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MULTISTAGE ROTARY PUMP

Filed May 10, 1921

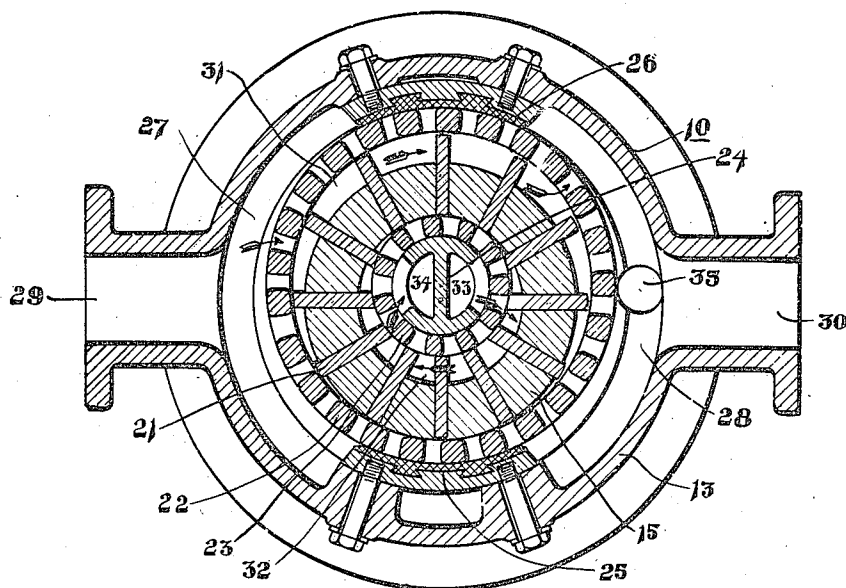


Fig. 1.

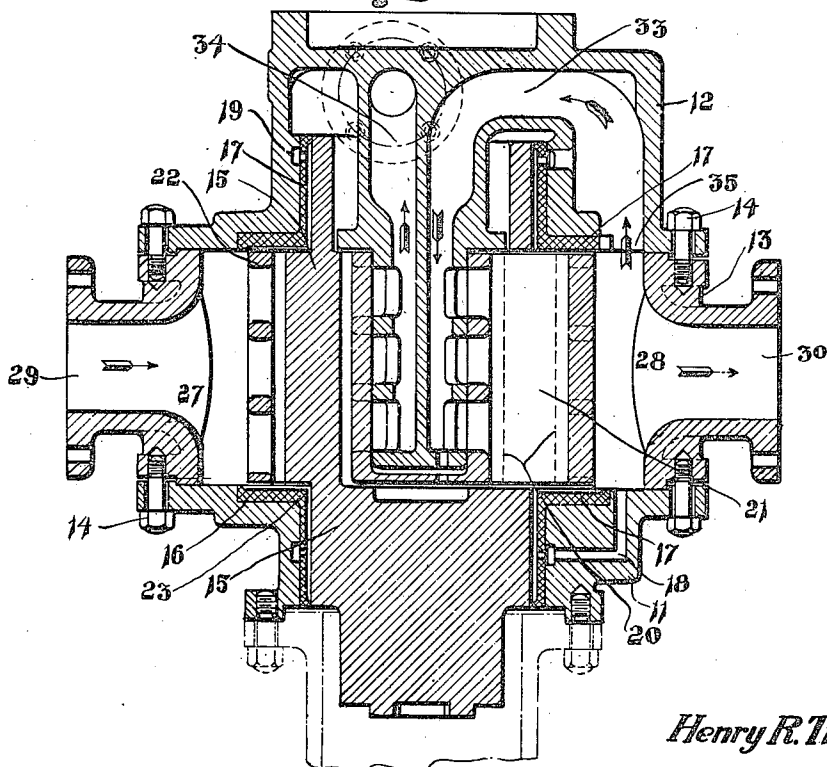


Fig. 2.

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MULTISTAGE ROTARY PUMP.

Application filed May 10, 1921. Serial No. 468,250.

To all whom it may concern:

Be it known that I, HENRY R. TROTTER, a citizen of the United States, and a resident of Swarthmore, in the county of Delaware and State of Pennsylvania, have invented a new and useful Improvement in Multistage Rotary Pump, of which the following is a specification:

This invention relates to pumps and more particularly to rotary pumps of the eccentric displacement type, and has for its object to provide an apparatus of the character designated which shall be capable of delivering a fluid at one or more pressures. It has for a further object to provide a multistage rotary pump of the character designated which shall be simple in operation, rugged in construction and in which wear and frictional resistance between the rotating and stationary parts is reduced to a minimum. These and other objects in view of the invention consists in certain novel features of construction and arrangement of parts, as will be more fully hereinafter set forth.

In the drawings, Fig. 1 is a longitudinal sectional view, and Fig. 2 is an end view in section taken on the line I—I of Fig. 1.

The present invention contemplates a multi-stage rotary pump in which a fluid may be forced successively through an outer and an inner annular series of expansible fluid chambers and be delivered therefrom at a high pressure, or in which the fluid may be delivered directly from the outer series of expansible fluid chambers at a lower pressure and in which common rotating plate pistons extending between cylindrical wall members of the expansible fluid chambers serve to effect a pumping action in each of the series of expansible fluid chambers. Suitable glands are provided in the pump casing for the cylindrical wall members, which may be said to be carried by the rotating piston plates. It results that the speed of rotation of the cylindrical-wall members is substantially the same as the peripheral speed of the portions of the plate pistons contacting therewith, thus largely eliminating the relative movement and consequent excessive wear and frictional losses between these engaging pump parts. The pump is so constructed that the employment of valves is unnecessary as the passages between the outlet of the low-pres-

sure stage and the inlet of the high-pressure stage may be continuously open during the operation of the pump. The several stages of pumping action are accomplished with relatively few moving parts and without the aid of control valve devices thus permitting the building of a compact, durable and efficient multi-stage rotary pump.

Referring to the drawing for a more detailed description of apparatus constructed in accordance with my invention, I indicate at 10 an annular pump casing assembled from end members 11 and 12 and an intermediate member 13, the members being secured as a unit in any suitable manner, for example by lag bolts 14. Located within the pump casing 10 and extending substantially the length thereof is a cylindrical pump runner 15. The portion of the runner 15 within the casing member 11 is provided to receive rotational movement, and the portions within the casing members 12 and 13 are hollow to receive pump elements of the second stage, as will hereinafter more fully appear. The central portion is relatively heavy and is arranged to present heavy flanges to bearing surfaces on the end members. The runner 15 is supported and guided in its rotational movement by the end members 11 and 12, said members having provided therein specially constructed journal bearings 16 and 17 adequately lubricated by oil grooves 18 and 19, respectively. The central portion of the runner extending between the vertical bearing surfaces of the end members is annular in cross-sectional configuration and is provided with a plurality of slots 20 which are adapted to accommodate radially disposed plate pistons or vanes 21 slidably mounted therein. The outer extremities of the plate pistons frictionally engage an outer ported cylinder 22 and the inner extremities of said pistons engage, in a similar manner, an inner ported cylinder 23, each of said cylinders being equal in length to the plate pistons and restricted as to axial movement by the end casing members 11 and 12.

The end casing member 12, which carries the open end of the cylindrical pump runner 15, is provided with a hollow stem portion 24 that extends eccentrically into the hollow pump runner and supports therein the inner ported cylinder 23. This stem

portion may be termed for brevity in this specification, an inside casing member. Arcuate guide elements 25 and 26 are carried by the intermediate casing members 13 and divide the annulus formed by the casing member 13 and the ported cylinder 22 into suction and discharge chambers 27 and 28. As shown, casing passages 29 and 30 connect with the respective chambers to form inlet and discharge means for the initial pressure stage of the pump. The inner ported cylinder 23 fits over the stem 24 and is held thereby in a fixed axial position. The outer ported cylinder 22 is retained in concentric relation to the inner ported cylinder 23 by the plate pistons 21 which frictionally engage both the ported cylinders 22 and 23 and by the arcuate guide elements 25 and 26. Both the inner and the outer ported cylinders are free to rotate and the plate pistons preferably fit therebetween with such tightness as to cause their rotation with the pump runner 15. However, it is to be understood, that the rotation of the cylinders 22 and 23 is not essential to the satisfactory operation of the pump and that the cylinders may be stationary or may rotate at any speed intermediate to the speed of rotation of the pump runner 15. From the above construction, it will be noted that the stem 24, the inner and outer ported cylinders 22 and 23, and the arcuate guide members 25 and 26 are concentric and positioned eccentrically with respect to the pump runner 15. The relative eccentric rotational movement of the runner 15 between the ported cylinders 22, 23 allows the plate pistons to form two series of expansible fluid chambers, an outer series 31 being formed between the runner and the outer ported cylinder 22 and an inner series 32 between the runner and the inner ported cylinder 23, the arrangement being such that when a portion of the outer series is discharging fluid a portion of the inner series is in a position to receive fluid and subject it to a second pressure. In order to reduce wear and obtain a uniform frictional contact relation between the plate pistons carried by the eccentric pump runner and the inner and outer ported cylinders, the contacting surfaces of the plate pistons are designed so that the lines of contact lie in planes passing through the axis of the stem 24. The end casing member 12 is also provided with two passages 33 and 34 arranged to conduct a fluid through the inside casing of the pump and may be designated as inlet and discharge means for the final pressure stage of the pump. The discharge chamber 28 of the initial stage connects directly into the inlet passage 33 of the final stage as indicated at port 35 thereby obviating the necessity of valves between the two stages.

Having thus described an apparatus con-

structed in accordance with my invention, the operation thereof is carried out in the following manner. Fluid is admitted to the inlet chamber 27 and flows through the ports in the cylinder 22 and fills the first series of expansible chambers 31 which are increasing in capacity in their movement from the wall element 25 to the wall element 26. When the chambers pass the wall element 26, their capacity is gradually diminished due to the relative eccentric rotation of the runner 15 and the cylinder 22, thus the fluid therein is discharged through the cylinder ports into the discharge chamber 28. Upon reaching the wall element 25 the chambers are substantially emptied and the fluid discharged therefrom has been subjected to a predetermined initial pressure. Some of the fluid discharged is delivered from the chamber 28 to points of use through the port 30 and the remainder enters the port 35 and is conducted through the inlet passage 33 of the casing stem 24. The fluid then undergoes in the second series of expansible chambers 32 a compressing action similar to that effected in the initial stage, the fluid being discharged through the outlet passage 34 at the desired final pressure.

In the appended claims the inner and the outer ported cylinders 22 and 23 have been termed "annular members". This term is intended to include the ported cylinders 22 and 23, as herein above described, and also generically to include elements which are the equivalents thereof.

The novel features of a device constructed in accordance with my invention reside in the double compression effected by the plate pistons or vanes carried by the pump runner. As will be observed, the fluid is given an initial pressure in passing through the outer series of expansible chambers 31 and the final pressure is effected in the inner series of expansible chambers 32, the plate pistons carried by the pump runner 15 effecting both the initial and the final pressures. I have found that a pump constructed in accordance with this invention satisfactorily delivers fluid, as for example lubricating oil, from the first stage at comparatively low pressure, and from the second stage at a higher pressure. This feature is very desirable in some turbine installations, where it is necessary that lubricating oil be supplied at a low pressure to the bearings and at a higher pressure to auxiliaries, as for example the governor oil relay cylinders.

The obvious advantages derived from a rotary pump constructed in accordance with the present invention may be briefly stated.

1. A multi-stage rotary pump occupying substantially the space of single stage devices now in use, thereby insuring compactness.

2. A multi-stage rotary pump in which

the several pressure stages are effected without the use of valves, thus making a simple operating device.

3. The elimination of excessive wear between the pump elements by reducing relative movements of pump parts and by providing adequately lubricated guides and bearings, thereby obtaining a more efficient pump.

10 While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various other changes and modifications, without departing from the spirit thereof and I desire, therefore, that only
15 such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

20 1. A rotary fluid pump comprising a casing member having inlet and outlet means, annular members supported by the casing member, a rotatable pump element located eccentrically between the annular members,
25 and means carried by the rotatable pump element and cooperatively engaging the annular members to pump a fluid.

30 2. A rotary fluid pump comprising a casing member having inlet and outlet means, annular concentric members supported by the casing member, a rotatable pump element located between the annular members and eccentric thereto, and means carried
35 by the rotatable pump element and cooperatively engaging the annular members to pump a fluid.

40 3. A rotary fluid pump comprising annular casing members having inlet and outlet means, annular concentric members supported by one of the casing members, a rotatable pump element located between the annular members and eccentric thereto, and
45 means carried by the rotatable pump element and cooperatively engaging the annular members to pump a fluid.

50 4. A rotary pump comprising inner and outer annular casing members having inlet and discharge means, a ported cylindrical member, a ported cylindrical member supported by the inner casing member, a
55 rotatable pump element located between the cylindrical members and eccentric thereto and means carried by the rotatable pump element and cooperatively engaging the cylindrical members to pump a fluid from each casing member.

60 5. A rotary fluid pump comprising eccentric inner and outer annular casing members each having inlet and discharge passages, an outer annular member eccentric to the outer casing member, an inner annular member concentric with the inner casing member and supported thereby, a rotatable
65 pump element located between the annular members and means carried by the rotatable

pump element to cooperatively engage the inner and outer annular members to pump a fluid successively through the casing members.

70 6. A rotary pump comprising eccentric inner and outer annular casing members each having inlet and discharge passages, inner and outer annular concentric members, an annular rotatable pump element eccentric to the inner casing member and to the
75 inner and outer annular members, and means carried by the rotatable pump element and cooperatively engaging the annular members to pump a fluid successively through the casing members.

80 7. A multi-stage pump comprising an outer annular casing member, an inner annular casing member, each of said casing members having inlet and discharge chambers therein, an annular member, a rotatable
85 pump element supported eccentrically of the annular member, plate pistons carried by the pump element and adapted to form with the annular members expansible fluid chambers through which a fluid is forced from the
90 inlet chamber to the discharge chamber of the outer casing, the discharge chamber of the outer casing communicating with the inlet chamber of the inner casing, an annular member carried by the inner casing and
95 concentric therewith, the plate pistons of the pump element cooperatively engaging the second annular member to pump the fluid through the inner casing and discharge the same at a higher pressure.

100 8. A multi-stage fluid pump comprising inner and outer casing members each having inlet and discharge means, annular members supported by one of the casing members,
105 fluid chambers in the casing members arranged to allow a requisite flow of fluid to and from the annular members, an annular rotatable pump element eccentrically located between the annular members, plate pistons
110 radially disposed in the pump element and cooperatively engaging the annular members to form expansible pressure chambers on the inside and outside of the pump element.

115 9. A rotary fluid pump comprising inner and outer casing members each having inlet and outlet means, a fluid passage connecting the inlet of one casing member and the outlet of the other casing member, an annular
120 member associated with each casing member, an annular rotatable pump element eccentrically located between the annular members, a series of plate pistons carried in the annulus of the rotatable pump element, said pistons cooperatively engaging the
125 annular members to form expansible fluid pressure chambers whereby a fluid is pumped from one casing to the other at an increased pressure.

10. A rotary fluid pump comprising a cas- 130

ing member having inlet and outlet means, annular members associated with the casing member, a cylindrical pump element located eccentrically between the annular members, and a series of freely moving radially disposed plate pistons carried by the rotatable pump element and located in the annulus between the annular members, said piston plates frictionally engaging each annular member to form in their rotation expansible fluid chambers to pump a fluid.

11. A rotary fluid pump comprising an outer annular casing member, an inner annular casing member located at a central portion of the outer casing, inlet and discharge passages in each casing member, the discharge passage of the outer casing member communicating with the inlet passage of the inner casing member, an annular rotary pump element eccentric with the inner casing, means associated therewith to force through expansible pressure chambers a fluid from the inlet to the discharge passages of the outer casing, means for delivering a portion of the discharged fluid to the inlet passage of the inner casing member, means associated with the rotary pump elements to force the said portion of the fluid through other expansible chambers and discharge the same through the discharge passage of the inner casing at an increased pressure.

12. A rotary fluid pump comprising a casing member having inlet and outlet means, partition glands formed in the casing member and separating the inlet and discharge means, annular members associated with the partition glands, a cylindrical rotatable pump element located eccentrically between the annular members and sliding plate piston elements projecting through the annulus of the rotary pump element and frictionally engaging the annular members to pump a fluid successively through the casing.

13. A rotary fluid pump comprising a casing member having inlet and outlet means, annular members supported in the casing member, a rotatable pump element located eccentrically between the annular members and sliding plate piston elements projecting through the annulus of the rotary pump element and frictionally engaging the annular members to form expansible chambers therewith, said chambers varying in volumetric capacity as the pump element is rotated on its eccentric axis, the arrangement being such that a fluid is pumped from the inlet to the outlet of the casing at an increased pressure.

14. In a rotary pump of the character designated, inner and outer annular casing members each having inlet and discharge means, glands formed in the casing members and separating the inlet and discharge means in each casing member, an outer an-

nular member, an inner annular member concentric with the inner casing member, a rotatable pump element located between the annular members, sliding plate piston elements carried by said pump element, said plate pistons projecting through the annulus of the pump element and frictionally engaging the annular members to form expansible chambers therewith, said chambers varying in fluid capacity as the pump element is rotated on its eccentric axis and means to conduct the fluid from one casing member to the other.

15. A rotary fluid pump of the character designated comprising a casing member having inlet and outlet means, annular concentric members guided in their rotational movement by the casing member, a rotatable pump element located between the annular members and eccentric thereto, sliding plate elements projecting through the annulus of the rotary pump element and frictionally engaging the annular members to form expansible fluid chambers therewith, said chambers varying in size as the pump element is rotated on its eccentric axis to pump a fluid through the casing member.

16. A multi-stage rotary fluid pump comprising inner and outer casing members having inlet and discharge glands separating the inlet and discharge means in each casing member, a passage connecting the discharge means of the outer casing and the inlet means of the inner casing, rotatable annular members associated with the glands in each casing member, a cylindrical pump element located eccentrically between the annular members and means positioned in the annulus of the pump element to pump a fluid successively through each casing.

17. A multi-stage rotary pump of the character designated comprising inner and outer casing members each having inlet and discharge means, a passage connecting the discharge means of one member and the inlet means of another member, concentric inner and outer ported cylindrical members, a rotatable pump element extending eccentrically between the ported members, plate pistons carried by the pump element and frictionally engaging each ported member during the rotational movement of the pump element, means carried by each casing member to separate the inlet and discharge means located therein, said means being arranged to guide the ported members in their concentric rotational movement, and expansible fluid chambers formed by the plate pistons, ported cylinders and the pump member during the rotational movement of the latter.

In testimony whereof, I have hereunto subscribed my name this 2nd day of May, 1921.

HENRY R. TROTTER.