No. 823,118. PATENTED JUNE 12, 1906.

H. F. GURNEY.

ELECTRICALLY DRIVEN PUMP.

APPLICATION FILED JUNE 20, 1904.

2 SHEETS—SHEET 1.

Fig. 1

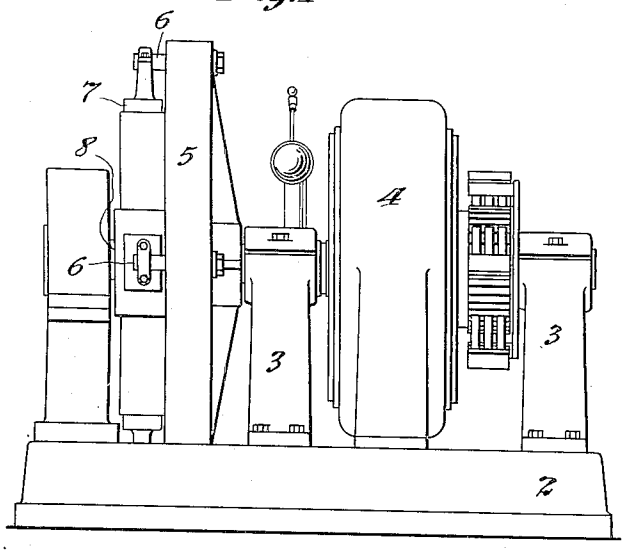
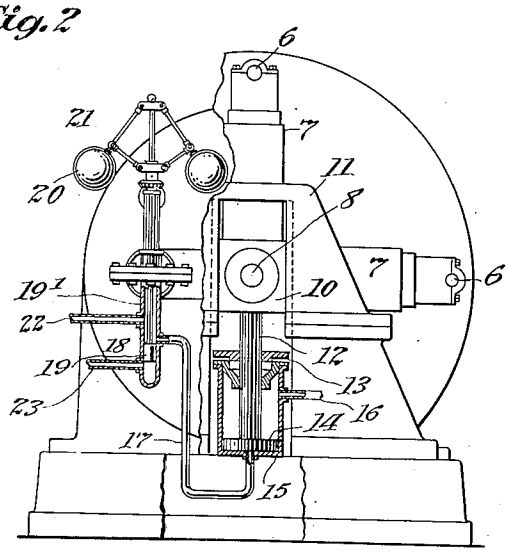


Fig. 2



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2 SHEETS—SHEET 2.

Fig. 2a.

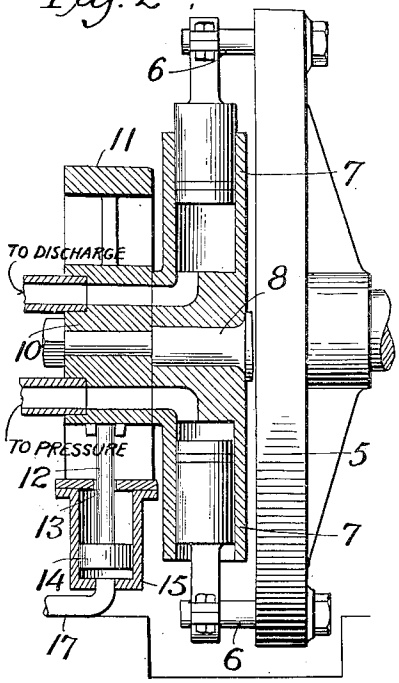


Fig. 3.

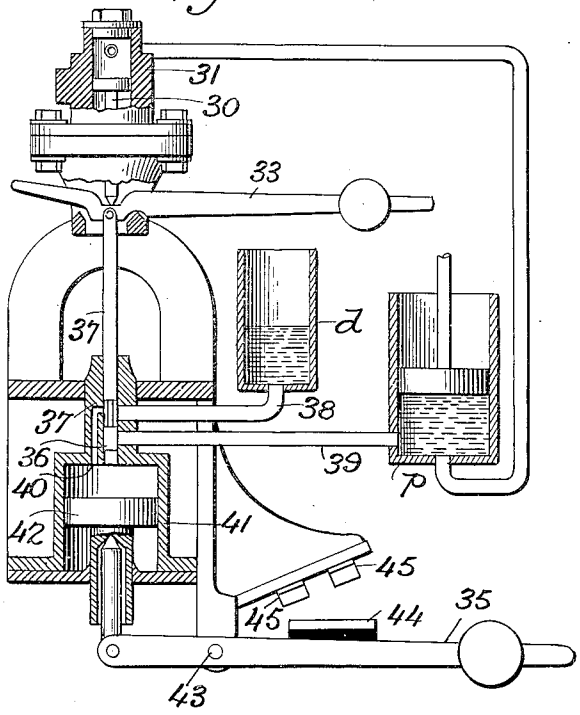
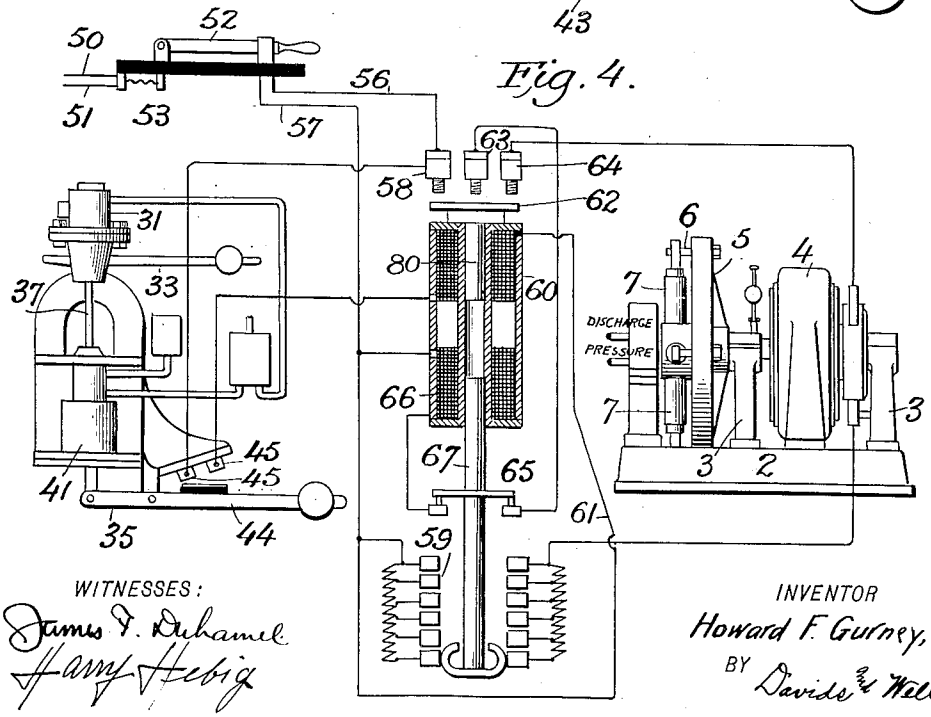


Fig. 4.



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ELECTRICALLY-DRIVEN PUMP.

No. 823,118. Specification of Letters Patent. Patented June 12, 1906.

Application filed June 20, 1904. Serial No. 213,271.

To all whom it may concern:

Be it known that I, HOWARD F. GURNEY, a citizen of the United States, and a resident of Jersey City, New Jersey, have invented a new and useful Improvement in Electrically-Driven Pumps, of which the following is a specification.

The organization of devices constituting the subject-matter of the present invention is designed to function as an automatically-controlled electrically-driven pump adapted to deliver against a head or pressure under the driving action of the associated electric motor.

The present organization is particularly suited for employment in hydraulic elevator systems, in which the operation of the latter involves the maintenance of a more or less constant head or pressure of water, although the invention is no wise limited to such application, but is applicable under circumstances generally where the conditions are like those obtaining in such pressure systems—that is to say, as a result of the operation of automatic features of the present invention a reduction in pressure functions to control first the starting and speeding up of an electric motor and then the operative relation between the running or rotating electric motor and a working pump, which latter is capable of forcing the water or other liquid against the head or pressure in the pressure tank or holder, the motor tending to continue in operation until such pressure shall have reached the maximum or upper limit against which the pump is designed to deliver. When this pressure is approximated to, the working of the motor automatically ceases.

One of the most important features of the present invention is that in accordance with which the resistance or retardant action incidental to the working of the pump is so applied to the motor as not to injuriously interfere with the rotation of the latter.

The present organization of devices is therefore peculiarly applicable to use under conditions in which the motor element of the organization comprises a motor of the alternating-current type or one which is driven by single or other phased currents. Among the disadvantages attending the use of these motors for pumping against a head is that of their liability to complete stoppage or getting out of step should the load be applied too suddenly or otherwise than in a gradual manner. If started under load, moreover, they are generally characterized by high current consumption, and they require in common with direct-current motors under such conditions of starting a heavy and expensive construction, and, again, a starter or controller, whatever its construction, must be of relatively large capacity to be satisfactorily used with the various types of motor under these conditions. For the purpose of precluding any occurrences of this sort and reducing the necessary size and cost of an electric motor and controller or starter adequate for a given service I have adopted as an element or feature of the present organization a pump whose construction is such that the load which it opposes to the action of the driving-motor may be made to gradually increase, so combining with the various features of the organization automatic devices for gradually increasing the load applied to the rotating motor after the latter has attained its proper speed.

In a general way the present organization may be said to include a suitable electric motor, means for opening and closing the circuit or circuits of the motor, a pump of the type hereinbefore referred to, and means for (automatically preferably) increasing the resistance offered by the working thereof from zero up to the maximum load of the pump after the motor has speeded up.

In the drawings accompanying the present specification the various features comprised in the present organization are set forth mainly in a diagrammatic or conventional way.

In the drawings, Figure 1 is a side elevation illustrating an electric motor and a pump of the type hereinbefore referred to operatively connected one with the other. Fig. 2 is an end elevation looking from the left in Fig. 1, part, however, being in section, the plane of which is taken through the valve-chamber, whose valve is under the control of the centrifugal governor. The plane of the section also coincides with the axis of the cylinder whose piston controls the movement of the shiftable cylinder-stud of the pump. Fig. 2ª is a section lengthwise of the rotary axis of the pump. Fig. 3 is a sectional view through the device responsive to changes in fluid-pressure and the movement of which serves to control the opening and the closing of the proper circuit. Fig. 4 is a diagrammatic

view of one arrangement of electric circuits, illustrating also in a conventional way a form of motor-starter.

Similar characters of reference designate corresponding parts in all figures.

One of the most important features of the present organization is a pump of a type in which the working capacity of the pump may by the shifting of a suitable part or parts be caused to increase more or less gradually from approximately zero to full capacity and thereafter be returned to a position of no load. The particular pump construction here illustrated enables such results to be attained by changing the stroke of the pump-pistons (one or more) to thereby increase or decrease the range of piston movement from zero to maximum stroke, and vice versa. Such changes in range of piston movement may be accomplished in various ways. When desired that it should take place automatically, its occurrence may be under the control of a movable part, the character of whose movement is preferably such that when the electric motor attains a predetermined proper speed the movable part will assume a corresponding definite position. Such a part is the shiftable arm of a motor-starter or centrifugal device driven from the motor. Whatever the nature or construction of this movable part, its direct or indirect relation to the pump is preferably such as not to bring any great part of the load on the motor until the latter has attained to nearly its proper working speed. Even therefore though the pump is designed and arranged to operate against a more or less constant pressure the load is by this means applied in a manner to the motor least tending to interfere with its continued rotation and least likely to cause an excessive starting-current.

The opening and closing of the motor-circuit may be under the control, where such action is desired to be automatic, of a device responsive to changes in fluid-pressure and so associated with the pressure-tank or its equivalent that a reduction in pressure therein serves to close the circuit and in consequence start the motor in operation. The speed of this latter accelerates until having reached a predetermined limit or velocity the pump is thereupon gradually brought into operation in the manner hereinbefore referred to.

The specific devices used for these various purposes—that is, the various constituent parts of the organization—may be varied within wide limits without departing from the spirit of the invention, and of course the particular means or motor-starter used may likewise be of various types and constructions. I have, however, for the purpose of illustration set forth an organization the specific relation and construction of the elements of which may be described as follows:

Upon a suitable bed-plate 2 is here shown mounted in appropriate standards 3 the armature of an electric motor 4, to whose shaft is secured a ring 5, carrying projecting pins 6. To these pins the pistons 7 of the pump are journaled, while the pump-cylinders are connected with a stud 8, shiftable into the concentric or eccentric relation of its axis to the axis of rotation of the ring 5. I do not deem it necessary to further describe the construction of this pump, since its construction and operation as a pump are set forth in Patent No. 368,424, granted to A. Rigg August 16, 1887.

For the purpose of shifting the cylinder-supporting stud of the mechanism of that patent when used as a pump the stud is carried by a sliding block 10, mounted in housings 11. This block is preferably actuatable by a power-applying device, here consisting of an engine having a piston-rod 12, which passes through a stuffing-box 13 and is provided with a piston 14, working in a cylinder 15. Uninterrupted communication between the pressure-tank into which the pump discharges and the cylinder-space on the piston-rod side of the piston occurs through a conduit 16, while extending from the cylinder-space on the opposite side of the piston is a conduit 17, whose opposite end opens into a valve-chamber 18. Working longitudinally in this valve-chamber is a valve 19, having a stem 19', connected in this particular instance with the balls or weights 20 of a centrifugal device 21, driven from the electric motor. Conduits 22 and 23, leading, respectively, to the discharge and the pressure tanks, are so positioned relatively to the port of the conduit 17 that when the balls have attained a position corresponding to the motor speed at which it is designed the pump shall be brought into action the valve shuts off communication between conduit 17 and the discharge-tank and permits pressure liquid to enter conduit 17 and press against the lower face of the piston. The surface exposed to pressure on this side being greater than the pressure area on the opposite side, (by an amount equal to the cross-sectional area of the piston-rod,) the sliding block 10 will move outward, increasing the eccentricity between the axes about which the cylinders and pistons of the pump respectively revolve. This increase in eccentricity occasions the increase of the working stroke of the pump-pistons. When, however, the electric motor ceases rotation by reason of the opening of the working circuit, (in a manner that will be presently described,) the centrifugal weights drop, and communication is opened by the shifting of the valve in the valve-chamber between the space below the piston and the discharge-tank. The continuously-maintained pressure on the upper side of piston 14 now forces the piston inward, decreasing the eccen-

tricity aforesaid until preferably the two axes mentioned are practically coincident.

In the specific construction of means for automatically opening and closing the circuit of the motor I have shown the shiftable element 30 (here illustrated as a piston) of a so-called "pressure-regulator," the same being mounted in a casing 31 and operative in the usual manner by changes in fluid-pressure. This element is here moved upward by a counterweighted lever 33 to a given position when free so to do by reason of reduction of pressure in the pressure-tank. The movement of the said shiftable element here serves to control a valve which in turn determines by its position the open or closed position of a switch-arm 35. Specifically, a valve 36, mounted on a stem 37, jointed to the counterweighted lever 33, is movable in the bore of a casing 37, having a pipe 38, communicating with the discharge *d*, a pipe 39, communicating with the pressure-tank *p*, and a passage 40, leading to the upper end of a cylinder 41. In this latter works a piston 42, operatively connected with the counterweighted switch-arm 35, pivoted at 43 and having an insulated blade 44, which when the piston moves downward places a pair of contacts 45 45 in electrical connection, thus closing the circuit. When as a result of an increase in pressure the valve 36 moves downward, the space above the piston is thereby connected with the discharge and the counterweighted switch-arm is shifted by gravity to break the circuit.

In the form of motor-starting means illustrated diagrammatically the leading-in wires or feeders are designated by 50 and 51, respectively, there being here interposed between each of these wires and the corresponding arms of the main switch 52 suitable fuses 53. The terminals of the main switch 52 lead, by suitable wires 56 57, respectively, to a contact-piece 58 and to one of the contacts of a rheostat 59. The aforesaid contact-piece 58 is in electrical connection with one of the contacts of the pressure-controlled switch already mentioned, while the opposite contact of the latter is in connection with one end of the coil of an electromagnet 60, whose opposite end connects by a wire 61 with the conductor 57. The movable core 80 of the mentioned electromagnet is secured to an arm 62, which when the core is raised by the energization of the magnet engages with the contact 58 and additional contacts 63 and 64. The former of these two is electrically connected, through an interposed circuit-breaker 65, with one end of the coil of an electromagnet 66, whose opposite end connects with the main-circuit wire 57. The core 67 of this latter magnet is secured to the contact-arm of the rheostat. The operation of throwing in and out the successive resistances of this rheostat will be evident without further explanation. Suffice it here to say that after all of such resistances have been thrown out the core will have reached a point where it will operate the circuit-breaker 65, thus breaking the circuit through the coil of the electromagnet 66 and the core is maintained in position by being within the field of action of the coil of the magnet 60. The motor 2 may be of the shunt-wound direct-current type.

It is evident, therefore, that the present invention furnishes an organization in which an electric motor of any one of the various types is enabled upon the closing of the actuating-circuit (automatically or otherwise) to first speed up to approximately its proper working velocity or synchronistic relation, after which the load of the pump is gradually thrown upon it. The practical advantages incident to such a mode of operation have already been adverted to.

Having described my invention, I claim—

1. The combination with an electric motor, of a pump having a variable working capacity, a power-applying device for regulating the working capacity of the pump, and a pump-controlling shiftable device whose shifting movement is a function of the motor speed and which device causes the movement of the power-applying device, thereby increasing the capacity of said pump with increase of motor speed.

2. The combination with an electric motor, of a shiftable device whose shifting movement is a function of the motor speed, a pump having a variable working stroke, a pressure-engine for regulating the length of such working stroke, and a valve mechanism operative from said shiftable device for controlling the admission of pressure fluid to and its exhaust from the pressure-engine.

3. The combination with an electric motor, of a pump having a variable working stroke, a pressure-engine for regulating the length of said working stroke, a valve mechanism for controlling the admission of pressure fluid to and its exhaust from the pressure-engine, and a shiftable device whose shifting movement is a function of the motor speed and which is operatively connected with said valve mechanism, said shiftable device opening said valve mechanism to admit fluid-pressure to said pressure-engine and thereby increase the working stroke of the pump with increase of motor speed.

4. The combination with an electric motor, of a pump having a variable working capacity, a power-applying device for regulating the working capacity of the pump, and a centrifugal regulator whose shifting movement is a function of the motor speed and which regulator causes the movement of the power-applying device, thereby increasing the capacity of said pump with increase of motor speed.

5. The combination with an electric mo-

tor and an automatically-operative motor-circuit switch, of a pump having a variable working capacity, a power-applying device for regulating the working capacity of the pump, and a pump-controlling shiftable device whose shifting movement is a function of the motor speed and which device causes the movement of the power-applying device, thereby increasing the capacity of said pump with increase of motor speed.

6. The combination with an electric motor, an automatically-operative motor-circuit switch, and a motor-starter, of a pump having a variable working capacity, a power-applying device for regulating the working capacity of the pump, and an independent pump-controlling shiftable device whose shifting movement is a function of the motor speed and which device causes the movement of the power-applying device, thereby increasing the capacity of said pump with increase of motor speed.

7. The combination of an electric motor, a revoluble pump-piston and cylinder adapted to revolve about independent axes having a variable eccentric relation, a pressure-engine for regulating the eccentricity between the axes of revolution specified and which engine is adapted to maintain a minimum eccentricity therebetween during the period required to bring the motor to a predetermined speed, and a pump-controlling shiftable device whose shifting movement is a function of the motor speed and which device causes the movement of said pressure-engine, thereby increasing the eccentricity between the axes specified with increase of motor speed.

8. The combination of a motor, a pump having a variable working stroke, and means for throwing the load of the pump onto the motor when the latter has approximated to a predetermined speed.

9. The combination of a motor, a pump having a variable working stroke, and means for increasing the stroke of the pump and throwing the resultant load onto the motor when the latter has approximated to a predetermined speed.

10. The combination of a motor, a pump having a variable working stroke, and means for automatically increasing the stroke of the pump and throwing the resultant load onto the motor when the latter has approximated to a predetermined speed.

11. The combination of a motor, a pump having a variable working stroke and which is connected to the motor, and means for maintaining the pump at a minimum stroke while the motor is speeding up and for increasing the stroke of the pump when the motor has approximated to a predetermined speed.

12. The combination of a motor, a piston and a cylinder adapted to revolve about independent axes having a variable eccentric relation, said motor being directly connected to one of the revoluble parts, and means for maintaining a minimum eccentricity between the said axes during the period required to speed up the motor and for increasing such eccentricity when the motor has approximated to a predetermined speed.

13. The combination of an electric motor, an automatically-operative motor-circuit switch, a pump having a variable working stroke, and means for throwing the load of the pump onto the motor when the motor has approximated to a pretedermined speed.

14. The combination of an electric motor, a pump comprising a piston and a cylinder revoluble about independent axes having a variable eccentric relation, and means for increasing the eccentric relation between said axes and throwing the resultant load of the pump onto the motor when the latter has approximated to a predetermined speed and for decreasing this eccentric relation upon reduction of motor speed.

15. The combination of an electric motor, a pump having a variable working capacity, and means for increasing the capacity of the pump and throwing the resultant load onto the motor when the latter has approximated to a predetermined speed and for decreasing the working capacity of the pump upon reduction of motor speed.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HOWARD F. GURNEY.

Witnesses:

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CHAS. H. DAVIDS.