 9550 x Power (in KW) / Speed (in R.P.M.) = 9550x15/1500 = 95.5 Nm. = 9.55 kg.m. (For 15 KW Motor Power).
(ii) For 12.5 KW it will be = 9550x12.5/1500 = 79.58 Nm. = 7.958 kg.m.

(3) Hydraulic Turbine: The power produced by the Hydraulic Turbine will be calculated by using the standard formula, H.P. = WQHn/75 … where W = 1000 kg/m3, Q = 2.464 m3/s., H = 6 meters and n = 85%. Substituting these values in the above formula, we have: H.P. = 1000 x 2.464 x 6 x 0.85/75 = 167.552 H.P. (124.993KW). Torque developed by Hydraulic Turbine is calculated as follows: H.P. = 2x3.142xNxTxn/4500. Hence, T = H.P.x4500/2x3.142x1500x0.90 = 167.552x4500/6.284x1500x0.90 = 88.877 kg.m.

(4) Butterfly Valves Nos. 1 and 2:

Butterfly Valves No.1 will be opened to let the water pumped by the centrifugal pump to fill up the reservoir and closed when the pumping operation is over. It will be suitable for a pipe size of 170mm diameter. The Butterfly Valve No.2 will be opened after the pump operation is completed allowing the water to flow down from the reservoir to flow through the Hydraulic Turbine to do the work. It will be suitable for a size of a pipe of diameter of 533 mm.

(5) Pipes: The pipe used for pumping operation will be designed as follows: First of all, we have to find out the velocity (in m/s.) of flow of the water through the pipe. The same is given by the standard formula, V2 = 2xgxH… where g = 9.81 m/s2 and H = 6 meters. Substituting these values in the above formula, we have: V2 = 2x9.81x6. Therefore, we have, V = 10.85 m/s. From this we can calculate the diameter of the pipe by using the standard formula, Q = V x A (Cross-sectional area of the pipe) = Vx3.142xdp2/4 = 0.2464. Thus, after solving the equation, we have, dp = 0.170 m. Hence, dp= 170 mm. (where dp is the diameter of delivery pipe).

Similarly, we can find out the diameter of the delivery pipe to the Hydraulic Turbine by using the same formula as used in case of the pump pipe: Q = V x A (cross- sectional area of the delivery pipe) = V x 3.142 x dt2/4 = 10.85.By solving the equation, we have: dt= 538mm. (where dt is the diameter of the Outlet (Drain) Pipe).

3 CONCLUSION

Power Evaluation Results

It will be worthwhile to account for power produced, power spent and what the net gain in power is. This will be done in relation to the **Phases**, that is, **I**, **II** and **III**.

Phase I: Power produced by the Batteries Pack to D.C. Motor, that is, 12.5 KW (16.756 H.P.) is fed to the centrifugal pump. (For 90 days of rainy season & operation time of 4058.44 sec. = 1.127 hrs.).
(Energy spent = -12.5 KWx1.127 Hr x 90 days = -101.4609 KWh).

Phase II (A): Power produced by Hydraulic Turbine is = 124.9937 KW (167.552 H.P.).

This is given to A.C. Generator, hence not counted as power produced by Hydraulic Turbine.
(Energy produced = 124.9937 KWx0.1127 Hr. x 90 days = 1267.811KWh). (#For 90 days of rainy season & operation time of 0.1127 hrs.).

Phase II (B): Torque transmitted by Fluid Coupling (T.C.) is 2.7 times the torque produced by Hydraulic Turbine @40% of Input Speed. Thus, 2.7 X 88.877 kg.m. = 239.9679 kg.m. Hence, power produced by the A.C. Generator is H.P. = 2 x 3.142 x 600 x 239.9679 x 0.9 / 4500 = 180.954 H.P. (134.992 KW). (A.C. Generator efficiency = 90%).
(Energy produced = + 134.992KWx0.1127 Hr. x #90 days = 13695.811 KWh).

Phase III (A): Power produced by the D.C. Motor with increased voltage through Batteries Pack and D.C. Controller is 15 KW (20.10 H.P.)
(Energy spent = -15 KW x *100Hr. = -1500 KWh).

Phase III (B): Torque transmitted by Fluid coupling is 2.7 times the torque produced by D.C. Motor at 40% of Input Speed. Thus, 2.7 x 9.55 kg.m. = 25.785 kg.m. Hence, the power produced by the A.C. Generator is H.P. = 2 x 3.142 x 600 x 25.785 x 0.9/4500 = 19.443H.P. (14.505 KW). (A.C. Generator efficiency = 90%).
(Energy produced = + 14.505KW x 3000 Hr. = 43515.48 KWh).

Thus, we have Energy produced and Energy spent. Energy spent = (-) 101.460 KWh + (-) 1500 KWh = (-) **1601.460 KWh**.
Energy produced = (+) 1369.223 KWh Plus (+) 43515.48 KWh = (+) **44884.70 KWh**.
Therefore, net gain in Energy = 44884.70 KWh –1601.46 KWh = (+) 4**3283.24 KWh**.
Thus, the net Energy gain % = 43283.24 / 1601.46 x 100% = 2702 **% = 2700 %.**
(A rounded off figure). This is over a period of 3000 hours of D.C. Motor life.
(* How 100 hours' work time for D.C. Motor is calculated? The acceleration time for torque multiplication is taken as 30 seconds. The flywheel stoppage time is taken as 15 minutes run. D.C. Motor's life is 3000 hours (= 180000 minutes). Hence, the calculation is based on this figure. The "starting and stopping" of D.C. Motor through a timer will occur for 12000 times (180000 / 15). Therefore, for 30 seconds acceleration time, it will be 12000 times x 30 seconds = 360000 seconds = 100 hours (360000 / 3600, since 1 hour = 3600 seconds).

N.B.:

1) The sketch of the Storage Water Reservoir and Block Diagram of the Equipment is enclosed herewith. The sketches are not drawn to the scale.

2) There will be 10 options to take care of 10 capacities of the Storage Water Reservoir. These will be in the range from 1, 00,000 liters to 10, 00,000 liters in steps of 1, 00,000 liters each.

The Innovative Idea presented in the above project report is conceptualized and designed by the under-mentioned Author of this Research Paper.

DIAGRAM 1 (THE SCEMATIC AND BLOCK DIAGRAM FOR MACHINERY

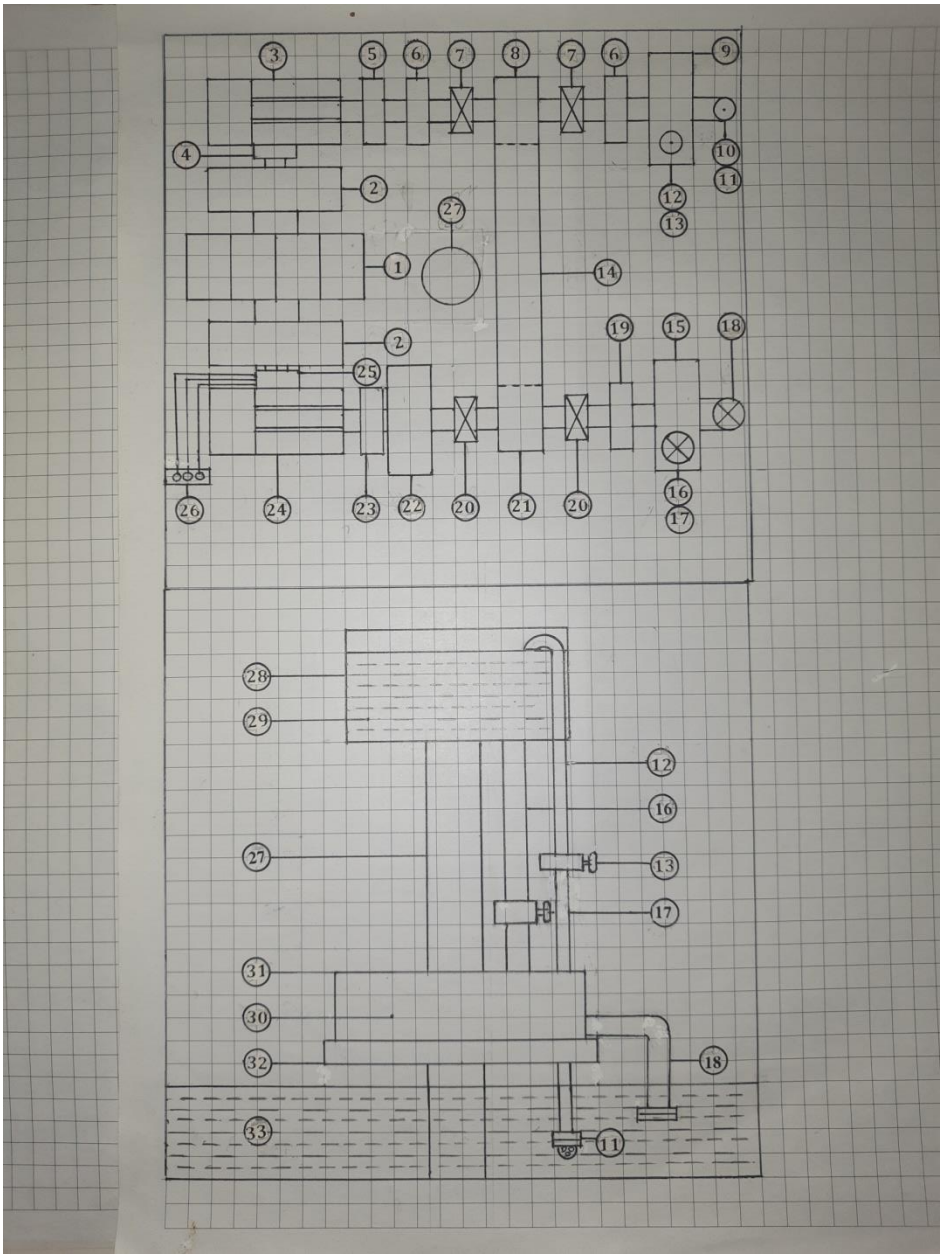

TABLE "A"

THE EQUIPMENT LIST

SR. NO.	DESCRIPTION	QUANTITY
1.	Batteries Pack	1 Set
2.	D.C. Controller	1 No.
3.	D.C. Motor	1 No.
4.	D.C. Motor Terminal	1 No.
5.	Flywheel No.1	1 No.
6.	Clutch Nos. 1 & 2	2 Nos.
7.	Plummer Block (with bearings)	2Sets
8.	Centrifugal Pump	1 No.
9.	Pulley No.1	1 No.
10.	Inlet (Suction) Pipe	1 No.
11.	Strainer for Inlet Pipe	1 No.
12.	Delivery Pipe	1 No.
13.	Butterfly Valve No.1	1 No.
14.	Belt	1 No.
15.	Hydraulic Turbine	1 No.
16.	Inlet Pipe for Hydraulic Turbine	1 No.
17.	Butterfly Valve No.2	1 No.
18.	Outlet (Drain) Pipe	1 No.
19.	Clutch No.3	1 No.
20.	Plummer Block (with bearings)	2 Sets
21.	Pulley No.2	1 No.
22.	Fluid Coupling (Torque Converter)	1 No.
23.	Flywheel No.2	1 No.
24.	Load	1 Set
25.	A.C. Generator	1 No.
26.	A.C. Generator Terminal Box	1 No.
27.	Central Pillar	1 No.
28.	Water Tank	1 No.
29.	Stored water	In M3
30.	Machinery House	1 No.
31.	Machinery House Canopy	1 No.
32.	Machinery House Platform (with Water Level Indicator)	1 No.
33.	Flood Water	-