"ABSTRACT"

The "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is provided with a mechanical arrangement which converts the rotary motion of a reduction gearbox driven by a prime-mover into a forceful self reversing reciprocating movement of a double acting hydraulic cylinder. The displaced oil due to this forceful action in turn operates another receiving cylinder wherein the reciprocating force and stroke-length of the receiving cylinder depends on the difference of the cross-section areas of the pistons of both the cylinders. The receiving cylinder operates a rubber piston inside a pumping cylinder which pumps during the forward stroke and sucks concrete in reverse stroke. The same oil also regulates the delivery & suction ports to achieve positive displacement of concrete. The rpm of the reduction gearbox represents the no. of working strokes which can be changed simply by changing the prime mover rpm or by using a variable speed reduction gearbox.

[008.00] We claim:

1. "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" **described in accordance with this patent application**; said device comprising with :

   a. A prime mover which can be an electric motor or a diesel engine, coupled with a suitable capacity reduction gearbox.

   b. A heavy duty steel fabricated off-centre drive from the said reduction gearbox,which converts the rotary movement into longitudinal to and fro movement of a high pressure heavy duty hydraulic cylinder, called the main cylinder, which is fixed at one end and reciprocates to and fro due to the mechanical linkage.

   c. A minimum one, separate high pressure hydraulic cylinder, hereinafter called the drive cylinder is operated by the oil displaced from the main cylinder. Alternatively, twin drive cylinders are used. The difference in cross section areas of pistons between the main cylinder and the drive cylinder result in multiplication or division of the force and increase or reduction in stroke length of the drive cylinder.

   d. The drive cylinder in turn operates a minimum one concrete pumping cylinder having a rubber Piston moving inside.

   e. Set of slide gate valves operated by hydraulic cylinders on both suction as well as delivery side, or optionally a sliding tube type valve operated by a hydraulic cylinder herein after called as the gate valve cylinder.

   f. A no. of high pressure rubber hoses to connect the working ports of all the hydraulic cylinders.

   g. A feed hopper on the suction side of the pumping cylinder having a mechanically driven agitator receiving drive from the prime mover.

h. A simple Directional control valve to operate or stop the strokes of the drive cylinder.

i. A suitable grade hydraulic oil filled in the entire hydraulic circuit and the cylinders.

j. A suitable capacity water tank between the pumping cylinder and the receiving cylinder.

k. Set of metering or proportioning valves in the slide gate lines & cross safety relief valves and anti-cavitations valves on both high pressure & low pressure sides.

l. A towable steel fabricated trolley with wheels on which the pump is mounted. Alternatively a truck chassis having a PTO drive which provides power to the said pump.

m. A tapered pipe at the end of the delivery valve to accommodate the widely available pipeline dia.

n. Mechanical stabilizers attached to the trolley.

o. Safety covers on the moving parts.

p. A cabled remote having simple functions on it, for the operation of the pump.

q. A small air-compressor for cleaning the delivery line after pumping operation is over.

2. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** an arrangement of mechanical drive converting the rotary movement into reciprocating movement of a double acting hydraulic cylinder by means of an off-centre drive which in turn operates another hydraulic cylinder driving the pumping cylinder.

3. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the** said device is typically provided with a double acting mechanically operated hydraulic cylinder to hydraulically drive the concrete pump without using a normal *conventional hydraulic pump.*

4. ***The Said* "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a plurality of mechanically forcefully operated double acting hydraulic cylinders which are made to work similar to a hydraulic pump.

5. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a system where the rotary movement of the prime-mover is converted into reciprocating movement of a hydraulic cylinder through a mechanical arrangement.

6. ***The Said* "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a hydraulic cylinder which is forcefully operated to & fro which causes displacement of oil in repetitive forward & reverse direction, which is used to achieve a self reversing mechanism of another hydraulic receiver.

7. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a mechanically forcefully operated double acting hydraulic cylinder which is made to work similar to a hydraulic pump, wherein the said drive system can be alternatively used for any other operation instead of concrete pumping.

8. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a prime mover either engine or electric motor coupled with a reduction gearbox having an off-centre drive which converts *the rotary movement into reciprocating movement of a double acting hydraulic* cylinder & the cylinder in turn operates the hydraulic cylinder driving the pumping cylinder thereby successfully eliminating a conventional hydraulic pump.

9. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a off-centre driven mechanically operated double acting hydraulic cylinder used to provide hydraulic power for the pumping operation.

10. ***The Said* "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a reduction gearbox having an off-centre drive to convert the rotary motion into reciprocating motion, wherein the reduction gearbox provided is of variable speeds so as to change the no. of strokes per minute.

11. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the *said device is typically provided with*** *a double acting hydraulic cylinder driven* by an off-centre drive to provide hydraulic power for the pumping operation. Alternatively, the hydraulic cylinder is operated by a cam type arrangement to generate hydraulic power for the pumping operation.

12. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is alternatively provided with** twin drive cylinders, which in turn

operate two separate pumping cylinders, however are driven by the main hydraulic cylinder.

13. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is alternatively provided with** twin drive cylinders, which in turn operate two separate pumping cylinders, however are driven by the two different main cylinders which are operated by two separate diagonally opposite off-centre drives by the same reduction gearbox.

14. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is alternatively provided** with a mechanically operated double acting pneumatic cylinder which is made to work similar to a air compressor to operate another pneumatic cylinder which in turn drives a pumping cylinder.

15. ***The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with*** a mechanically operated double acting hydraulic cylinder which is made to work similar to a hydraulic pump & the rpm of the off-centre drive represents the no. of strokes working strokes in a minute.

16. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a mechanically operated double acting hydraulic cylinder which is made to operate the hydraulic cylinder driving the pumping cylinder thorough a directional control valve to allow reverse pumping and neutral position.

17. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the** said device is typically provided with driving & driven cylinders wherein the cross-

sections of their pistons determine the reciprocating force & the length of the stroke of the pumping cylinder.

18. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the** said device is typically provided with a double acting hydraulic cylinder *mechanically driven to operate the driven cylinder in combination with a variety of* gate valves which include a flat slide gate valve or a reciprocating tube type gate valve.

Dated this 11th day of DECEMBER, 2013

AMIT ARUN GOKHALE **ANAND ARUN GOKHALE**

(20)

12 DEC 2013

THE FOLLOWING SPECIFICATION PARTICULARLY DESCRIBES THE INVENTION AND THE MANNER IN WHICH IT IS TO BE PERFORMED

[001] TECHNICAL FIELD OF INVENTION

The present invention relates to a self regulating apparatus for pumping concrete and thick pasty mass. In particular, the present application relates to a concrete pump which *uses a simple static hydraulics* WITHOUT USING A CONVENTIONAL HYDRAULIC PUMP and using a mechanical drive so as to drastically bring down the capital and operation cost apart from simplifying the pumping operation.

. [002] BACKGROUND OF THE INVENTION

[002.01] Many inventions have been well documented in the history of development of concrete pumps over the years. A concrete pump is an apparatus which is used to pump concrete over a distance which includes horizontal & vertical displacement of concrete.

[002.02] Today a variety of concrete pumps are available in the market, which include simple ball valve pumps for small aggregate size and advanced concrete pumps using electronic managing systems and heavy duty hydraulic systems having load sensing high precision hydraulic pumps. The concrete pumps are also available in various capacities, trolley mounted and truck-mounted versions.

[002.03] *However, still there remains a big void in terms of capacity and cost effectiveness and ease of production for the pump manufacturer. The available concrete* pumps are highly complex and thus cannot be easily manufactured by a small manufacturer having limited resources. There also exists a huge entry barrier for the end user in terms of very high initial capital cost irrespective of his job size. This patent application therefore discusses a novel concept which uses simple basic laws of static hydraulics in combination with a highly cost effective mechanical drive and mechanical

reversal of pumping strokes which not only increases the mechanical efficiency but also is very easy to manufacture for manufacturer of any size.

[002.04] There has been a particular segment of market, wherein the customers have limited volume concrete work and for whom a small machine is sufficient and big machines may not be required. Also the size of the work calls for more economical operation. This patent application enables to make concrete pumps in various capacities for pumping commonly used mix designs of ready-mix concrete, including very small equipment depending upon specific requirements.

[002.05] Therefore there has been a huge requirement of such a concrete pump which can be made even in smaller versions as well, has a very reasonable initial capital investment and a simple cost-effective operation.

[003] PRIOR ARTS & TECHNICAL PROBLEMS :

[003.01] Until the early 20th century, concrete was mixed on the job site and transported from the cement mixer to the formwork, either in wheelbarrows or in buckets lifted by cranes. This required a lot of time and labor. As per our knowledge, In 1927, the German engineers Max Giese and Fritz Hull came upon the idea of pumping concrete through pipes. They pumped concrete to a height of 38 meters (125 ft) and a distance of 120 meters (130 yd). Shortly after, a concrete pump was patented in Holland in 1932 by Kweimn Jacob Cornelius (Jacobus Cornelius Kooyman). This patent incorporated the developer's previous German patent.

[003.02] Before we get into the prior arts and their limitations, let us have a look on the basic requirements of a concrete pump.

The concrete pump has to be a positive displacement pump. Therefore its suction and delivery ports should be closed to each other to avoid loss of pressure and slurry. The earlier pumps used rotary valves, followed by simple ball valves, etc. The major issue with these valves was that they could not effectively seal the

delivery side from the suction side because of the nature of the material under pumping and the size of the aggregates. Let us consider a single piston reciprocating pump.

The basic requirements of a simple reciprocating type concrete pump are:

1. The basic requirement is that the piston should move forward and reverse, with sufficient force enough to displace & suck the column of concrete.
2. When the piston moves forward the suction port should be closed and the delivery port should be open.
3. When the reverse stroke starts, the delivery port should be closed and the suction port should be open.
4. With the delivery port closed, the reversing piston should create low pressure and should suck the concrete from the open suction port.
5. At the start of the forward stroke, the delivery port should be open and suction port should be completely closed and the pumping cylinder should be filled with concrete.
6. *There has to be a mechanism to control, advance or retard the opening & closing* of the delivery & suction ports so as to have optimum efficiency and optimum fill.
7. There has to be some mechanism to change the direction of movement of the piston, i.e., forward and reverse.
8. All the reciprocating pumps whether single cylinder or multi-cylinder need the above basic requirements fulfilled.

Since the invention of the first concrete pump using a mechanically reciprocating piston, there has been various inventions, which have achieved the above requirements by various means.

a. Initially, the reciprocating pistons were driven mechanically with a CAM type arrangement. However, the reciprocating force could not be multiplied or the working stroke could not be changed. In the same design, the delivery and suction ports were operated by mechanical tie rods which had severe limitations of dimensions and size and types of valves used and the valve opening & closing control options were limited.

b. Over the years, heavy duty load sensing reversing hydraulic pumps came into picture which increased the working pressure and the hence the reciprocating force. However, the use of pump-hydraulics made the equipment very costly apart from highly complicated and difficult to make even for the manufacturers as it involved several machined parts made to very high precision. Today majority of the pumps are using hydraulic pumps to drive the concrete pumps.

c. A majority of the currently available concrete pumps use hydraulic systems either separate or in-built for reversal of directions of the reciprocating pistons.

d. *A few inventions are discussed hereunder to understand the means used by* various inventors to fulfill the above mentioned basic requirements of a reciprocating concrete pump.

[003.03] *The Concrete Pump patented under the patent application no US2017975 A in* the year 1935 by J.C.Kooyman is displayed as Prior Art No. 1. This particular invention used a mechanical drive to operate a reciprocating cylinder by means of a cam type arrangement similar to the Internal combustion engine. The concrete pump made by Mr. J.C. Kooyman was provided with mechanically actuated rotary valves which regulated the suction and delivery ports. The mechanical actuations achieved by using simple mechanical tie rods having mechanical length adjustments. Kindly refer to the said prior

art No.1 reproduced here for reference. This invention has been a tremendous breakthrough in the history of concrete pumps. which was followed by a no. of inventions. As the construction industry grew, the limitations of the invention became clear which were mainly related to the mechanical actuators which operated rotary valves which limited the aggregate size & the leakages through the valves causing leakage of slurry & pressure and subsequent choking, mechanical cam actuators had vibrations and the mechanical linkage which directly pumped concrete was found inadequate in force as the pumping lengths both horizontal & vertical increased during the course of time.

[003.04] *Concrete Pump by Charles F. Ball in 1935, under US patent no.* US1991342 represents a twin cylinder reciprocating pump driven by a hydraulic pump and having hollow steel balls acting as valves for opening and closing of the delivery and suction ports. The design is reproduced herewith as PRIOR Art No. 2. The hydraulic pump here is driven by an Internal combustion engine.

One of the major limitations of this design was the use of ball valves. Ball valves are used even today but have certain limitations especially related to the aggregate size.

Today also there are mechanically driven pumps which use ball valves. These pumps are small and are highly sensitive to the aggregate size.

The above two inventions have been cited as closest prior arts, because both of these provide mechanical drive for the operation of the pump. However the above two inventions, had several short-comings due to their direct mechanical linkages and valve systems which were completely mechanical.

Majority of the other patent applications and patents since 1935 till today including the most advanced technologies relate to reciprocating concrete pumps driven by a conventional hydraulic pump driven by a prime mover. Some of the modern patents and patent applications are discussed randomly hereunder for clarity of subject.

1. US patent no. 3682575 dated 08/08/72 is related to the arrangement of pumping cylinders and outlet shape & design of valve bodies and is not related to the drive system. Similarly the US patent no. 3877847 is also related to pumping cylinders & gate valve design. Another US patent no. 3647325 describes a concrete pump having an arrangement of a common hopper & pair of pumping cylinders irrespective of the source of fluid pressure.

2. US patent no. US 2549851 dated 24/6/1946 describes a concrete pump which uses a conventional oil hydraulic pump. US patent no. 3712762 dated 23/1/1973 describes a very different method of pumping. Similarly US patent 3663129 describes a method to provide constant flow of concrete & arrangement of valves mounted in the hopper & is not related to the drive system. Another US patent 8439657 dated 14/5/2013 describes a concrete pump provided with a system which enables complete removal of residual concrete from the pump & is not related to the basic drive system of the pump.

3. The US patent no. 5344290A describes a concrete pump which again uses a conventional hydraulic pump for providing fluid pressure. Another European patent no. EP 1847710B1 dated 15/7/2009 describes " Improved open circuit oleodynamic system to actuate &control a hydraulic piston pump " which also use a conventional hydraulic pump. Another European patent No.EP 0167635B1 dated 27/09/1989 also describes " Hydraulic circuit for the control of reciprocating piston pump" which relates to various types of control hydraulic circuits, however all of them use a conventional hydraulic pump. Another European patent no. EP 1906012A1 describes a pumping apparatus which also uses a conventional hydraulic reversing pump.

[003.05] All the modern concrete pumps which are available today manufactured by various leading manufacturers like SCHWING / Putzmeister / Sany /Zoomlion/ Reed etc, use variable displacement advanced hydraulic pumps for operating the concrete pumps. Some manufacturers use a separate hydraulic circuit to operate the delivery and suction valves. Some manufacturers still use sensors and limit switches to change the forward & reverse directions of the pumping cylinders by using conventional reversing hydraulic pumps. Some manufacturers use servo-piston circuits to change the swash plate direction for reversal of direction. These high precision systems are also controlled by sophisticated computer software. However it all adds to the capital cost and a complex manufacturing.

[003.06] Hence there has been a long felt need to have a very simple self regulating concrete pump wherein all the basic requirements of the concrete pump as listed above are fulfilled by simple laws of static hydraulics, without using the conventional hydraulic pump, thereby making it a very simple low cost reliable equipment easy to manufacture, service and operate.

004 SOLUTION TO THE PROBLEM / ~~OBJECT OF THE ADDITION~~ :

[004.01] An important object of the present ~~addition~~ invention is to provide a uniquely designed self regulating concrete pump which -

a) works on simple basic fundamentals of hydraulics without using a costly conventional hydraulic pump which is widely used in currently available reciprocating concrete pumps as mentioned above.

b) has its own in-built system to achieve the forward & reverse strokes without a separate hydraulic circuit.

c) has its own in-built system to achieve controlled & adjustable operation of the delivery & suction ports.

d) can increase or decrease the number of strokes simply by changing the rpm.

e) has a very low initial cost when compared to the conventionally available concrete pumps having conventional hydraulic pumps.

f) is easy to manufacture, service and operate.

g) is able to handle the normally used ready-mix concrete or sludge

h) is mechanically driven but having a variable reciprocating force and variable stroke length depending upon the requirement.

i) could be made in various capacities as per the requirements of the end user simply by using components which are available of the shelf.

j) can be operated & maintained even by a lay man.

k). is compact and can be made in stationary, trolley or trailer mounted or truck-mounted.

l) is mechanically driven but has all the advantages of a modern hydraulic pump driven concrete pump without the cost & manufacturing hassles.

[004.02] Another object of the present addition is to provide a user friendly apparatus for placement of concrete which is highly cost effective both in terms of capital & operational cost.

[005.00] DISCLOSURE OF THE INVENTION : In accordance with the present invention there is provided a **"Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" which typically consists off the following components:**

a. A prime mover which can be an electric motor or a diesel engine, coupled with a suitable capacity reduction gearbox.

b. A heavy duty steel fabricated off-centre drive from the said reduction gearbox, converts the rotary movement into longitudinal to and fro movement of a high pressure heavy duty hydraulic cylinder, hereinafter called the main cylinder, which is fixed at one end and reciprocates to and fro due to the mechanical linkage.

c. A minimum one, separate high pressure hydraulic cylinder, hereinafter called the drive cylinder is operated by the oil displaced from the main cylinder. The difference in cross section areas of pistons between the main cylinder and the drive cylinder result in multiplication or division of the force and increase or reduction in stroke length of the drive cylinder.

d. The drive cylinder in turn operates a minimum one concrete pumping cylinder having a rubber Piston moving inside.

e. Set of slide gate valves operated by hydraulic cylinders on both suction as well as delivery side, or optionally a reciprocating tube type valve operated by a hydraulic cylinder herein after called as the gate valve cylinder.

f. A no. of high pressure hoses to connect the working ports of all the hydraulic cylinders.

g. A feed hopper on the suction side of the pumping cylinder having a mechanically driven agitator.

h. A simple Directional control valve to operate or stop the strokes of the drive cylinder.

i. A suitable grade hydraulic oil filled in the entire hydraulic circuit and the cylinders.

j. A suitable capacity water tank between the pumping cylinder and the receiving cylinder .

k. Set of metering or proportioning valves in the slide gate lines & cross safety relief valves and anti-cavitations valves on both high pressure & low pressure sides.

l. A towable steel fabricated trolley with wheels on which the pump is mounted.

m. A tapered pipe at the end of the delivery valve to accommodate the widely available pipeline dia.

n. Mechanical stabilizers attached to the trolley.

o. Safety covers on the moving parts.

p. A cabled remote having simple functions on it, for the operation of the pump.

q. A small air-compressor for cleaning the delivery line after pumping operation is over.

[006.00] CONSTRUCTION, WORKING & DETAILED DESCRIPTION WITH REFERENCE TO THE DRAWINGS ENCLOSED: CONSTRUCTION :

"Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" is hereinafter described with reference to the drawings enclosed.Pl. refer to the fig. No. which shows the working Diagram of **"Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump"** : A prime mover either an internal combustion engine or an electric motor(1) coupled to a suitable capacity high ratio reduction gearbox (2) with a off-center drive (3) to the Main Cylinder (4) which is connected to the Drive cylinder (5) with the help of hydraulic hoses A & B. The Driving cylinder operates the rubber piston (6) in the pumping cylinder (7). The

pumping cylinder is provided with a slide gate valve system (8) which is operated by a hydraulic cylinders (10) and (11).

[006.01] WORKING OF THE SAID "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" :

Working : The Prime mover (1) is coupled with a heavy duty high torque reduction gearbox (2) wherein the prime mover rotation speed is highly reduced by increasing the torque. The output rpm of the said reduction gearbox represents the no. of working & suction strokes of the pumping cylinder(s).

1. The prime mover (1) starts & imparts rotary motion to the reduction gearbox (2) the off -centre drive (3) causes the main cylinder (4) piston to move to *and fro. When the main cylinder piston (4A) moves to the right, it causes* displacement of the oil through the hose (A) to the receiving cylinder (5). Because of this displacement, the receiving cylinder piston is forced forward. Which is the forward working stroke.

2. Thus typically the output rpm of the reduction gearbox represents the no. of forward strokes in a minute. It is possible to have a multi-geared reduction gearbox wherein the no. of strokes can be changed depending upon the mix and distance. Alternatively the number of working strokes can be simply changed by changing the rpm of the prime mover. Since the hose A is pressurized because of the displacement, it also provides pressure to operate the slide gate valves system (8).

3. As the forward stroke starts, the displaced oil starts closing the slide gate valve on the suction side at the same time it starts opening the slide gate valve on the delivery side. The piston 5A of the said Drive cylinder is pushed forward which in turn pushes the rubber piston (6) forward in the pumping cylinder (7).

4. As the off –centre point (3) comes diagonally opposite, the forward stroke of the drive cylinder is completed and the reverse stroke starts when the off-center point (3) moves further. The difference in cross section areas of the pistons (4A) and (5A) determines multiplication or division of the force and also the increase & decrease in the stroke length of the drive cylinder.

5. A suitable throttle control valves can fine tune the working of the slide gate valve, which are not shown in the diagram.

[006.02] Other aspects of the invention will become apparent by consideration of the accompanying drawing and their description stated above, which is merely illustrative of a preferred embodiment of the invention and does not limit in any way the nature and scope of the invention.

Figure 1 illustrates the said "PRIOR ART NO. 1" in accordance with the present addition as described in this patent application;

Figure 2 illustrates the said "PRIOR ART NO.2" in accordance with the present addition;

Figure 3 illustrates a very common hydraulic circuit currently used for concrete pumps called the "PRIOR ART NO. 3"

Figure 4 & 5 illustrates the said "Working Diagram" in accordance with the present invention;

[007.00] ADVANTAGEOUS EFFECTS AND ECONOMIC SIGNIFICANCE :

[007.001] The said invention uses a normal double acting hydraulic cylinder which replaces a conventionally available hydraulic pump which reduces the cost of the equipment as various types of double acting cylinders are available off the shelf in various sizes at comparatively very low capital costs compared to the conventional hydraulic pump.

[007.002] Also the said invention, the reversing action is achieved mechanically rather than using a servo-piston circuit, which again reduces the running & capital cost.

[007.003] The use of high torque low speed reduction gearbox results in very high mechanical efficiency & optimum utilization of power available when compared to the normal hydraulic pump driven system, allowing the prime-mover to be operated at low rpms typically from 960 to 1440 for electrical drives & from 1500 to 1900 for internal combustion engines resulting in huge saving of fuel. Typically

with direct engine drives, the optimum torques are obtained during these speeds. Unlike the conventional hydraulic pumps which are operated at higher rpms to achieve larger flows.

[007.004] The present invention therefore results in following techno-commercial advantages.

1. It lowers the cost & lead time of manufacturing due to its very simple operation.
2. It also enables the manufacturer to use all the components which are already available in the market and drastically reduces in house machining and manufacturing process.
3. It eliminates the use of conventional hydraulic pump as it uses a simple double acting hydraulic cylinder to generate the reciprocating force and hence reduces the capital cost by huge margin.
4. It enables the manufacturer to have various capacities of pumps by having multiple combinations of the cross-sectional areas of the pistons of the main & the drive cylinders.
5. It also enables the end user to change the number of working strokes simply by adjusting the engine rpm or having a variable speed reduction gearbox. This feature is highly useful as the strokes can be changed according to the mix & the distance.
6. The mechanical drive results in very high mechanical efficiency. Further the displaced oil remains in the closed loop increasing the efficiency further.
7. The invention thus reduces the cost of capital investment for the end user by a huge margin.
8. The invention enables the manufacturer to make the pumps in various sizes & capacities by using the same or different power input & cylinder combinations.
9. Technically, the use of heavy duty high ratio reduction gearbox means a very high input torque which operates the main cylinder. Which in turn enables use of heavy duty hydraulic cylinders having huge oil displacements per minute.

10. **Since the pump itself regulates the reversal of direction by successfully eliminating the sensors or limit switches or separate hydraulic circuits and servo pistons to change the swash plate direction, it makes the invention a very simple self regulating device having huge commercial advantages over such systems.**

[007.05] While considerable emphasis has been placed herein on the components and component parts of the preferred embodiments, it will be appreciated that many embodiments can be made and that many changes can be made in the preferred embodiments without departing from the basic principles of the invention. These and other changes in the preferred embodiment as well as other embodiments of the invention will be apparent to those skilled in the art from the disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the invention and not as a limitation.

[008.00] We claim:

1. "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" **described in accordance with this patent application**; said device comprising with :

   a. A prime mover which can be an electric motor or a diesel engine, coupled with a suitable capacity reduction gearbox.

   b. A heavy duty steel fabricated off-centre drive from the said reduction gearbox,which converts the rotary movement into longitudinal to and fro movement of a high pressure heavy duty hydraulic cylinder, called the main cylinder, which is fixed at one end and reciprocates to and fro due to the mechanical linkage.

   c. A minimum one, separate high pressure hydraulic cylinder, hereinafter called the drive cylinder is operated by the oil displaced from the main cylinder. Alternatively, twin drive cylinders are used. The difference in cross section areas of pistons between the main cylinder and the drive cylinder result in multiplication or division of the force and increase or reduction in stroke length of the drive cylinder.

   d. The drive cylinder in turn operates a minimum one concrete pumping cylinder having a rubber Piston moving inside.

   e. Set of slide gate valves operated by hydraulic cylinders on both suction as well as delivery side, or optionally a sliding tube type valve operated by a hydraulic cylinder herein after called as the gate valve cylinder.

   f. A no. of high pressure rubber hoses to connect the working ports of all the hydraulic cylinders.

   g. A feed hopper on the suction side of the pumping cylinder having a mechanically driven agitator receiving drive from the prime mover.

h. A simple Directional control valve to operate or stop the strokes of the drive cylinder.

i. A suitable grade hydraulic oil filled in the entire hydraulic circuit and the cylinders.

j. A suitable capacity water tank between the pumping cylinder and the receiving cylinder.

k. Set of metering or proportioning valves in the slide gate lines & cross safety relief valves and anti-cavitations valves on both high pressure & low pressure sides.

l. A towable steel fabricated trolley with wheels on which the pump is mounted. Alternatively a truck chassis having a PTO drive which provides power to the said pump.

m. A tapered pipe at the end of the delivery valve to accommodate the widely available pipeline dia.

n. Mechanical stabilizers attached to the trolley.

o. Safety covers on the moving parts.

p. A cabled remote having simple functions on it, for the operation of the pump.

q. A small air-compressor for cleaning the delivery line after pumping operation is over.

2. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** an arrangement of mechanical drive converting the rotary movement into reciprocating movement of a double acting hydraulic cylinder by means of an off-centre drive which in turn operates another hydraulic cylinder driving the pumping cylinder.

3. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the** said device is typically provided with a double acting mechanically operated hydraulic cylinder to hydraulically drive the concrete pump without using a normal *conventional hydraulic pump.*

4. ***The Said* "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a plurality of mechanically forcefully operated double acting hydraulic cylinders which are made to work similar to a hydraulic pump.

5. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a system where the rotary movement of the prime-mover is converted into reciprocating movement of a hydraulic cylinder through a mechanical arrangement.

6. ***The Said* "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a hydraulic cylinder which is forcefully operated to & fro which causes displacement of oil in repetitive forward & reverse direction, which is used to achieve a self reversing mechanism of another hydraulic receiver.

7. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a mechanically forcefully operated double acting hydraulic cylinder which is made to work similar to a hydraulic pump, wherein the said drive system can be alternatively used for any other operation instead of concrete pumping.

8. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a prime mover either engine or electric motor coupled with a reduction gearbox having an off-centre drive which converts *the rotary movement into reciprocating movement of a double acting hydraulic* cylinder & the cylinder in turn operates the hydraulic cylinder driving the pumping cylinder thereby successfully eliminating a conventional hydraulic pump.

9. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a off-centre driven mechanically operated double acting hydraulic cylinder used to provide hydraulic power for the pumping operation.

10. ***The Said* "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a reduction gearbox having an off-centre drive to convert the rotary motion into reciprocating motion, wherein the reduction gearbox provided is of variable speeds so as to change the no. of strokes per minute.

11. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the *said device is typically provided with*** *a double acting hydraulic cylinder driven* by an off-centre drive to provide hydraulic power for the pumping operation. Alternatively, the hydraulic cylinder is operated by a cam type arrangement to generate hydraulic power for the pumping operation.

12. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is alternatively provided with** twin drive cylinders, which in turn

operate two separate pumping cylinders, however are driven by the main hydraulic cylinder.

13. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is alternatively provided with** twin drive cylinders, which in turn operate two separate pumping cylinders, however are driven by the two different main cylinders which are operated by two separate diagonally opposite off-centre drives by the same reduction gearbox.

14. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is alternatively provided** with a mechanically operated double acting pneumatic cylinder which is made to work similar to a air compressor to operate another pneumatic cylinder which in turn drives a pumping cylinder.

15. ***The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with*** a mechanically operated double acting hydraulic cylinder which is made to work similar to a hydraulic pump & the rpm of the off-centre drive represents the no. of strokes working strokes in a minute.

16. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the said device is typically provided with** a mechanically operated double acting hydraulic cylinder which is made to operate the hydraulic cylinder driving the pumping cylinder thorough a directional control valve to allow reverse pumping and neutral position.

17. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the** said device is typically provided with driving & driven cylinders wherein the cross-

sections of their pistons determine the reciprocating force & the length of the stroke of the pumping cylinder.

18. **The Said "Hydraulically operated but mechanically driven & mechanically reversed simple Concrete Pump" as described in claim one, wherein the** said device is typically provided with a double acting hydraulic cylinder *mechanically driven to operate the driven cylinder in combination with a variety of* gate valves which include a flat slide gate valve or a reciprocating tube type gate valve.

Dated this 11th day of DECEMBER, 2013

AMIT ARUN GOKHALE **ANAND ARUN GOKHALE**

(20)

12 DEC 2013