T. M. CHANCE.

APPARATUS FOR PUMPING LIQUIDS.

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1,079,898.

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FIG. I.

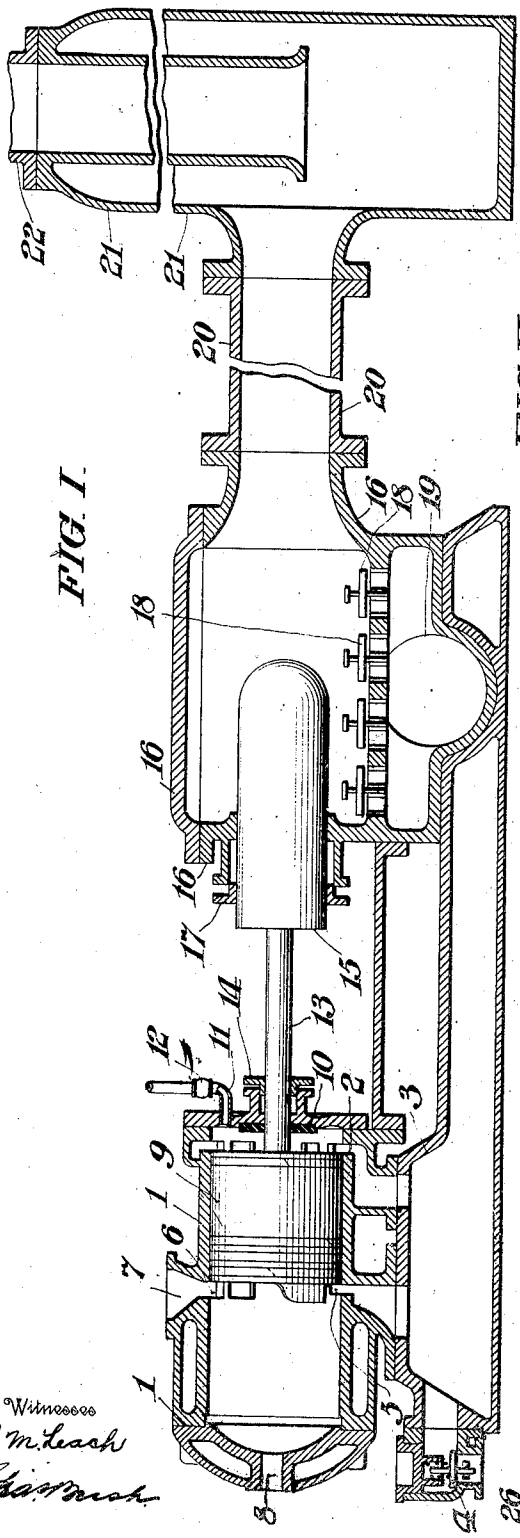
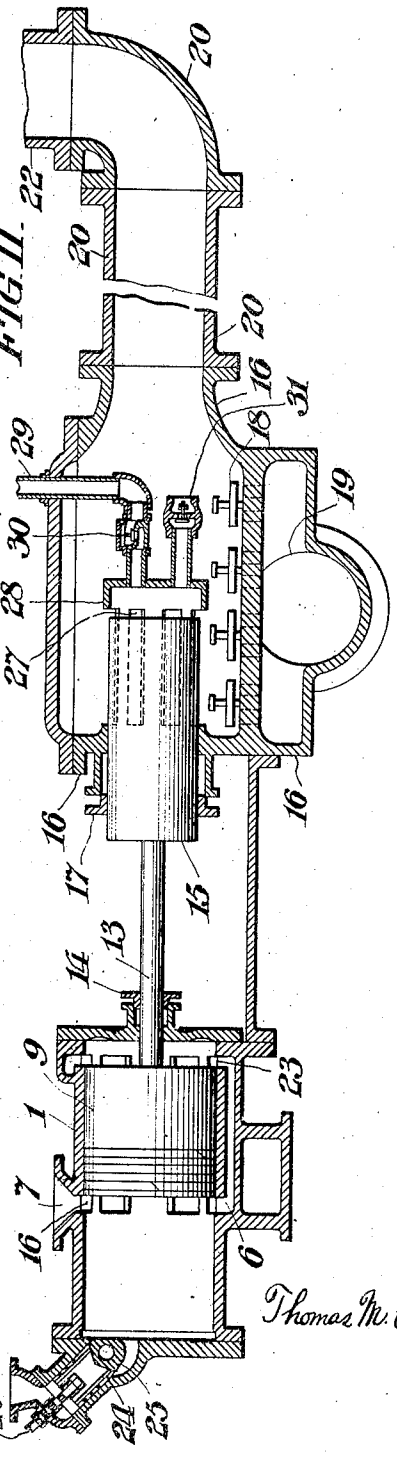


FIG. II.



Witnesses

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APPARATUS FOR PUMPING LIQUIDS.

1,079,898. Specification of Letters Patent. Patented Nov. 25, 1913.

Application filed January 10, 1912. Serial No. 670,413.

To all whom it may concern:

Be it known that I, THOMAS M. CHANCE, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a certain new and useful Apparatus for Pumping Liquids, whereof the following is a specification.

My invention relates to apparatus for pumping liquids adapted to be used in operating a method of pumping liquids for which an application for patent was filed by me in the United States Patent Office August 5th 1910, Serial No. 575,669, and in which said application I have described and shown, but have not claimed, apparatus of the type described in this specification. The method of pumping liquids to which the said application of August 5th 1910 relates, is one in which a piston actuated by a medium having high initial pressure and expansion force is used to impart relatively high velocity to a body of liquid, in which the piston is decelerated and stopped while this body of liquid has relatively high velocity and in which the continued travel of the body of liquid after the end of the stroke of the piston is used to draw in and to discharge liquid, and in which a portion or all of the energy represented by the travel of the body of liquid during the power stroke of the piston is used to effect, or to assist, the return stroke of the power piston and to react upon the prime medium; the kinetic energy represented by the velocity of the moving body of liquid being used to draw in and to discharge liquid.

To carry out this method I have invented the herein described apparatus.

The construction of this apparatus may be varied as to the shape, size, and number of its component parts and by the use of known devices for controlling the flow of liquids and for governing and operating prime movers actuated by an expanding medium and those skilled in the art will be able readily to construct an apparatus adapted to the varying requirements of practice from the drawings and description herein given.

Figure I is a central vertical cross-section of such an apparatus illustrated by a type in which an ignited combustible mixture may be used as the prime medium, and Fig. II is a central vertical cross-section of the apparatus illustrated by a type in which steam or compressed air may be used as the prime medium.

In Fig. I, 1 is the power cylinder, which in this illustration is shown as a cylinder of the two-stroke cycle type in which the front end of the cylinder is used as a scavenging and mixture pump, connecting through the port 2 with a receiver 3 which in the drawing is shown as located in the base of the apparatus; 4 is an inlet valve for combustible mixture, 5 is an inlet port to the cylinder 1, 6 is an exhaust port, 7 is an exhaust outlet and 8 is an aperture in which a spark plug or other igniting device may be placed; 9 is the power piston, the stroke of which is limited by over-running the port 2 and cushioning on the confined air or gas, or by a cushion 10 of rubber or other elastic material to prevent actual contact of the piston and cylinder head if the air or mixture should escape too rapidly from the cushioning clearance space, a connection 11 with a non-return valve 12 may be used to convey away a portion of the air or mixture compressed in this cushioning space for use in the accumulator or for other use to which compressed air or mixture is adapted.

The power piston 9 is connected by means of a piston rod 13, working through the packing gland 14, with the pump piston 15 which works in the pump chamber 16 through the packing gland 17. The pump chamber 16 is provided with inlet valves 18 and an inlet 19 and is connected with a conduit 20 forming an elongated extension of the pump chamber 16. This conduit is connected through an air chamber 21, designed to perform the functions of an accumulator, with a discharge main 22. When the discharge main 22 is of proper length and dimensions for use as an accumulator, the functions of the air chamber 21 may be performed by the discharge main, and the air chamber may be allowed to fill with liquid, or it may be removed and the conduit 20 may be connected directly to the discharge main 22.

In Fig. II, which illustrates a type of the apparatus designed to be operated by a gaseous medium under pressure, such as steam or compressed air, 1 is the power cylinder, in which the front end through the port 23 is in communication with the ex-

haust or with the atmosphere, 24 is a valve for the admission of the prime medium. This valve is cylindrical, resting when closed upon a conical seat 25 and is opened and closed by the valve stem 26 which may be connected to any mechanism in common use for mechanically opening and closing the admission valves of prime movers using steam or compressed air expansively. The exhaust port 6 and exhaust outlet 7 are, as in Fig. I, operative at the end of the power stroke of the power piston 9 the stroke of which is limited by over-running the port 23 and cushioning upon the steam or air caught in the end of the cylinder. The power piston 9, connecting rod 13 and other parts will be understood from the preceding description of Fig. I, like numbers referring to like parts. This Fig. II also illustrates the apparatus as constructed without an air chamber, and illustrates another independent or supplemental method of cushioning and stopping the piston 9 at the end of the power stroke. This is accomplished by means of a hydraulic cushion formed by causing the piston 9 to operate in a cylindrical sleeve 27 which is perforated by ports 28 permitting the free inflow and outflow of liquid. The end of this sleeve 27 is closed and, after running past the end of the ports 28 the piston 9 cushions upon liquid in the end of this sleeve or cylinder 27. A portion of this liquid may be permitted to discharge through the outlet 29 and non-return valve 30 and may be conveyed directly from this outlet 29 into the pump delivery main, and a non-return valve 31 may permit liquid to reënter the end of the sleeve or cylinder 27 after the end of the power stroke.

The apparatus shown by these drawings consists of a combination of certain elements essential to all types of the apparatus. These elements comprise a pump chamber, a pump piston, a power piston connected to said pump piston, a power cylinder constructed with ports and valves to adapt said cylinder to use a prime medium having high pressure and expansive force, with means for regulating the quantity of said medium to permit its expansion during the power stroke of the piston, with means to decelerate and stop the piston at the end of its power stroke, a conduit connecting said pump chamber and adapted to contain a body of liquid of such mass as to be used as a liquid flywheel to absorb and subsequently to give out the excess of high pressure energy developed during the early part of the power stroke of the piston and to retain sufficient kinetic energy after the end of the power stroke to draw in and to discharge the liquid to be pumped, said conduit being designed to be connected to a discharge main or to an accumulator, and the said pump chamber being connected with an inlet and an inlet valve to control the admission of liquid.

The apparatus differs from apparatus in common use for pumping liquids by means of the energy of an expanding medium in the absence of discharge valves, compensators or flywheels, the body of liquid, with which the conduit must be filled before the apparatus can be operated, acting as a flywheel to store up energy and to permit the travel of the piston to the end of its stroke even although the prime medium has expanded before the end of the power stroke to a pressure less than the pressure required to move the piston against the pressure against which liquid is to be pumped. In constructing apparatus of this kind, the areas of the power piston and pump piston must be so proportioned as to develop the desired mean effective pressure in the power cylinder during the return or compression stroke of the piston, and as this mean effective pressure will be governed by the pressure to which it is desired to compress the prime medium at the end of said return stroke, these areas are determined by the relation of this latter pressure to the pressure against which liquid is to be pumped. An important feature of the apparatus therefore is that which relates to the proportioning of the relative areas of the power and pump pistons, and the construction adopted in building such apparatus must therefore be such as will permit the use of pistons of the proper relative dimensions.

As the piston is to be decelerated and stopped while the body of liquid to which it has imparted movement still has relatively high velocity the apparatus is constructed in a manner which will permit of the piston being cushioned and stopped by a hydraulic or gaseous cushion or an elastic material such as a rubber or metallic spring or buffer, or other known device used for similar purposes. The energy absorbed or stored by the cushioning device may be utilized to perform useful work in pumping liquid or in starting or in assisting to start the piston on its return stroke. In designing the apparatus it is advantageous to keep the weight of the pistons and any accessories attached thereto, constituting the moving parts, as light in weight as is consistent with their proper strength.

When the piston is decelerated and stopped by a hydraulic cushion or other device which acts upon the pump piston 15, as illustrated by Fig. II, it is not necessary to rigidly connect the pump piston 15 with the power piston 9 and the piston rod 13 may be disconnected from the pump piston 15 and from the power piston 9 without rendering the apparatus inoperative, for when such means are used for decelerating the

pump piston the piston rod is not subjected to tension, and mere contact of such rod with the driven and driving pistons is sufficient to insure operation of the apparatus.

The inlet valve to control the admission of liquid is shown in the drawings as an automatic non-return flat-seated lift valve of a type in common use, but I do not confine myself to the use of valves of this particular type for it is evident that valves of the puppet, globe, piston, disk or other types, single or multiple seated, or automatically or mechanically operated may be used to admit liquid to the apparatus.

The type of power cylinder construction and method of scavenging illustrated by Figs. I and II are not claimed in this application as they have been made the subject of another application filed in the U. S. Patent Office July 12 1913, Serial Number 778,682, for improvement in internal combustion engines and method of scavenging same.

Having described my invention, I claim—

1. An apparatus for pumping liquids comprising in combination a pump chamber, a pump piston operatively connected to the piston of a prime mover adapted to be actuated by a medium having high initial pressure and expansive force, said pump piston being adapted to work in said pump chamber, an extension of said pump chamber forming a conduit connecting said chamber with an accumulator, and a valved inlet for the admission of liquid to be pumped, said conduit being of such dimensions as may be necessary to contain a body of liquid whose mass, cross-sectional area and length are such as to adapt it efficiently to perform the functions of a fly wheel or compensator in absorbing a portion of the energy developed during the early part of the power stroke of said pump piston and in giving out energy in performing work after the end of the power stroke of said piston.

2. An apparatus for pumping liquids comprising in combination a pump chamber, a pump piston operatively connected to the piston of a prime mover adapted to be actuated by a medium having high initial pressure and expansive force, said pump piston being adapted to work in said pump chamber, an extension of said pump chamber forming a conduit connecting said chamber with an accumulator, a discharge outlet adjacent to said accumulator and a valved inlet for the admission of liquid to be pumped, said conduit being of such dimensions as may be necessary to contain a body of liquid whose mass, cross-sectional area and length are such as to adapt it efficiently to perform the functions of a fly wheel or compensator in absorbing a portion of the energy developed during the early part of the power stroke of said pump piston and in giving out energy in performing work after the end of the power stroke of said piston, and also efficiently to perform similar functions during the return stroke of said piston in absorbing energy from said accumulator during the early part of said return stroke and in giving out energy in work done upon said piston during the completion of said return stroke.

3. An apparatus for pumping liquids comprising in combination a pump chamber, a pump piston operatively connected to the piston of a prime mover adapted to be actuated by a medium having high initial pressure and expansive force, said pump piston being adapted to work in said pump chamber, an extension of said pump chamber forming a conduit connecting said chamber with an accumulator, a discharge outlet adjacent to said accumulator and a valved inlet for the admission of liquid to be pumped, said conduit being of such dimensions as may be necessary to contain a body of liquid whose mass, cross-sectional area and length are such as to adapt it efficiently to perform the functions of a fly wheel or compensator capable of absorbing all that portion of the energy developed during the power stroke which is to be utilized in discharging and drawing in liquid and of giving out said energy after the end of said power stroke, and also capable of performing similar functions during the return stroke of said piston in absorbing energy from said accumulator during the early part of said return stroke and in giving out energy in work done upon said piston during the completion of said return stroke.

4. An apparatus for pumping liquids comprising in combination a pump chamber, a pump piston operatively connected to the piston of a prime mover adapted to be actuated by an elastic prime medium having high initial pressure and expansive force, said pump piston being adapted to work in said pump chamber, means for arresting the further movement of said piston at the end of its power stroke, an extension of said chamber forming a conduit connecting said chamber with an accumulator, a discharge outlet adjacent to said accumulator, a valved inlet for the admission of liquid to be pumped, and means for admitting an elastic prime medium into said prime mover and for exhausting said prime medium after the expansion thereof, said conduit being of such length and diameter as may be required to contain a body of liquid whose mass, cross-sectional area and length are such as to adapt it to efficiently perform the functions of an oscillating flywheel or compensator in absorbing a relatively large amount of energy during the power stroke of said pump piston, in giving out this absorbed energy after the end of said power stroke,

in absorbing a relatively smaller quantity of energy during a portion of the return stroke of said piston and in giving out this energy during the balance of said return stroke.

5. An apparatus for pumping liquids comprising in combination a pump chamber, a pump piston connected to the piston of an internal combustion power cylinder, said pump piston being adapted to work in said pump chamber, means for arresting the further movement of said piston at the end of its power stroke, an extension of said pump chamber forming a conduit connecting said chamber with an accumulator, a discharge outlet for liquid adjacent to said accumulator, a valved inlet for the admission of liquid to be pumped, and means for admitting combustible matter to said cylinder and for exhausting the products of combustion therefrom, said conduit being of such length and diameter as may be required to contain a body of liquid whose mass, cross-sectional area and length are such as to adapt it efficiently to perform the functions of an oscillating flywheel or compensator in absorbing a large portion of the energy of the power stroke of said power piston and in giving out said energy after the end of said power stroke and also in absorbing energy from said accumulator during the early part of the return stroke of said piston and in so giving out this energy during the balance of said return stroke that said return stroke may compress a combustible mixture contained in the combustion chamber to a pressure much higher than that of the said accumulator.

6. An apparatus for pumping liquids comprising in combination a pump chamber, a pump piston adapted to work therein, an internal combustion power cylinder, a power piston adapted to work therein, said power piston and said pump piston being operatively connected, an extension of said pump chamber forming a conduit of greater length than diameter and connecting said pump chamber with an accumulator, an outlet for liquid adjacent to said accumulator and a valved inlet for liquid, said conduit providing free communication between said pump chamber and said accumulator whereby reaction from said accumulator toward said pump chamber may compress a charge of combustible mixture contained in said power cylinder.

7. An apparatus for pumping liquids comprising in combination a pump chamber, a pump piston adapted to work therein, a two-stroke cycle internal combustion power cylinder, a power piston adapted to work therein, said power piston and said pump piston being operatively connected, an extension of said pump chamber forming a conduit of greater length than diameter and connecting said pump chamber with an accumulator, an outlet for liquid adjacent to said accumulator and a valved inlet for liquid, said conduit providing free communication between said pump chamber and said accumulator so that said accumulator may freely react toward said pump chamber and compress a charge of combustible mixture contained in said power cylinder.

In testimony whereof I have hereunto signed my name at Philadelphia, Pennsylvania, this eighth day of January, 1912.

THOMAS M. CHANCE.

Witnesses:
CHAS. BUSH,
E. M. LEACH.